Environmental Impact Statement - FINAL

Union County Yadkin River Water Supply Project

Proposed Interbasin Transfer to the Rocky River Basin

December 31, 2015

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EXECUTIVE SUMMARY

Introduction

Union County (County) is seeking to develop a Yadkin River Water Supply Project (YRWSP) to ensure long-term, sustainable water supply to its current, and projected, future service areas in the Yadkin River Basin. This effort includes securing the required regulatory permits and approvals for delivering additional water to the County's customers in the Rocky River Basin, which is a part of the greater Yadkin River Basin. Under the current legislative and regulatory framework, the County must obtain an interbasin transfer (IBT) certificate for this project.

Purpose of Proposed Action

Union County has seen significant growth over the past two decades and is expected to continue to have steady growth and development into the foreseeable future. In response to this growth, the County has worked diligently to meet the increasing demands for public water supply and other services. Further, the County has completed an extensive water supply planning effort, and has identified opportunities to provide a long-term, sustainable water supply solution for its citizens and community.

The Union County Water System currently serves customers in both the Catawba River Basin (Catawba River Basin Service Area) and the Rocky River IBT Basin (Yadkin River Basin Service Area) of the Yadkin River Basin as illustrated in Figure 1-1 (All maps and "figures" referenced within this document are located in Appendix A). The ridgeline between the Catawba River Basin and Yadkin River Basin divides the County, with neither of these two major rivers flowing within the County boundaries.

The County currently holds a 5 million gallons per day (mgd) authorized transfer (i.e., a grandfathered IBT amount) of water from the Catawba River Basin to the Rocky River IBT Basin. To maintain compliance with the Catawba River Basin grandfathered IBT, the County currently returns a portion of the transferred water back into the Catawba River Basin. The County also has plans to return additional water to the Catawba River Basin via the Crooked Creek Wastewater Treatment Plant. Additionally, the County currently holds a water purchase agreement (which is up for renewal in 2017) with Anson County for 4 mgd of water supply that is utilized in the County's Yadkin River Basin Service Area.

Water needs in the County's Yadkin River Basin Service Area are projected to increase from a current (2013) maximum month average daily demand of 7.7 mgd to 28.9 mgd by 2050 (equivalent to a current maximum daily demand of 9 mgd to 35.3 mgd by 2050). The projected increase in the County's water demand is a combined result of projected county population growth and Union County water system service area growth, as further detailed in Section 2.3. The County's current grandfathered IBT from the Catawba River Basin and the Anson County water supply are not capable of meeting the projected future demand within the Rocky River IBT Basin; and therefore, the County must secure a reliable water supply from other sources to meet its future demand in this service area. As reflected in Illustration ES-1, it is the intent of the YRWSP to meet these additional future water demands. This illustration depicts the current and proposed water sources and wastewater treatment facilities serving the County's Yadkin River Basin Service Area, along with their corresponding current (2013) and future (2050) flow projections.

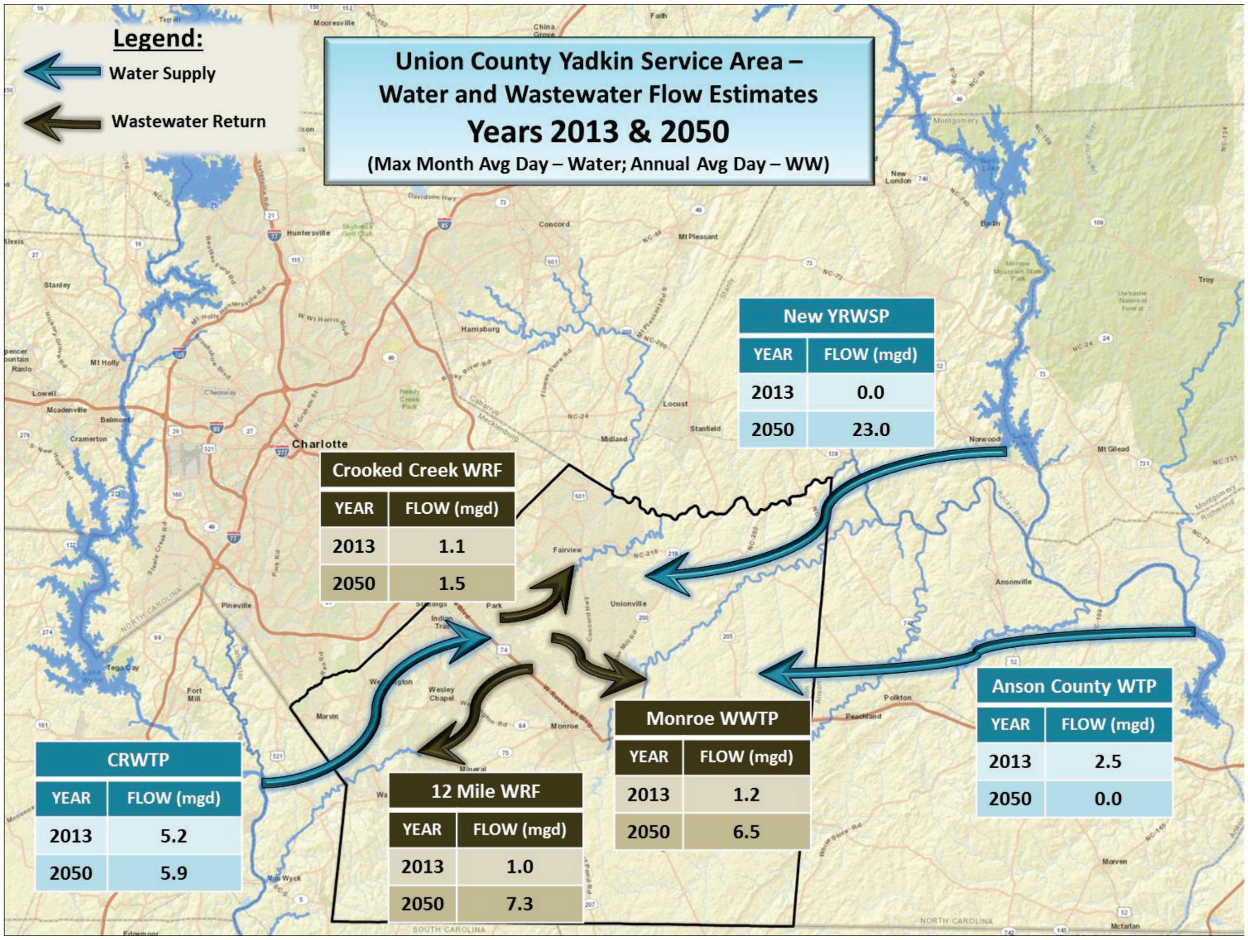

Illustration ES-1 Union County Yadkin River Basin Service Area Projected Water Supply and Demand

Description of Proposed Action

Union County is pursuing an IBT certificate to meet the water supply needs of its current and future residents, and on behalf of the wholesale communities served by the County. On August 12, 2013, the County submitted a Notice of Intent to the North Carolina Environmental Management Commission (EMC) regarding its request for an IBT for a maximum month average daily amount of 23 mgd (equivalent to a maximum day amount of 28 mgd) from the Yadkin River IBT Basin (Basin code 18-1) to the Rocky River IBT Basin (Basin code 18-4), both of which are part of the Yadkin River Basin. While these two IBT basins are each part of the primary Yadkin River Basin, North Carolina IBT statute considers these two IBT basins as separate, and the proposed water transfer to be an interbasin transfer.

The requested amount is based on 2050 water demand projections in the County's Yadkin River Basin Service Area. The intent of this IBT is to supplement the County's existing water supply sources to meet projected water demands through 2050. Illustration ES-2 depicts the County's current (2012) and projected future water use, including authorized and requested IBT amounts within their Yadkin River Basin Service Area. This illustration additionally outlines how this future water demand is anticipated to be met through the year 2050.

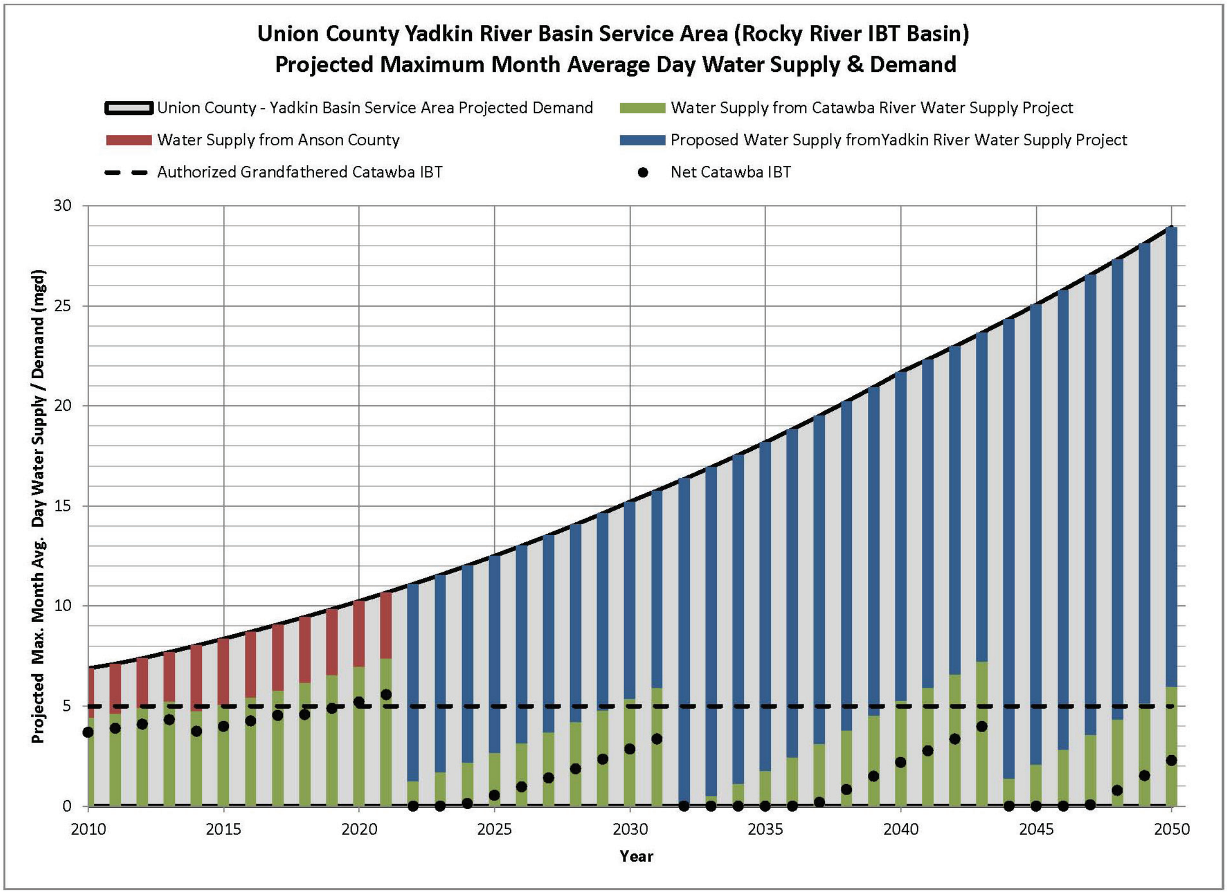

Illustration ES-2 Union County Yadkin River Basin Service Area Projected Water Supply and Demand

Description of Proposed Alternatives

Twelve (12) alternatives for Union County's Yadkin River Water Supply Project, including the No Action Alternative, have been identified for evaluation in the EIS and include the following:

- **Surface Water Supply Alternatives:**
  - **Alternative 1 -** Pee Dee River raw water supply from Lake Tillery (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
    - **Alternative 1A –** Raw water transmission alignment from Lake Tillery to new WTP in northern Union County primarily following road Right-of-Ways.
    - **Alternative 1B –** Raw water transmission alignment from Lake Tillery to new WTP in northern Union County primarily following power utility easements.
  - **Alternative 2A -** Yadkin River raw water supply from Narrows Reservoir (Badin Lake) (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.

- **Alternative 2B -** Yadkin River raw water supply from Tuckertown Reservoir (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
- **Alternative 3 -** Pee Dee River raw water supply from Blewett Falls Lake (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
  - **Alternative 3A –** Raw water transmission alignment from Blewett Falls Lake to new WTP in northern Union County primarily following power and natural gas utility easements.
  - **Alternative 3B –** Raw water transmission alignment from Blewett Falls Lake to new WTP in eastern Union County primarily following US-74 Right-of-Way.
- **Alternative 4 -** Raw water supply from the main stem of the Pee Dee River (from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
- **Alternative 5 -** Raw water supply from the Rocky River within Union County (non-IBT alternative) with a new water treatment plant in Union County.
- **Alternative 6 -** Expansion of the Catawba River Water Supply Project (CRWSP) (modification to existing grandfathered IBT amount for a larger IBT from the Catawba River Basin to the Rocky River IBT Basin of the Yadkin River Basin).
- **Alternative 7 -** Interconnection with Charlotte Water (IBT from Catawba River Basin to the Rocky River IBT Basin of the Yadkin River Basin).

▪ **Interbasin Transfer Minimization Alternatives:**
- **Alternative 8 -** Raw water supply through groundwater withdrawal within Union County with a new water treatment plant in Union County.
- **Alternative 9 -** Water demand management/conservation.
- **Alternative 10 -** Direct potable reuse.
- **Alternative 11 -** Evaluation of water returns (wastewater) from the Rocky River IBT Basin back to the Yadkin River IBT Basin.
- **Alternative 12 -** No Action Alternative

The surface water supply alternatives being evaluated and their relative locations are illustrated in Figure 2-3, found in Appendix A.

Evaluation of Impacts

The potential environmental, cultural and socioeconomic impacts associated with the proposed action alternatives are documented in the EIS. The resources evaluated in the EIS include:

- Topography and Geology
- Soils
- Land Use
- Public Lands and Scenic, Recreational, and State Natural Areas
- Prime or Unique Agricultural Lands
- Areas of Archaeological or Historic Value
- Resources of Historic Value
- Air Quality

- Noise Levels
- Floodways and 100-Year Floodplains
- Wetlands
- Water Resources (Surface and Groundwater), to include water quantity and quality
- Shellfish or Fish and Their Habitats
- Forest Resources
- Wildlife and Natural Vegetation
- Environmental Justice
- Introduction of Toxic Substances

The relative severity of an impact is denoted in this EIS as negligible, minor, moderate, or significant. Negligible impacts are those impacts that may occur but may not be detectable. Minor impacts are those impacts that are measurable but are clearly not significant. Moderate impacts are impacts whose effects may require additional care, employment of best management practices (BMPs), application of precautionary measures to minimize adverse impacts, or have some uncertainty inherent in whether the effects forecast by a predictive model would occur. Major impacts are defined by the Council on Environmental Quality regulations 40 CFR 1508.27 as requiring consideration of both context and intensity of the effect.

The following basic definitions were used in evaluating impacts:

- Temporary impact: A temporary impact is an impact associated with a particular activity for a finite period. Typically, a temporary impact occurs during construction.
- Permanent impact: An impact that is persistent or chronic.
- Negligible impacts: Negligible impacts are not detectable or are slight.
- Minor impacts: Minor impacts are not readily noticeable.
- Moderate impacts: Moderate impacts are readily noticeable.
- Major impacts: Major impacts are clearly noticeable and severely adverse or exceptionally beneficial.
- Secondary (indirect) impacts: Impacts that are reasonably foreseeable from growth and development induced or supported by an infrastructure project
- Cumulative impacts: Environmental impacts resulting from the incremental effects of an activity when added to other past, present and reasonable foreseeable future activities.

The State Environmental Policy Act (SEPA) requires that the impacts of the No-Action Alternative be evaluated. No new infrastructure is planned as part of the No-Action Alternative, so there are no direct impacts to the natural or human environment. However, growth and development in the service area would still occur with the No-Action Alternative. The resulting indirect impacts are documented in the impacts analysis.

Summary of Impacts for Alternatives

Direct, secondary, and cumulative environmental impacts have the potential to occur as the result of implementation of a project alternative. Secondary (indirect) impacts are defined as the impacts that are reasonably foreseeable from growth and development induced or supported by an infrastructure project. Cumulative impacts are environmental impacts resulting from the incremental effects of an activity when added to other past, present and reasonable foreseeable future activities.

A summary of the potential environmental, cultural, and socioeconomic impacts associated with the proposed action alternatives are provided in Table ES-1.

There are twelve jurisdictions in Union County that have the potential to be served with water as a result of the proposed action. The number of jurisdictions in the service area will vary depending on the selection of a specific project alternative. No communities are anticipated to be served outside of county borders.

Existing local, state, and federal programs and ordinances will mitigate the potential for direct and indirect impacts from the proposed action. Mitigation for secondary and cumulative impacts related to stormwater, floodplain, riparian buffer, erosion and sedimentation control, wetland protection, open space and parks, water use, land use, historic preservation, tree preservation, endangered species protection, and regional transportation planning measures will be provided, as directed by the state and federal programs and local ordinances for each community, where applicable.

A summary of impacts shown in Table ES-1 is as follows:

<u>Topography and Geology</u>

- Direct Impact Potential (minor impacts)
    - Temporary impacts during construction of raw water collection system and transmission lines
    - Permanent impacts from grading at pump stations, intakes, access roads, and WTP site
- Indirect and Cumulative Impact Potential (minor impacts)
    - Topography changes from development
- Direct and indirect impacts will be mitigated via local programs and ordinances

<u>Soils</u>

- Direct Impact Potential (minor impacts)
    - Temporary impacts from land clearing and construction activities
    - Permanent impacts at pump stations, intakes, access roads, transmission lines, and WTP site
- Indirect and Cumulative Impact Potential (minor impacts)
    - Soil erosion from new development
- Direct and indirect impacts will be mitigated via local programs and ordinances

<u>Land Use</u>

- Direct Impact Potential (minor impacts)
    - Permanent conversion of agricultural and undeveloped, wooded land use for utility easement, pump stations, access roads, and WTP site

- Indirect and Cumulative Impact Potential (minor impacts)
    - Conversion of agricultural and undeveloped, wooded land use to residential and commercial use
- Direct and indirect impacts will be mitigated via local programs and ordinances

<u>Public Lands and Scenic, Recreational, and State Natural Areas</u>

- Direct Impact Potential (moderate impacts)
    - Temporary impacts during construction
    - Permanent impacts from utility easement
- Indirect and Cumulative Impact Potential (minor impacts)
    - Conversion of adjacent land uses
- Direct and indirect impacts will be mitigated via local programs and ordinances

<u>Prime or Unique Agricultural Lands</u>

- Direct Impact Potential (negligible to minor impacts)
    - Permanent conversion of agricultural land for utility easement, pump stations, access roads, and WTP site
- Indirect and Cumulative Impact Potential (minor impacts)
    - Conversion of adjacent land uses
- Direct and indirect impacts will be mitigated via local programs and ordinances

<u>Areas of Archaeological or Historic Value</u>

- Direct Impact Potential (negligible to minor impacts)
    - No impacts to historic sites
    - Archaeological impact unknown, analysis to be completed upon review of preferred alternative; however, no impacts anticipated by utilizing existing, previously disturbed right-of-ways
- Indirect and Cumulative Impact Potential (negligible impacts)
    - Conversion of adjacent land uses
- Direct and indirect impacts will be mitigated via local programs and ordinances

<u>Air Quality</u>

- Direct Impact Potential (minor impacts)
    - Temporary increase in airborne particulates during project construction
    - Negligible permanent impacts from intermittent generator operation
- Indirect and Cumulative Impact Potential (minor impacts)
    - Minor impacts from potential new development reducing air quality and visibility due to increased automobile traffic
- Direct and indirect impacts will be mitigated via local programs and ordinances

<u>Noise Levels</u>

- Direct Impact Potential (minor impacts)

  - Temporary increase in noise during construction
  - Permanent increase in noise associated with pump station and WTP operation
- Indirect and Cumulative Impact Potential (minor impacts)
  - Increased overall noise in service area
- Direct and indirect impacts will be mitigated via local programs and ordinances.

Floodways and 100-Year Floodplains

- Direct Impact Potential (minor impacts)
  - Temporary impacts during construction of raw water collection system and transmission lines
  - Permanent impacts from grading at pump stations, intakes, access roads, and WTP site
- Indirect and Cumulative Impact Potential (negligible impacts)
  - Potential loss of 100 year floodplain from development
  - Isolation of floodplain due to stream channel entrenchment
- Direct and indirect impacts will be mitigated via local programs and ordinances.

Wetlands

- Direct Impact Potential (negligible to moderate impacts)
  - Temporary impacts during construction to jurisdictional wetlands
  - Permanent conversion of forested wetlands to non forested wetlands
- Indirect and Cumulative Impact Potential (negligible to minor impacts)
  - Wetland loss via development
  - Loss of habitat and habitat fragmentation
  - Loss of attenuation in flow
  - Loss of wetland function from pollutant loading
- Direct and indirect impacts will be mitigated via local programs and ordinances.

Surface Water Resources

- Direct Impact Potential (minor to moderate impacts)
  - Temporary impact from stream crossings during construction
  - Permanent impact from stream / reservoir withdrawal
- Indirect and Cumulative Impact Potential (minor to moderate impacts)
  - Water quality degradation due to increase in stormwater runoff
  - Water quantity and quality impacts from withdrawal
  - Alteration of natural hydrograph
  - Alteration of channel morphology
- Direct and indirect impacts will be mitigated via local programs and ordinances.

Groundwater Resources

- Direct Impact Potential (negligible to major impacts)
  - Temporary impacts to during construction

  - Permanent impact from groundwater withdrawal (Alternative 8)
- Indirect and Cumulative Impact Potential (negligible to major impacts)
  - Potential for contamination leading to reduction in use for drinking water
  - Decrease in groundwater inflow reduces stream base flow, particularly during droughts
- Direct and indirect impacts will be mitigated via local programs and ordinances.

Shellfish or Fish and Their Habitats

- Direct Impact Potential (minor impacts)
  - Temporary impacts to during construction
  - Permanent impact from stream withdrawal (Alternatives 4, 5 and 6) and low head dams (Alternative 5 only)
- Indirect and Cumulative Impact Potential (minor impacts)
  - Aquatic habitat degradation
  - Change in stream morphology
  - Reduction in aquatic diversity
  - Reduction in long-term population sustainability
- Direct and indirect impacts will be mitigated via local programs and ordinances.

Forest Resources

- Direct Impact Potential (minor impacts)
  - Temporary impacts to forest resources during construction
  - Permanent conversion to other land uses at pump stations, transmission lines, access roads, and WTP sites
- Indirect and Cumulative Impact Potential (minor impacts)
  - Conversion to other land uses
  - Habitat fragmentation
  - Potential reduction in air quality
- Direct and indirect impacts will be mitigated via local programs and ordinances.

Wildlife and Natural Vegetation

- Direct Impact Potential (minor impacts)
  - Temporary impacts to habitat during construction
  - Permanent impacts to habitat at pump station, access road, and WTP sites
- Indirect and Cumulative Impact Potential (minor impacts)
  - Reduction in habitat
  - Habitat fragmentation
  - Reduction in species diversity and tolerance
  - Reduction in long-term population sustainability
- Direct and indirect impacts will be mitigated via local programs and ordinances.

Environmental Justice

- Direct Impact Potential

  - None to minor temporary disproportionate impacts to minority or low-income populations
  - No permanent impacts
- Indirect and Cumulative Impact Potential
  - None

<u>Introduction of Toxic Substances</u>

- Direct Impact Potential (minor impacts)
  - Temporary increase in use of hazardous and toxic materials during construction
- Indirect and Cumulative Impact Potential (negligible impacts)
  - Increase in likelihood of contamination
  - Negative impacts to human health
- Direct and indirect impacts will be mitigated via local programs and ordinances.

Table ES-1 on the following pages also provides a summary of the opinion of probable project costs associated with the YRWSP Alternatives. Cost opinions for Alternatives 9 and 10 were not developed, as Alternative 9 does not require new infrastructure or the use of land outside of the treatment facilities proposed by the other alternatives. Additionally, Alternative 10 has been eliminated from consideration based on current regulatory framework, thereby preventing it from meeting the project's purpose and need.

Table ES-1 **Summary of Temporary and Permanent Direct Impacts and Indirect Impacts for YRWSP Alternatives**

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Topography and Geology	Direct, Temporary	No impacts	Minor from pipe installation	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from grading for construction of WTP	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Minor from grading for raw water intake, pump station and access road	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from grading for WTP, raw water intake, pump station and access road	Same as Alternative 1A	Minor from grading for low-head dam, raw water intake, pump station and access road	Minor from grading for raw water intake and WTP expansion, pump station, and access road	Minor from grading for pump station and access road	Minor from grading for WTP and groundwater well installation	Minor from grading for discharge, pump station and access road	Minor from grading for WTP	Same as WTP A	Same as WTP A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Soils	Direct, Temporary	No impacts	Minor from: ○ Impacts from land clearing, excavation and grading ○ Fuel, oil, and other emissions from construc-tion vehicles	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Minor from construction of raw water intake, pump station, and access road	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from construction of WTP, raw water intake, pump station, and access road	Same as Alternative 1A	Minor from construction of low-head dam, raw water intake, pump station, and access road	Minor from construction of raw water intake and WTP expansion, pump station, and access road	Minor from construction of pump station and access road	Minor from construction of WTP and groundwater well installation	Minor from construction of discharge, pump station, and access road	Minor from construction of WTP	Same as WTP A	Same as WTP A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Land Use	Direct, Temporary	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Direct, Permanent	No impacts	Moderate from conversion of wooded/ undeveloped areas and residential, commercial, and agricultural uses to permanent utility use	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Land Use (con't)	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Public Lands and Scenic, Recreational Areas, and State Natural Areas	Direct, Temporary	No impacts	Minor to 5.3 miles of bike routes and 7.2 acres of other areas from transmission line	Minor to 0.3 mile of bike routes and 6.5 acres of other areas from transmission line	Minor to 14.0 miles of bike routes and 5.6 acres of other areas from transmission line	Minor to 14.0 miles of bike routes and 9.4 acres of other areas from transmission line	Minor to 46.5 acres from transmission line	Minor to 15.5 acres from transmission line	Minor to 0.5 acre from transmission line	Minor to 5.5 acres from transmission line	No impacts	Minor to 0.6 acre from transmission line	Impacts from well field are not known	Minor to10.6 miles of bike routes and 8.4 acres of other areas from transmission line	No impacts	No impacts	Minor to 7.2 acres from transmission line
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	No impacts	Minor to 0.5 acre of Pee Dee River State Game Land from pump station and access road	Minor to 0.8 acre of Pee Dee River State Game Land from pump station and access road	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Indirect	Same as Alternative 1A	Minor from conversion of adjacent land uses	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Prime or Unique Agricultural Land	Direct, Temporary	No impacts	Minor to 18.9 acres from pipe installation	Minor to 22.8 acres from pipe installation	Minor to 30.8 acres from pipe installation	Minor to 23.1 acres from pipe installation	Minor to 25.4 acres from pipe installation	Minor to 6.2 acres from pipe installation	Minor to 25.5 acres from pipe installation	No impacts	Minor to 41.4 acres from pipe installation	Minor to 4.8 acres from pipe installation	Minor to 5.2 acres from pipe installation	Minor to 41.9 acres from pipe installation	No impacts	Minor to 2.5 acres from pipe installation	Minor to 3.6 acres from pipe installation
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	Minor to less than 0.1 acre from pump station and access road	No impacts	Impact from WTP is not known	Minor to 0.9 acre from access road	No impacts	No impacts	No impacts	Impacts from WTP and well field are not known	No impacts	No impacts	Impacts from WTP is not known	Impacts from WTP is not known
	Indirect	Same as Alternative 1A	Minor from conversion of agricultural land to residential and commercial use	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Areas of Archaeological or Historic Value	Direct, Temporary	No impacts	○ No impacts to historic sites ○ Impacts to archaeological resources unknown, but unlikely	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Areas of Archaeological or Historic Value (con't)	Direct, Permanent	No impacts	○ No impacts to historic sites ○ Impacts to archaeological resources unknown, but unlikely	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Air Quality	Direct, Temporary	No impacts	Minor from increase in airborne particulates during project construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Negligible from intermittent generator operation	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Noise Levels	Direct, Temporary	No impacts	Minor nuisance noise associated with project construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Negligible from intermittent generator operation	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Negligible from increased overall noise in service area	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Floodways and 100 year Floodplains	Direct, Temporary	No impacts	Minor impacts from construction to 13.5 acres of 100-year floodplain	Minor impacts from construction to 32.2 acres of 100-year floodplain	Minor impacts from construction to: ○ 1.6 acres of floodway ○ 21.2 acres of 100-year floodplain	Minor impacts from construction to: ○ 1.0 acre of floodway ○ 19.9 acres of 100-year floodplain	Minor impacts from construction to 86.9 acres of 100-year floodplain	Minor impacts from construction to: ○ 6.7 acres of floodway ○ 49.3 acres of 100-year floodplain	Minor impacts from construction to 33.4 acres of 100-year floodplain	Minor impacts from construction to 1.7 acres of 100-year floodplain	Minor impacts from construction to: ○ 0.6 acre of floodway ○ 7.6 acres of 100-year floodplain	Minor impacts from construction to: ○ 0.2 acre of floodway ○ 4.7 acres of 100-year floodplain	Minor impacts from construction to 0.2 acre of 100-year floodplain	Minor impacts from construction to: ○ 0.6 acre of floodway ○ 28.1 acres of 100-year floodplain	No impacts	No impacts	Minor impacts from construction to 0.8 acre of 100-year floodplain

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Floodways and 100 year Floodplains (con't)	Direct, Permanent	No impacts	Minor impacts to 0.1 acre of 100-year floodplain	Minor impacts to 0.1 acre of 100-year floodplain	Minor impacts to 0.3 acre of 100-year floodplain	No impacts	Minor impacts to 2.0 acres of 100-year floodplain	Minor impacts to 2.0 acres of 100-year floodplain	Minor impacts to 0.2 acre of 100-year floodplain	Minor impacts to 0.5 acre of 100-year floodplain	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Indirect	Same as Alternative 1A	Negligible from: ○ Potential loss of 100-year floodplain from development ○ Topography changes from development ○ Isolation of floodplain due to stream channel entrenchment	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Wetlands	Direct, Temporary	No impacts	No impacts	Minor impacts to 7.5 acres of forested wetland from transmission line	Minor impacts to 0.6 acre of forested wetland from transmission line	Minor impacts to 0.6 acre of forested wetland from transmission line	Minor impacts from transmission line to: ○ 44.8 acres of forested wetland ○ 8.7 acres of non-forested wetland	Minor impacts from transmission line to: ○ 2.8 acres of forested wetland ○ 0.5 acre of non-forested wetland	No impacts	No impacts	Minor impacts from transmission line to: ○ 0.5 acre of forested wetland ○ 0.1 acre of non-forested wetland	Minor impacts from transmission line to 0.1 acre of forested wetland	No impacts from transmission line Impacts from well field are not known	Minor impacts to 0.9 acre of forested wetland from transmission line	No impacts	No impacts	No impacts
	Direct, Permanent	No impacts	No impacts	Minor impacts to 0.5 acre of forested wetland from transmission line	No impacts	No impacts	Minor impacts to 3.2 acres of forested wetland from transmission line	No impacts	No impacts	○ No impacts associated with transmission line or pump station. ○ Impacts due to low-head dam unknown	Minor impacts to less than 0.1 acre of forested wetland from transmission line	No impacts	Minor impacts expected, but not quantified	No impacts	No impacts	No impacts	No impacts
	Indirect	Same as Alternative A1	Minor from: ○ Wetland loss via development ○ Loss of habitat and fragmentation ○ Loss of wetland function from pollutant loading	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Surface Water Resources	Direct, Temporary	No impacts	Minor from transmission line to: o 2,848 feet of perennial streams from 11 crossings o 11,014 feet of intermittent streams from 20 crossings o 0.3 acre of buffer	Minor from transmission line to: o 5,857 feet of perennial streams from 14 crossings o 10,598 feet of intermittent streams from 31 crossings o 1.7 acre of buffer	Minor from transmission line to: o 2,339 feet of perennial streams from 11 crossings o 9,498 feet of intermittent streams from 22 crossings o 1.0 acre of buffer	Minor from transmission line to: o 1,914 feet of perennial streams from 9 crossings o 9,572 feet of intermittent streams from 27 crossings o 0.9 acre of buffer	Minor from transmission line to: o 5,242 feet of perennial streams from 20 crossings o 8,194 feet of intermittent streams from 22 crossings o 4.1 acres of buffer	Minor from transmission line to: o 4,634 feet of perennial streams from 16 crossings o 7,683 feet of intermittent streams from 24 crossings o 8.2 acres of buffer	Minor from transmission line to: o 1,715 feet of perennial streams from 7 crossings o 6,979 feet of intermittent streams from 14 crossings o 11.6 acres of buffer	Minor from transmission line to 1,343 feet of intermittent streams from 3 crossings	Minor from transmission line to: o 1,509 feet of perennial streams from 7 crossings o 3,913 feet of intermittent streams from 18 crossings o 3.8 acres of buffer	o No impacts due to use of trenchless construction methods for installation of the installation line across 2 perennial streams and 7 intermittent streams o 6.4 acres of buffer	Minor from transmission line to: o 407 feet of perennial streams from 2 crossings o 1,530 feet of intermittent streams from 5 crossings	Minor from transmission line to: o 4,508 feet of perennial streams from 18 crossings o 17,449 feet of intermittent streams from 25 crossings o 3.7 acres of buffer	No impacts	Minor from transmission line to 1,438 feet of intermittent streams from 5 crossings	Minor from transmission line to 3,426 feet of intermittent streams from 11 crossings
	Direct, Permanent	No impacts	Minor to: o 50 feet of Pee Dee River from raw water intake o Less than 0.1 acre of buffer from raw water intake and transmission line	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.1 acre of buffer	Minor to: o 50 feet of Yadkin River for raw water intake o 0.1 acre of buffer	Minor to: o 50 feet of Yadkin River for raw water intake o 0.1 acre of buffer	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.2 acre of buffer	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.3 acre of buffer	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.6 acre of buffer	o Minor impacts to 100 feet of Rocky River for raw water intake and low-head dam or Ranney wells o Unknown impacts to 6,000 feet of Rocky River due to low-head dam effects	Minor to: o 50 feet of Catawba River for raw water intake expansion o 0.2 acre of buffer	Minor impacts to 0.3 acre of buffer	No impacts	Minor to: o 50 feet of Pee Dee River for discharge o 0.2 acre of buffer	No impacts	No impacts	No impacts
	Indirect	Same as Alternative 1A	Minor from: o Water quality degradation due to increase in stormwater runoff o Alteration of natural hydrography o Alteration of channel morphology o Increased natural utilization of buffers due to increase in stormwater	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Surface Water Quantity and Quality	Lake Levels - Aesthetics	No Impacts	Negligible to minor direct, permanent impacts to lake levels due to lower average lake elevations	Same as Alternative 1A	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor direct, permanent impacts to lake levels due to lower average lake elevations	Minor to moderate direct, permanent impacts to lake levels due to lower average lake elevations	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
	Lake Levels – Water Withdrawals	No Impacts	Negligible impact to water withdrawals based on restricted operation at lake located intakes	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor impact to water withdrawals based on restricted operation at lake located intakes	Minor impact to water withdrawals based on restricted operation at lake located intakes	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
	Reservoir Outflows	No Impacts	Negligible to minor direct, permanent impacts due to increased days below specified reservoir release values	Same as Alternative 1A	Minor to moderate direct, permanent impacts due to increased days below specified reservoir release values	Minor to moderate direct, permanent impacts due to increased days below specified reservoir release values	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Negligible impact to reservoir outflows based on days below specified reservoir release values	Negligible to minor direct, permanent impacts due to increased days below specified reservoir release values	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
	Water Quantity Mgmt	No Impacts	Negligible impact to water quantity management, based on time in LIP stages	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor impact to water quantity management, based on increased time in more severe LIP stages	Minor to moderate impact to water quantity management, based on increased time in more severe LIP stages	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Surface Water Quantity and Quality (con't)	Hydropower Generation	No Impacts	Negligible to minor direct, permanent impacts to lake levels due to lower average lake elevations	Same as Alternative 1A	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor direct, permanent impacts to lake levels due to lower average lake elevations	Minor to moderate direct, permanent impacts to lake levels due to lower average lake elevations	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
Groundwater Resources	Direct, Temporary	No impacts	Negligible from construction of transmission line, raw water intake, pump station and access road	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Negligible from construction of transmission line, WTP, raw water intake, pump station and access road	Same as Alternative 1A	Negligible from construction of transmission line, low-head dam, raw water intake, pump station and access road	Negligible from construction of transmission line, raw water intake and WTP expansion, pump station, and access road	Negligible from construction for transmission line, pump station, and access road	Negligible from construction of transmission line, WTP, and groundwater well installation	Negligible from construction of transmission line, discharge, pump station, and access road	Negligible from construction of WTP	Negligible from construction of WTP and transmission line	Negligible from construction of WTP and transmission line
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	Moderate if Ranney well option is selected	Moderate if Ranney well option is selected	No impacts	No impacts	Major from extraction of 28 mgd of raw water from 1,295 wells	No impacts	No impacts	No impacts	No impacts
	Indirect	Same as Alternative 1A	Minor from: ○ Potential for contamination leading to reduction in use for drinking water ○ Reduction in groundwater inflow contribution to stream base flow, particularly during droughts	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Shellfish or Fish and Habitats	Direct, Temporary	No impacts	Minor from erosion and sedimentation during construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Negligible from erosion and sedimentation during construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 7	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Shellfish or Fish and Habitats (con't)	Direct, Permanent	No impacts	Minor from raw water intake	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from low-head dam and raw water intake	Same as Alternative 1A	No impacts	Anticipated to be negligible from infrastructure footprint	Minor from discharge	No impacts	Same as Alternative 8	Same as Alternative 8
	Indirect	Same as Alternative 1A	Minor from: ○ Aquatic habitat degradation ○ Change in stream morphology ○ Reduction in aquatic diversity ○ Reduction in long-term population sustainability	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Forest Resources	Direct, Temporary	No impacts	Minor impacts to 130 acres for transmission corridor	Minor impacts to 226 acres for transmission corridor	Minor impacts to 129 acres for transmission corridor	Minor impacts to: ○ 126 acres for transmission corridor ○ 1 acre for access road	Minor impacts to: ○ 325 acres for transmission corridor ○ Less than 1 acre for access road	Minor impacts to: ○ 116 acres for transmission corridor ○ Less than 1 acre for access road	Minor impacts to 121 acres for transmission corridor	Minor impacts to 4 acres for transmission corridor	Minor impacts to 56 acres for transmission corridor	Minor impacts to 34 acres for transmission corridor	Minor impacts to 14 acres for transmission corridor Impacts from WTP and well field are not known	Minor impacts to 163 acres for transmission corridor	No impacts	Minor impacts to 18 acres for transmission corridor	Minor impacts to 27 acres for transmission corridor
	Direct, Permanent	No impacts	Minor impacts to 11 acres for transmission corridor	Minor impacts to 18 acres for transmission corridor	Minor impacts to 1 acre for transmission corridor	Minor impacts to: ○ 9 acres for transmission corridor ○ Less than 0.5 acre for pump station ○ Less than 0.5 acre for access road	Minor impacts to: ○ 27 acres for transmission corridor ○ Less than 0.5 acre for pump station ○ Less than 0.5 acre for access road	Minor impacts to: ○ 3 acres for transmission corridor ○ Less than 0.5 acre for pump station ○ Less than 0.5 acre for access road ○ Impacts not known for WTP	Minor impacts to: ○ 11 acres for transmission corridor ○ Less than 0.5 acre for pump station	Minor impacts to less than 0.5 acre for transmission corridor	Minor impacts to 7 acres for transmission corridor	Minor impacts to 3 acres for transmission corridor	Minor impacts to: ○ 1 acre for transmission corridor ○ Impacts not known for WTP or well field	Minor impacts to 13 acres for transmission corridor	Impacts not known for WTP	Minor impacts to: ○ 1 acre for transmission corridor ○ Impacts not known for WTP	Minor impacts to: ○ 2 acres for transmission corridor ○ Impacts not known for WTP
	Indirect	Same as Alternative 1A	Minor from: ○ Conversion to other land uses ○ Habitat fragmentation ○ Potential reduction in air quality	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Wildlife and Natural Vegetation	Direct, Temporary	No impacts	o Minor during construction in project areas o Potential impacts to threatened or endangered species are unknown	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	o Minor with less than 30 percent of the total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with 30 percent and fifth largest impact on wildlife habitat based on the percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with less than 25 percent of the total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with less than 20 percent of the total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with 36 percent and second largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with 37 percent and largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with 35 percent and fourth largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with less than 25 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with 35 percent and third largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with less than 25 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with less than 20 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with less than 25 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with 30 percent of total WTP area located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with less than 30 percent of total project corridor and 65 percent of the total WTP area located on forested land o Potential impacts to threatened or endangered species are unknown	Minor with less than 35 percent of total project corridor and less than 30 percent of total WTP area located on forested land o Potential impacts to threatened or endangered species are unknown
	Indirect	Same as Alternative 1A	Minor from: o Reduction in habitat o Habitat fragmentation o Reduction in species diversity and tolerance o Reduction in long-term population sustainability	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Environmental Justice	Direct, Temporary	No impacts	No disproportionate impacts to minority or low-income populations	No disproportionate impacts to minority or low-income populations	No disproportionate impacts to minority or low-income populations	○ No disproportionate impacts to minority or low-income populations	○ Minor disproportionate impacts from 9.4 miles of pipe corridor traversing 3 block groups with minority populations greater than 50 percent ○ No disproportionate impacts to low-income populations	Minor disproportionate impacts as 10 of 15 block groups in which pipe corridor is located are comprised of minority populations greater than 50 percent ○ No disproportionate impacts to low-income populations	○ No disproportionate impacts to minority or low-income populations	No disproportionate impacts to minority or low-income populations	○ No disproportionate impacts to minority or low-income populations	No disproportionate impacts to minority or low-income populations	○ Minor disproportionate impacts from well field having two block groups with minority populations greater than 50 percent ○ No disproportionate impacts to low-income populations	Minor disproportionate impacts from pipe corridor traversing one block group comprised of minority population greater than 50 percent ○ No disproportionate impacts to low-income populations	No disproportionate impacts to minority or low-income populations	No disproportionate impacts to minority or low-income populations	No disproportionate impacts to minority or low-income populations
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Indirect	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
Introduction of Toxic Substances	Direct, Temporary	Same as Alternative 1A	Minor from increase in storage and use of hazardous and toxic materials, and generation and disposal of hazardous waste during construction activities	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	Same as Alternative 1A	Minor from increase in storage and use of hazardous and toxic materials, and generation and disposal of hazardous waste during operations	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Introduction of Toxic Substances (con't)	Indirect	Same as Alternative 1A	Minor from: ○ Increase in likelihood of contamination ○ Impacts to human health	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Total Project Cost			$239.7 M	Costs similar to Alternative 1A	$294.1 M	$294.0 M	$282.2 M	$248.9 M	$332.2 M	$190.6 M	$252.0 M	$261.1 M	$294.6 M	$377.2 M			

[1] It should be noted Alternative 9 is located exclusively within areas currently in use as water treatment facilities. This alternative does not require new infrastructure or the use of land outside of the treatment facilities, so direct impacts to natural resources are not anticipated. As such, a discussion of direct impacts for Alternative 9 is not provided. Alternative 10, direct potable reuse, is also not assessed in this evaluation due to this alternative being eliminated from consideration based on current regulatory framework.

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Discussion of Preferred Alternative

Alternative 1A is designated as the Preferred Alternative after a thorough assessment of each alternative's ability to meet the project's purpose and need of delivering a safe, sustainable water supply to meet the County's current and future water demands in their Yadkin River Basin Service Area, as well as the associated environmental impacts, mitigation measures, technical feasibility, financial impacts, and political and community acceptance. Alternative 1A includes the withdrawal of water from Lake Tillery in the Yadkin River IBT Basin and the transfer of this water into the Rocky River IBT Basin in Union County for treatment and distribution. A portion of the water will be returned via treated wastewater effluent back through the Rocky River into the Pee Dee River approximately five miles downstream from the Lake Tillery dam.

Alternative 1A, in conjunction with the existing grandfathered IBT from the Catawba River Basin, is capable of delivering the stated 28.9 mgd 30-year maximum month (23.0 mgd from the Yadkin River Basin, supplemented by up to 5.9 mgd from the existing Catawba supply) and 35.3 mgd maximum day demands (28.0 mgd from the Yadkin River Basin, supplemented by up to 7.3 mgd from the existing Catawba supply) of Union County. The water modeling efforts completed for this EIS indicate that withdrawal from Lake Tillery has less impact on lake aesthetics and other water withdrawal interests, including during drought conditions and hydropower production, than withdrawal of water from other locations along the main stem of the Yadkin-Pee Dee River. The environmental impacts of Alternative 1A are similar, or significantly less, than the other alternatives evaluated. Mitigation measures are in place throughout the proposed service area to mitigate these environmental impacts.

The cost of developing a water supply solution for Union County's Yadkin River Basin Service Area is significant and represents the largest future capital expenditure for the County over the next twenty years. Alternative 1A represents one of the lowest cost project alternatives and has been determined to be a financially feasible option for this water supply. In developing this project, Union County held discussions with numerous entities along the Yadkin-Pee Dee River regarding potential partnerships for water supply. Of all those contacted, the Town of Norwood was the only political jurisdiction who expressed a desire to participate in a partnership with mutual benefits for both parties. Currently, Union County and the Town of Norwood have an Interlocal Intake and Transmission Agreement in place for water withdrawal from a common raw water intake in Lake Tillery at the site of the Town of Norwood's current intake. Additionally, regional partnership for water supply between the Town of Norwood and Union County easily makes the most politically acceptable alternative.

Table ES-2 provides a brief, practical review of the key differentiators between alternatives and the rationale for selecting the Preferred Alternative. As illustrated and summarized in this table, Alternative 1A is recommended as the Preferred Alternative for Union County's Yadkin River Water Supply Project.

Table ES-2 Review of Key Differentiators for Project Alternatives

Alt.	Description	Key Differentiators in Comparison to Alternative 1
1A	Lake Tillery to Union County	**Preferred Alternative**
1B	Lake Tillery to Union County	▪ Longer raw water transmission lengths with greater environmental impacts. ▪ More costly than Preferred Alternative.
2A, 2B	Narrows Reservoir (2A) or Tuckertown Reservoir (2B) to Union County	▪ More significant consequences for water interests in the Yadkin River Basin including lake elevations, reservoir discharges, hydropower generation and surface water quality. ▪ Less politically acceptable. ▪ Longer raw water transmission lengths. ▪ More costly/cost prohibitive.
3A, 3B	Blewett Falls Reservoir to Union County via Alternative Transmission Routes (3A, 3B)	▪ More significant consequences for water interests in the Yadkin River Basin including reservoir discharges during drought periods. ▪ Less politically acceptable. ▪ Longer raw water transmission lengths. ▪ More costly/cost prohibitive.
4	Pee Dee River to Union County	▪ More significant environmental consequences associated with raw water storage (i.e. terminal reservoir). ▪ Source water not classified for public drinking water supply by NC. ▪ Is cost prohibitive.
5	Rocky River to Union County	▪ May not meet the purpose and need for overall water demand. ▪ Source water not classified as a drinking water source by NC. ▪ More significant environmental consequences associated with raw water collection (i.e. low head dam) and storage (i.e. terminal reservoir).
6	Catawba River to Union County via Existing Catawba River Water Supply Project	▪ Places additional demands on existing high-demand surface waters ▪ More significant environmental consequences for surface water quantity and quality interests in the Catawba River Basin, as indicated in Table ES-1. ▪ Likely would not be acceptable from a political/community perspective. ▪ More costly than Preferred Alternative.
7	Catawba River to Union County via Charlotte Water's Mountain Island Lake Withdrawal	▪ Places additional demands on existing high-demand surface waters ▪ More significant environmental consequences for surface water quantity and quality interests in the Catawba River Basin, as indicated in Table ES-1. ▪ Likely would not be acceptable from a political/community perspective. ▪ More costly than Preferred Alternative.
8	Groundwater Supply	▪ Has more significant environmental consequences associated with magnitude of groundwater well system. ▪ Requires extensive, prohibitive land acquisition to meet purpose and need. ▪ Is cost prohibitive.
9	Water Demand Management and Conservation	▪ Does not meet the purpose and need. ▪ Demand management and conservation reflected in historical water demand and future projections for Union County.
10	Direct Potable Reuse	▪ Does not meet the purpose and need since no regulatory framework exists to make this alternative possible in North Carolina. ▪ Likely cost prohibitive and not accepted politically or by the community.
11	Alternative 1 with Wastewater Returns to Lake Tillery	▪ Has greater environmental consequences associated with wastewater return transmission mains and treated effluent discharge to Lake Tillery. ▪ Provides little additional environmental benefits. ▪ Is cost prohibitive from a capital cost perspective; would have long-term cost and environmental impacts from continuous pumping of wastewater effluent.
12	No Action Alternative	▪ Does not meet purpose and need. ▪ Development and population growth within the County will continue to occur, but with less planning and mitigation. ▪ Additional strains put on other water supply sources (e.g. groundwater).

Table of Contents

List of Illustrations

List of Tables

Acronyms

7Q10	Seven-day, consecutive low flow with 10 year return frequency
30Q2	Thirty-day, consecutive low flow with 2 year return frequency
ADD	Average annual daily demand
ADWT	Advanced drinking water treatment
ANSI	American National Standards Institute
AOP	Advanced oxidation process
APGI	Alcoa Power Generating, Inc.
AQI	Air Quality Index
ARG	Argillite
ARRA	American Recovery and Reinvestment Act of 2009
AWWA	American Water Works Association
BFE	Base flood elevation
BGPA	Bald and Golden Eagle Protection Act of 1940, as amended
BOC	Biological activated carbon
C	Candidate
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CHEOPS™	Computerized Hydro Electric Operations Planning Software
CWA	Clean Water Act
CRWSP	Catawba River Water Supply Project
CRWTP	Catawba River Water Treatment Plant
CS	Carolina Slate Belt
C-t	Disinfectant contact time

DAQ	North Carolina Division of Air Quality
dB(A)	A-weighted decibel
DBP	Disinfection by-products
DENR	North Carolina Department of Environment and Natural Resources
DFR	North Carolina Division of Forest Resources
DPR	Direct potable reuse
DWR	North Carolina Division of Water Resources
DWQ	North Carolina Division of Water Quality
DO	Dissolved oxygen
E	Endangered
EA	Environmental Assessment
EAA	Engineering Alternatives Analysis
EFSAB	North Carolina Ecological Flows Scientific Advisory Board
EIS	Environmental Impact Statement
EMC	North Carolina Environmental Management Commission
EOC	Endocrine disruptive compounds
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ETJ	Extra-territorial jurisdiction
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FSC	Federal Species of Concern
FW	Freshwater
GAC	Granular activated carbon
GCWQMP	Site Specific Water Quality Management Plan for the Goose Creek Watershed
GIS	Geographic Information System
gpcd	Gallons per capita per day
gpm	Gallons per minute
HAA5	Haloacetic Acid
HPOWEB	North Carolina State Historic Preservation Office GIS Service
HQW	High Quality Waters
HSPS	High Service Pump Station
HUC	Hydrologic unit code
IBT	Interbasin Transfer
IDSA	Income Demographic Study Area
IPR	Indirect potable reuse
IWA	International Water Association
LIP	Low Inflow Protocol
LOX	Liquid oxygen
MBR	Membrane reactors
MBTA	Migratory Bird Treaty Act of 1918, as amended
MCL	Maximum contaminant level
MCWQP	Mecklenburg County Water Quality Program
MDD	Maximum day daily demand

MDSA	Minority Demographic Study Area
MF	Microfiltration
MG	Million gallons
mgd	Million gallons per day
MIF	Metaigneous-felsic
MII	Metaigneous-intermediate
MMDD	Maximum month daily average demand
msl	Mean sea level
MVE	Metavolcanic-epiclastic
MVF	Metavolcanic-felsic
MVU	Metavolcanic-undifferentiated
NAA	No Action Alternative
NAAQS	National Ambient Air Quality Standards
NCAC	North Carolina Administrative Code
NCDOT	North Carolina Department of Transportation
NF	Nanofiltration
NHP	North Carolina Natural Heritage Program
NMFS	National Marine Fisheries Service
NO3	Nitrate
NOx	Nitrogen oxides
NEPA	National Environmental Policy Act
NOI	Notice of Intent to File a Petition
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Unit
NWI	National Wetland Inventory
O3	Ozone
ONRW	Outstanding National Resource Waters
ORW	Outstanding Resource Waters
PAC	Powder activated carbon
PCBs	Polychlorinated biphenyls
PM	Parent material
PM2.5	Fine particulate matter
PMS	Performance Measures Sheet
ppb	Parts per billion
PPCP	Pharmaceuticals and personal care products
RCW	Red-cockaded woodpecker
RM	River Mile
RO	Reverse osmosis
RWPS	Raw Water Pump Station
SAESH	Significant Aquatic Endangered Species Habitat
SCDHEC	South Carolina Department of Health and Environmental Control

SCDNR	South Carolina Department of Natural Resources
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SFHA	Special Flood Hazard Area
SHPO	North Carolina State Historic Preservation Office
SNHA	Significant Natural Heritage Area
SO	Surveyed only
T	Threatened
TAZ	Traffic Analysis Zone
TDH	Total dynamic head
TDS	Total dissolved solids
THM	Trihalomethane
TMDL	Total maximum daily load
TOC	Total organic carbon
TOT	Time-of-travel
TSS	Total suspended solids
UCPW	Union County Public Works Department
UF	Ultrafiltration
UOSA	Upper Occoquan Service Authority
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UT	Unnamed tributary
UV	Ultraviolet radiation
VOC	Volatile organic compound
WMA	Wildlife Management Area
WQI	Water Quality Index
WRC	North Carolina Wildlife Resources Commission
WRF	Water Reclamation Facility
WSACC	Water and Sewer Authority of Cabarrus County
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
YRWSP	Yadkin River Water Supply Project

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1.0 PURPOSE AND NEED

1.1. Introduction and Background

In late 2011, Union County (County), through its Public Works Department (UCPW), completed a Comprehensive Water and Wastewater Master Plan (Black & Veatch, December 2011). This Master Plan and subsequent water supply studies outline future needs for additional water supply in the County's current and future service areas, and presents alternative scenarios for securing new water supply from the Catawba and/or Yadkin River Basins.

UCPW understands the complexities of delivering additional water supply to its customers due to the County's geography and development patterns (i.e., population centers, proximity to water sources, and river basin boundaries) as well as the regulatory restrictions/hurdles that exist for Interbasin Transfers (IBTs).

In May 2013, the County and the Town of Norwood completed an Interlocal Intake and Transmission Agreement that provided a framework for bringing raw water supply from the Yadkin River Basin into Union County's Yadkin River Basin Service Area. This service area lies within the Rocky River IBT Basin, which is a part of the greater Yadkin River Basin.

The County is now moving forward with the Yadkin River Water Supply Project (YRWSP) to ensure long-term, sustainable water supply to its current, and projected, future service areas in the Yadkin River Basin. This effort includes securing the required regulatory permits and approvals for delivering additional water to the County's customers in the Rocky River IBT Basin, including the evaluation of alternative scenarios that consider new water supply into this area from various sources. Under the current legislative and regulatory framework, the County must obtain an IBT certificate for this project.

1.2. Purpose of Proposed Action

Union County has seen significant growth over the past two decades and is expected to continue to have steady growth and development into the foreseeable future. In response to this growth, the County has worked diligently to meet the increasing demands for public water supply and other services. Further, the County has completed an extensive water supply planning effort, and has identified opportunities to provide a long-term, sustainable water supply solution for its citizens and community.

The Union County Water System currently serves customers in both the Catawba River Basin (Catawba River Basin Service Area) and the Rocky River IBT Basin (Yadkin River Basin Service Area) of the Yadkin River Basin as illustrated in Figure 1-1 (All maps and "figures" referenced within this document are located in Appendix A). The ridgeline between the Catawba River Basin and Yadkin River Basin divides the County, with neither of these two major rivers flowing within the County boundaries

The County currently holds a 5 million gallons per day (mgd) authorized transfer (i.e., a grandfathered IBT amount) of water from the Catawba River Basin to the Rocky River IBT Basin. This value is based upon the definition of a grandfathered IBT as stipulated in North

Carolina Administrative Code 15A NCAC 02E .0401(d) where an IBT certificate is not required to transfer water from one river basin to another up to the full capacity of a facility to transfer water from one basin to another if the facility was existing or under construction on July 1, 1993. The full capacity of a facility to transfer water shall be determined as the capacity of the combined system of withdrawal, treatment, transmission, and discharge of water, limited by the element of this system with the least capacity as existing or under construction on July 1, 1993. The County's 5 mgd authorized transfer from the Catawba River Basin to the Rocky River IBT Basin is based upon the capacity of the water transfer infrastructure which was in place within the County as of July 1, 1993, as documented in the County's Grandfathered IBT Worksheet prepared by CH2MHill on behalf of the County and submitted to the North Carolina Division of Water Resources (DWR) on October 19, 2000. This authorized transfer is referred to herein as the grandfathered IBT amount.

To maintain compliance with the Catawba River Basin grandfathered IBT, the County currently returns a portion of the transferred water back into the Catawba River Basin via the Poplin Road wastewater pumping station. The County also has plans to build scalping infrastructure to allow the capability to return additional water to the Catawba River Basin via the Crooked Creek Wastewater Treatment Plant. Additionally, the County currently holds a water purchase agreement (which is up for renewal in 2017) with Anson County for 4 mgd of water supply that is utilized in the County's Yadkin River Basin Service Area.

Water needs in the County's Yadkin River Basin Service Area are projected to increase from a current maximum month average daily demand of 7.7 mgd to 28.9 mgd by 2050 (equivalent to a current maximum daily demand of 9 mgd to 35.3 mgd by 2050). The County's current grandfathered IBT from the Catawba River Basin and the Anson County water supply are not capable of meeting the projected future demand within the Rocky River IBT Basin; and therefore, the County must secure a reliable water supply from other sources to meet its future demand in this service area.

1.3. Description of Proposed Action

Union County is pursuing an IBT certificate to meet the water supply needs of its current and future residents, and on behalf of the wholesale communities served by the County. On August 12, 2013, the County submitted a Notice of Intent to the North Carolina Environmental Management Commission (EMC) regarding its request for an IBT for a maximum month average daily amount of 23 mgd (equivalent to a maximum day amount of 28 mgd) from the Yadkin River IBT Basin (Basin code 18-1) to the Rocky River IBT Basin (Basin code 18-4), both of which are part of the Yadkin River Basin. While these two IBT basins are each part of the primary Yadkin River Basin, North Carolina IBT statute considers these two IBT basins as separate, and the proposed water transfer to be an interbasin transfer. Pursuant to statutory requirements, the County conducted three public meetings to date as part of the scoping process.

The requested amount is based on 2050 water demand projections in the County's Yadkin River Basin Service Area. The intent of this IBT is to supplement the County's existing water supply sources to meet projected water demands through 2050. Illustration 1-1 depicts the County's current (2012) and projected future water use, including authorized and requested IBT amounts within their Yadkin River Basin Service Area. This illustration additionally outlines how this future water demand is anticipated to be met through the year 2050. "Illustrations" are the graphical images depicted throughout the text of this document and are referenced accordingly.

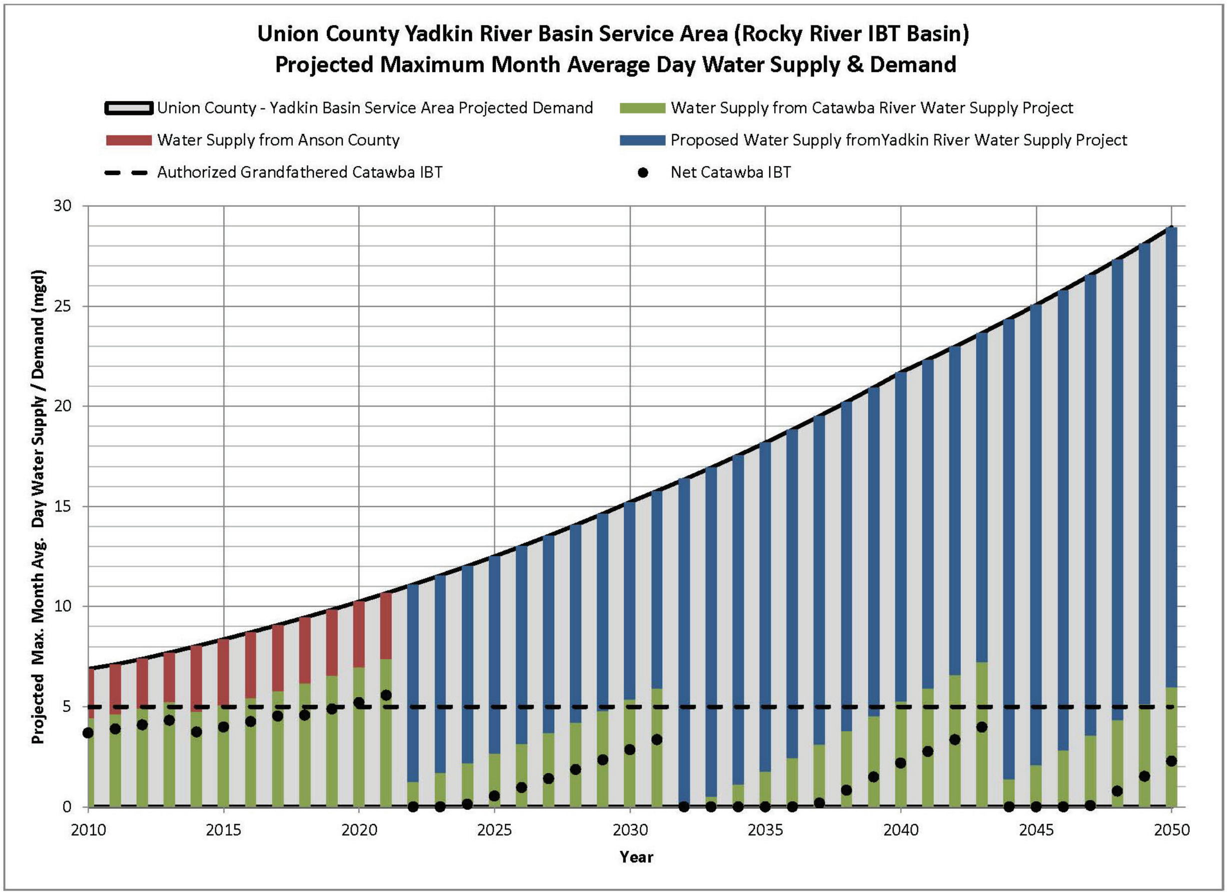

Illustration 1-1 Union County Yadkin River Basin Service Area Projected Water Supply and Demand

1.4. Description of Service Area

The Project Area is dependent upon the water supply source location evaluated, but generally consists of the point of water withdrawal from the source river basin (proposed as the Yadkin River IBT Basin of the Yadkin River Basin), the raw water transmission route (in both the Yadkin River IBT Basin and Rocky River IBT Basin of the Yadkin River Basin), and the water treatment site and route of the finished water distribution system (in Union County, within the Rocky River IBT Basin of the Yadkin River Basin).

Figure 1-1 depicts the extent of current supply to the County's water system service areas, while Figure 1-2 depicts the current pressure zones. Portions of the areas of the 853 (West, and South) and 935 pressure zones within the County's Yadkin River Basin Service Area (Rocky River IBT Basin) are currently served with water from the Catawba River Basin via Union County's existing grandfathered IBT for the Catawba River Water Supply Project. These areas are noted accordingly.

Figure 1-3 depicts the potential extent of future supply to the County's water system service area, while Figure 1-4 depicts the potential future pressure zones. Areas of several pressure zones within the County's Yadkin River Basin Service Area (Rocky River IBT Basin) currently served with water from Catawba River Basin via Union County's existing grandfathered IBT for the Catawba River Water Supply Project, as indicated in Figure 1-2, are shown in Figure 1-4 with an intent to be served in the future by the Yadkin River Water Supply Project's IBT being evaluated in this EIS. Additional areas for potential future service areas not currently served by the County are also identified in Figure 1-4. The Union County water system does not currently serve the City of Monroe or Town of Marshville.

However, beginning in 2014, Union County has a contract agreement to supply the City of Monroe up to 1.99 mgd of treated water on an as-needed wholesale basis from the County's Catawba River Water Treatment Plant, if requested by Monroe. The physical infrastructure for this interconnection is located in the Catawba River Basin southeast of the Charlotte-Monroe Executive Airport, and is and will continue to be served by water originating from Union County's Catawba River Water Supply Project. Furthermore, the City of Monroe owns the physical infrastructure (finished water line) crossing the Catawba-Yadkin basin boundary, and the maximum transfer by contract is 1.99 MGD, which is below the State's regulated IBT threshold. Therefore, this wholesale does not constitute an IBT for Union County or Monroe, and does not relate to the County's proposed Yadkin River Water Supply Project.

The intent of the Union County's proposed Yadkin River Water Supply Project is to more closely align the County's Yadkin/Catawba Basin supply boundary with the Yadkin/Catawba Basin geographic boundary.

1.5. Summary of Need for Proposed Action

Adequate water supply can be determined by comparing the existing available supply of current sources to projected future water demands within Union County's Yadkin River Basin Service Area. Existing water supplies available to the County's Yadkin River Basin Service Area include a 5 mgd grandfathered IBT limitation for the transfer of water from the Catawba River Basin to the Yadkin River Basin through finished water provided from the Catawba River Water Treatment Plant in Lancaster County, South Carolina, and an additional water supply of up to 4 mgd provided through a contract with Anson County to supply finished water from the Yadkin River Basin.

Union County's water needs within its Yadkin River Basin Service Area are projected to exceed available supply limits by the Year 2020 and increase from a current maximum month average daily demand of 7.7 mgd to 28.9 mgd by the Year 2050. The County's current grandfathered IBT from the Catawba River Basin through the Catawba River Water Treatment Plant and existing contract with Anson County for finished water supply are not capable of meeting the projected future demand within this service area. Union County is currently approaching its grandfathered IBT limit from the Catawba River Basin, and the initial term of their existing water supply contract with Anson County expired in 2012 and is currently under an auto-renewing cycle up for renewal in 2017, which could be terminated by either party if notice is given to the other party. Furthermore, the County is experiencing significant capacity limitations which exist in water delivery infrastructure from Anson County.

While some of Union County's projected demand is anticipated to continue to be met by the grandfathered Catawba River Basin IBT, this limit is anticipated to be reached within the next five years. As a result, the County must evaluate options to secure a reliable water supply from other sources to meet its future demand in the Rocky River IBT Basin. It is for this reason that Union County requests an IBT certificate to transfer up to 23 mgd of raw water from the Yadkin River IBT Basin (Basin code 18-1) to the Rocky River IBT Basin (Basin code 18-4) of the Yadkin River Basin, as calculated on a maximum month daily average demand (MMDD).

2.0 INTERBASIN TRANSFER REQUEST

Surface water transfers within North Carolina are regulated by North Carolina Statute G.S. 143.215.22L and North Carolina Administrative Code 15A NCAC 02E .0401. Modifications to G.S. 143-215.22L made through North Carolina Session Law 2013-388 now require an interbasin transfer (IBT) certificate from the North Carolina Environmental Management Commission (EMC) for new water transfers of 2 mgd or more, calculated as a daily average of a calendar month (maximum month average daily demand [MMDD]) and not to exceed 3 million gallons in any one day, from one river basin to another. IBT certificates are also required if an existing water transfer is increased by 25-percent or more above the average daily amount transferred during the year ending July 1, 1993 if the total transfer, including the increase, is 2 mgd or more per day. Finally, IBT certificates are also required if an existing transfer of water from one river basin to another is increased above a “grandfathered” amount previously defined by statute and determined by NCDENR.

Union County’s need for an IBT certificate to transfer water from the Yadkin River IBT Basin to the Rocky River IBT Basin is founded on three basic conditions:

1) Union County is geographically isolated from any major water supply source (i.e. the Yadkin-Pee Dee and Catawba-Wateree Rivers and surface water reservoirs). The ridge-line between the Yadkin-Pee Dee and Catawba-Wateree River Basins runs directly through Union County and, as such, these water supply sources are located outside of the County, with the Yadkin-Pee Dee River to the east and the Catawba-Wateree River to the west. The only existing large surface water source within Union County is the Rocky River, forming the northern border of Union County, with Cabarrus and Stanly Counties. However, this water source is not currently classified by the State of North Carolina for use as a public water supply.
2) Projected population growth within the roughly two-thirds of the County’s land area located in the Yadkin River Basin (Rocky River IBT Basin) necessitates that the County have access to a reliable water supply source of sufficient quantity to serve its existing and future customers in this service area.
3) Based on current and projected water demands in Union County’s Yadkin River Basin Service Area (Rocky River IBT Basin), its existing 5 mgd authorized water transfer from the Catawba River Basin to the Rocky River IBT Basin is insufficient to meet both near term and long term future water demands in this service area. Union County recognizes the need to secure a reliable water source from within the Yadkin River Basin to service its customers within the same primary river basin (albeit a different IBT basin designation), as opposed to increasing its IBT transfer from the Catawba River Basin.

2.1. Union County Water Supply and Distribution

The County’s primary water supply and production is delivered from the Catawba River Water Supply Project (CRWSP) in Lancaster County, SC. Additional water supply is provided from the east from Anson County, NC. The CRWSP joint venture includes the Catawba River Water Treatment Plant (CRWTP) which is a regional water treatment facility with a permitted operating capacity of 36 mgd. Union County, NC, and Lancaster County Water and Sewer District, SC, have 50 percent ownership rights of the facilities. Both owners have current ownership of 18 mgd capacity from the CRWTP. With the County's ownership stake in this plant, issues of reliability and water quality are proactively addressed by direct negotiation and funding of necessary improvements with an owner's share of the costs. Union County has leased an additional 3 mgd of treatment capacity from Lancaster County's capacity allocation in the CRWTP. This additional capacity, however does not address the existing IBT limitation in the Rocky River IBT Basin, but rather seeks to secure additional capacity to serve Union County customers in their Catawba River Basin Service Area.

The CRWSP is currently in the planning stages of another expansion. Based upon current demand projections for both owners, additional plant capacity will be needed sometime between 2018 and 2022. Once completed, Union County's portion of the treatment capacity will be 27 mgd. Other improvements currently being permitting for construction at this facility include a new river pump station and intake, a new 92-acre off-stream reservoir (1.094 billion gallon storage capacity), and reservoir pump station to provide a drought buffer during periods of low flow in the Catawba River. An additional expansion of this facility is expected to be needed by 2040 to provide up to 36 mgd of capacity to Union County. Despite the planned expansions at the CRWTP, which are needed to meet the growing demand of the County's customers in their Catawba River Basin Service Area, such expansions do not directly address the projected future water demand growth in the County's Yadkin River Basin Service Area, due to the existing 5 mgd grandfathered IBT limitation for water transfers from the Catawba to Yadkin River Basins.

The County also has a purchase water agreement with Anson County for 4 mgd of maximum day capacity. To-date, negotiations for an extension to this agreement and any increase in capacity between the two counties have been unsuccessful. Water supplied from Anson currently serves the Town of Wingate and areas of the County with service delivery as far north as northern Unionville and Fairview. Transmission upgrades within Union County along Hwy 74 were completed in May, 2011 to convey the full 4 mgd provided by the existing agreement. However, physical infrastructure limitations within Anson County limit the actual flow to approximately 3 mgd, and would require transmission enhancements within Anson County to transfer the full 4 mgd per the agreement. Additionally, further system enhancements would be needed within both counties to increase the capacity beyond the existing 4 mgd agreement. As a wholesale customer of Anson County, Union County has experienced multiple periods in recent years of unstable water quality and insufficient supply that has impacted the reliability and dependability of water delivery from this source.

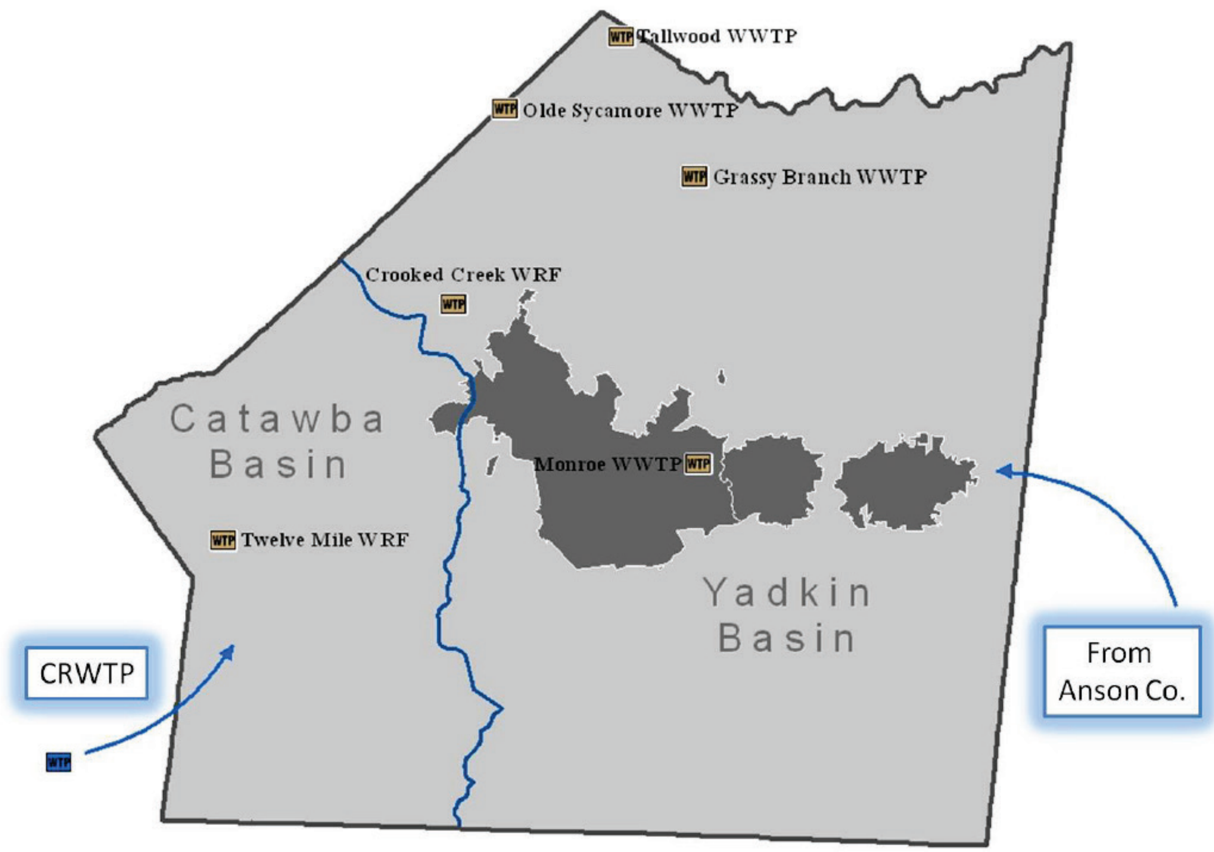

Illustration 2-1 Union County Water Sources and Wastewater Treatment Facilities (Black & Veatch, 2011)

Illustration 2-1 depicts the existing sources of finished water provided to Union County from the CRWTP and Anson County, as well as the existing wastewater treatment facilities within Union County which are either operated or utilized by the County. Additionally, Figures 1-1 and 1-2 depict the existing finished water distribution network and pressure zones, respectively, within Union County's system.

A key objective outlined in the County's 2011 Comprehensive Water and Wastewater Master Plan (Master Plan) (Black & Veatch, 2011) is securing additional water supply necessary to meet the projected peak day demands with an emphasis on securing this water supply at the lowest cost, greatest reliability, maximum contribution to satisfying the water portion of the IBT equation, and minimal impact to the surrounding environment. While the Master Plan identified the Catawba River as offering the lowest cost water supply to the County, Union County recognizes the inherent challenges, legal and political hurdles and potential environmental affects of increasing its grandfathered IBT from the Catawba River to serve its customers in the Yadkin River Basin Service Area. As such, Union County has initiated the planning and permitting for the Yadkin River Water Supply Project to secure water from the Yadkin River Basin to serve its customers in the Yadkin River Basin Service Area. This proposed water transfer, although considered an IBT according to state regulations, would be between two IBT basins (Yadkin River IBT Basin to the Rocky River IBT Basin) of a major river basin (Yadkin River Basin). Such a transfer is viewed by Union County to be a much more logical and acceptable solution to meeting the current and future water demands within this area of the County.

The Master Plan notes that leveraging the use of the Catawba River and CRWSP for the maximum amount of supply available must also be balanced against a Yadkin-Pee Dee River water supply strategy (e.g., Yadkin River Water Supply Project). Relying primarily on the CRWSP would result in the majority of County's water being supplied from one source, one plant, and one major transmission system. Source water coming from the Yadkin River Basin would provide the County with some level of redundancy, a sustained water quality, and better watershed balance in context of the IBT. Such a water supply also provides additional security should there be drought or contamination issues associated with either supply (Catawba River or Yadkin-Pee Dee River).

As noted previously, the current water supply purveyor for the eastern portion of Union County's Yadkin River Basin Service Area is Anson County, with Union County being a wholesale customer of finished water. There is no investment stake in the Anson County WTP and Union County is essentially unable to influence investments and operating decisions at the plant or in the transmission system needed to deliver the finished water to the point of interconnection with Union County at the County line. Ideally, a secure Yadkin River Basin water strategy would emulate a similar relationship as that with Lancaster County, SC for the CRWSP, where a joint ownership stake exists in the water supply infrastructure and/or provides Union County more control over capital investments and operations. Such a partnership was developed in 2012 between Union County and the Town of Norwood in Stanly County, as part of the Interlocal Intake and Transmission Agreement. The details of this Agreement are further discussed as part of Alternative 1 of this EIS.

2.2. Union County Wastewater Treatment and Collection

Wastewater conveyance and treatment has several parallel issues to the water supply and transmission in the County. The western portion of the County is where the greater density of the population resides and is where the larger existing wastewater treatment capacity exists. It is also where the greatest potential for treatment capacity expansion exists. In general, treatment plant capacity has followed where the development and resulting population distribution and density dictated that treatment capacity should be provided. The exceptions are several small capacity treatment facilities constructed to serve specific developments or where school requirements dictated local treatment works that the County has inherited for operation.

County owned and operated treatment plants (and associated capacities) include Twelve Mile Creek Water Reclamation Facility (WRF) (6.0 mgd), Crooked Creek WRF (1.9 mgd), Olde Sycamore WRF (0.15 mgd), Tallwood Estates WRF (0.05 mgd), and Grassy Branch WRF (0.05 mgd). Union County is currently in the process of increasing the capacity of the Twelve Mile Creek WRF from 6.0 mgd to 12.0 mgd. Treatment capacity has also been purchased from Charlotte Water at the McAlpine Wastewater Treatment Plant (WWTP) (3.0 mgd) which serves the County's Six Mile wastewater service basin in the County and from the City of Monroe WWTP (2.65 mgd) which serves the eastside including the Towns of Marshville and Wingate through Interlocal wastewater agreements. All capacities are presented as maximum month average day treatment capacities.

As the County's Master Plan indicates, public sewer is not anticipated to be the solution for wastewater disposal throughout the entire County. Onsite systems will continue to play a major role for wastewater disposal in the County. Portions of the County are desired and projected to remain rural in nature and would not receive public sewer, although future public water supply to these areas is much more likely.

In order to develop population projections for areas receiving public sewer service, a "sewer boundary" was developed for the Master Plan, which assumed sewer service would be provided within the boundary and onsite wastewater disposal generally provided outside the boundary. The County's defined sewer service basins are displayed in Figure 2-1.

2.3. Water Demand Projections

2.3.1. Background

During the early part of the 2000 decade, Union County was the fastest growing county in North Carolina and one of the top 20 fastest growing counties in the entire nation. Growth rates within the County during this time outpaced the balance of the State's growth rate by a factor of 3 to 4. Union County's proximity to the Charlotte metropolitan area and increasing job base and quality of life were key drivers to this high population growth rate. However, since the economic recession in the late 2000 decade, growth rates within the County have been observed at more modest rates of 2 to 3 percent per year.

In preparation of the 2011 Master Plan water demand projections, data was reviewed from Union County's previous County planning documents, previous water and sewer Master Plans, County planning projections including the 2025 Comprehensive Plan, State planning projections and forecasts, regional planning projections, spatial population distributions, and corresponding water demand and wastewater flow projections. Additionally, towns, villages and cities within the County were engaged to share their current land use plans and describe their economic development drivers for the both the short and long term. The Master Plan used the County's GIS data (community data, water and sewer inventory) to spatially distribute existing population and customers and project growth and future water demand with the County's service areas.

Additional consideration was given to Master Plan population projections and spatial distributions using traffic analysis zones (TAZ) which incorporate household and employment projections developed by local/regional planning organizations. These TAZs were used for Master Plan purposes because they are spatially distributed within topographical areas that often correspond to watersheds and sewer service basins as boundaries are drafted around primary and arterial roads which often follow the ridge lines. Several other factors were also considered in the Master Plan projections including:

- County population versus public water/sewer population components,
- Capacity constraints and impacts to growth

- Impact of the Monroe Bypass in future planning years, and
- Potential water supply requirements of major commercial or industrial development in the eastern portion of the County

Projections for water demands in the 2011 Master Plan were made through the 2030 decade. For purposes of evaluating water supply needs for the Yadkin River Water Supply Project, and subsequent water demand projections, the projection approach established in the Master Plan has been carried forward for this evaluation. However, recognizing that projections outlined in the Master Plan did not extend through the full evaluation period for the Yadkin River Water Supply Project (i.e. through the Year 2050), the previous projections of the Master Plan were extended from 2030 to 2050 for the County and updated, based on more recent historical system data gathered since development of the Master Plan. Such projection updates have also been reflected in Union County's North Carolina DWR Local Water Supply plan, beginning with the year 2013 report.

2.3.2. Population Growth and Allocation

In the development of Master Plan projections, the County's geographic information system (GIS) was used to spatially populate the current and future water service area boundaries for the base year (2010) and future planning years (2015, 2020, and 2030). The Master Plan notes that while the entire County could be considered as a future service area, there were considerations incorporated into water service areas that respected existing and future land use as a core basis for planning. The use of GIS-based land use evaluations also enabled the spatial allocation of the existing and future population growth into watersheds by parcels. Additionally, the Master Plan made considerations for future groundwater well failures/contamination in the County, by making a specific water allocation for the transition of certain onsite well customers to public water.

2.3.3. Population and Service Area

As part of the 2011 Master Plan, a number of local, regional and state planning organizations' forecasts were used to develop a reasonable annual population growth rate to develop projections. Many of those forecasts were developed in the early 2000 decade, prior to the most recent economic recession, resulting in projections with very high rates of growth. The ongoing economic environment since 2008 has dictated population projections that are lower, with rates of growth that are slower.

Due to these considerations, the Master Plan utilized an overall 2.4% annual rate of population growth for the County. However, allocation of the future population was differentially applied to geographic regions in order to reflect the different growth drivers over time, and is consistent with the methodology used in the County's 2025 Comprehensive Plan. For purposes of extending water use projections for the YRWSP, the overall 2.4% county-wide population growth projection approach established in the Master Plan through 2030 was maintained. However, recognizing a constant county-wide annual growth rate of 2.4% through the year 2050 is unlikely to continue, projections for the YRWSP were updated to reflect decreasing growth rates in later decades, as indicated in Tables 2-1 and 2-2.

Additionally, recognizing that development of the YRWSP will provide a reliable source of water for County residents in the Yadkin River Basin Service Area, as well as the development potential which currently exists in this portion of the County, projected population and service area growth rates in this area are considered to be slightly higher than those for the Catawba River Basin Service Area, in the western part of the County. The Catawba River Basin Service Area is already relatively highly developed, in comparison to the Yadkin River Basin Service Area, and therefore presents less opportunity for long-term sustained population growth and continued development through the year 2050.

Consideration has also been made in water demand projections for future water service area expansion in both the Catawba and Yadkin River Basin Service Areas. Similar to population growth projections, there is less potential for expansion of the County's water service area within the Catawba River Basin, while a more significant opportunity exists in the Yadkin River Basin Service Area, particularly in the northeastern portion of the County. Tables 2-1 and 2-2 summarize the population and water service area growth rates used to update and extend the previous 2011 Master Plan projections through the year 2050 for the YRWSP.

Table 2-1 Union County Population and Water Service Area Growth Projections

Service Area	Projection Decade(s)	Annual Growth Rate
Catawba River Basin	2010 to 2020	2.4%
	2021 to 2050	1.8%
	Service area growth	0.2%
Yadkin River Basin	2010 to 2030	2.7%
	2031 to 2040	2.4%
	2041 to 2050	1.8%
	Service area growth	1.0%

Table 2-2 Union County Served Population Projections

Projection Year	Projected Population Served by Union County Water System		
	Catawba River Basin	Yadkin River Basin	System Total
2010	59,925	47,123	107,048
2013	64,722	52,550	117,271
2020	77,461	67,767	145,228
2030	94,424	97,456	191,880
2040	115,103	136,149	251,251
2050	140,309	179,450	319,760

2.3.4. Per Capita Average Unit Water Demand

As the basis of the 2011 Master Plan projections, County data was examined to establish unit water demand rates to convert population forecasts to water demand projections. Available water production records and system operating records were reviewed to determine historical average day, maximum day, and peak hour water demands. Also reviewed were metered water sales records to identify historical customer consumption and unit water consumption. The historical water loss component was calculated by comparing consumption and production records. Water demand on a per capita basis is important to determine future water demands in the system, and have similarly been employed for purposes of YRWSP evaluations.

As stated in the 2011 Master Plan projections for water demand, the overall gallons per capita per day (gpcd) unit demand was established at 125 gpcd (total system demand divided by estimated persons served for residential accounts), which included irrigation demands. This value was based upon total categorical (residential, commercial, industrial and institutional) billed water consumption plus non-revenue water (unbilled authorized consumption used for line flushing, hydrant testing, and other purposes, plus water losses). Master Plan demand projections estimated non-revenue water at 15% of the total water demand for future year demand projections. It is noted that from 2007 to 2013, the County's non-revenue water has averaged slightly more than 12% of the total system water demand, with 1-2% from unbilled authorized consumption and the remainder from water losses. Union County is also in the process of implementing a schedule to conduct routine water system audits according to the AWWA M36 Water Audit Method as a means to identify and potentially reduce non-revenue water volumes, particularly water losses. For purposes of developing total system per capita demand rates for the YRWSP evaluations, it has been assumed that in the future, the County's water loss rate may be reduced to between 8-11% with an additional 3-5% of the total per capita demand needed for water treatment processes at the proposed water treatment plant for the YRWSP and 1-2% needed for unbilled authorized consumption. Note that water treatment process volumes have not typically been included in the County's non-revenue water calculation as this water is supplied from sources outside the County. Thus, for purposes of establishing a total per capita demand for the YRWSP, the 15% value previously identified in the Master Plan is dedicated to the non-revenue portion of water production and distribution for the project, including the additional water use necessary for treatment processes at a new Yadkin River Water Treatment Plant, proposed to be located within Union County.

In recent years, the American Water Works Association (AWWA) and International Water Association (IWA) have used the term "Non-Revenue Water" to reflect the distributed volume of water that is not reflected in customer billings. Non-Revenue Water however, is specifically defined as the sum of Unbilled Authorized Consumption (water for firefighting, flushing, etc.) plus Apparent Losses (customer meter inaccuracies, unauthorized consumption and systematic data handling errors) plus Real Losses (system leakage and storage tank overflows). In this way, the term "Non-Revenue Water" includes the sum of the varied and disparate types of losses and authorized unbilled consumption typically occurring in water utilities (AWWA, 2012). Illustration 2-2 reflects the distinction between "Revenue Water" and "Non-Revenue Water" as well as Apparent and Real Losses, according to the IWA/AWWA Standard Water Balance.

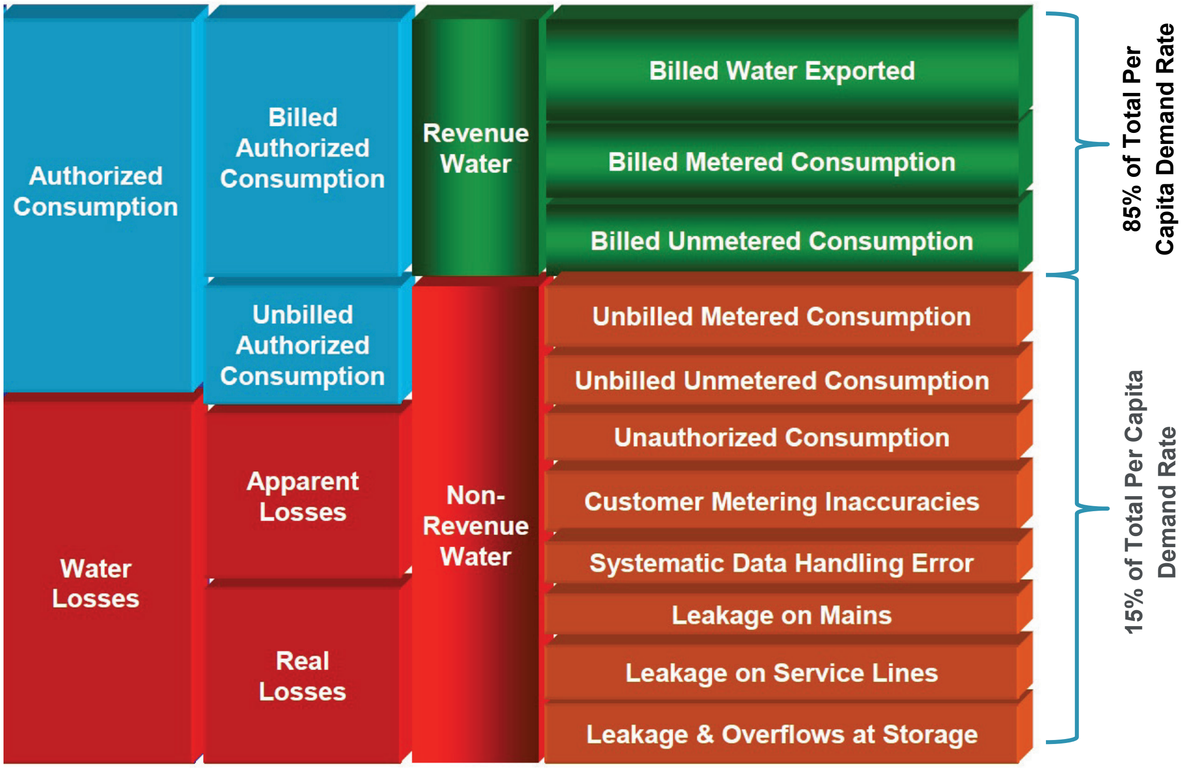

Illustration 2-2 Excerpt from IWA/AWWA Standard Water Balance Table

However, some water utilities and regulatory agencies attempt to continue quantifying water loss by quoting the "unaccounted-for" percentage. Using percentage indicators to assess water loss standing in water utilities gives misleading and unreliable measures of utility performance because:

- This type of performance indicator is mathematically skewed
- It is impossible to reliably represent multiple types of non-revenue water typically occurring in a water utility with a single simplistic percentage
- A simple percentage reveals nothing about water volumes and costs, the two most important factors in water loss assessments of water utilities
- The mathematical flaws of the percentage indicator stem from the fact that the percentage is unduly affected by varying levels of customer consumption.

While the term “unaccounted-for” water appears to be self-explanatory, it suffers from inconsistent use and interpretation. The concept is to identify the collective volume of water that a water utility supplies to its distribution system that is not reflected in customer billing volumes. The Water Loss Task Force of the International Water Association found that the definition of the term “unaccounted for” varied so much in different jurisdictions around the world that it was impossible to conduct reliable performance comparisons using the term (AWWA, 2012).

Many water utilities and regulatory agencies have varying definitions for “accounted for” vs. “unaccounted for” water volumes. For instance, some definitions allow a certain volume of leakage – deemed “unavoidable” leakage – to be included as “accounted-for” water. Similarly, utility personnel have sometimes classified leaks that are known to exist in inaccessible locations (such as pipelines under streams or rivers) as “accounted-for” water. In the IWA/AWWA Water Audit Method, all types of leakage – regardless of size or difficulty of repair – are included under the heading of Real Losses.The IWA/AWWA Water Audit Method states that all volumes of water supplied to distribution go to either beneficial consumption or wasteful loss. Hence, there is no “unaccounted-for” water since all of the water is "accounted for" in this method (AWWA, 2012).

The IWA/AWWA Water Audit Method relies upon the quantification of water volumes, costs and system characteristics as input to several performance indicators to reveal water loss standing. It does not rely on a single, simplistic percentage such as "unaccounted-for water percentage." Instead, it employs distinct performance indicators on global water supply, apparent losses, and real losses. Having the use of several robust, detailed performance indicators instead of a single, simplistic indicator is a vastly superior means by which to assess water loss standing in water utilities (AWWA, 2012).

AWWA recommends against use of the term "unaccounted-for" water and the "unaccounted-for water percentage." Instead, it recommends use of the term “Non-Revenue Water” and the array of performance indicators included in the IWA/AWWA Water Audit Method (AWWA, 2012).

For purposes of the YRWSP projection updates, a review of the County’s historical water use data over the past decade indicates that per capita per day unit water demands (total system demands) have averaged between 110 to 120 gpcd, with slightly lower values in the most recent years due to ongoing mandatory water restrictions, increased conservation efforts, and more favorable climate conditions (more annual rainfall and slightly lower annual temperature averages). As such, the water demand projections of the recently completed Master Plan have been reduced for the updated YRWSP projections to reflect an average unit demand of 120 gpcd for future water demands of all new system customers to be served after the Year 2012. The use of a 120 gpcd unit demand is representative of customer demands within the County over the last decade during historically drier years, which should be used as the basis for water demand planning to secure a sufficient water supply to meet peak year demands.

Additionally, the use of the top of the range of historical unit demands allows for the potential for future industrial or commercial/institutional water uses in the demand projections. While such future uses are difficult to quantify, a single new industry which has a large water demand for process purposes can drive up system-wide unit demand rates. Use of the 120 gpcd unit demand for future projections provides the flexibility to meet such future demands should they materialize within the County.

As a portion of this 120 gpcd total system demand, residential water use per capita demand is to be estimated to be 80 gpcd. This is based upon historical Union County residential water use which has averaged 65 to 70 percent of the total treated water supply since 1997. The 80 gpcd residential per capita water demand value compares favorably with the Catawba-Wateree Water Management Group’s 2014 Catawba-Wateree Water Supply Master Plan, which assumed a basin-wide average residential categorical water use rate of 85 gpcd for planning purposes (CWWMG, 2014).

Further, the County's current residential/non-residential categorical water demand ratio is relatively high (approximately 75% to 80% residential), given how the County has developed over time. Based on this fact, as well as future land use plans, planned transportation corridors and large tracts of land available within the County, it is likely that non-residential development will occur over the next 50 years. The County's water supply must be prepared to meet these demands for continued economic development.

2.3.5. Water Demand Peaking Factors

As part of the 2011 Master Plan, Max Day to Average Day peaking factors were identified from historical water production records. The majority – more than 80% – of the water demand in the distribution system has historically been supplied from the Catawba River Water Supply Project (CRWSP). A much smaller portion – less than 20% – has been supplied from Anson County. Using primarily CRWSP production records, peaking factors as high as 2.3 have been observed in the system. The Master Plan identified the average Max Day to Average Day peaking factor from 2004 to 2009 to be approximately 1.9, which was carried forward in Master Plan water demand projections.

In recent years, however, County-wide mandatory and voluntary irrigation restrictions have impacted historical Max Day factors, as irrigation uses are a major driver of the Max Day demands typically occurring during summer months. With irrigation restrictions over the past seven years, the County has been able to achieve Max Day to Average Day peaking factors at an average rate of 1.8. These factors were observed to be higher during the last major drought (2007-2008), and lower in more recent non-drought years as part of the Master Plan adoption. The Union County Board of Commissioners previously reached consensus in favor of implementing demand management practices in the future to avoid the very high peaking factors (those greater than 2.0) that have been experienced in the past (Black & Veatch, 2011). The County's newly adopted (May 4, 2015) Water Use Ordinance, as further discussed in Section 2.6 and 6.0 of this EIS, outlines the specific demand management initiatives now implemented within the County.

Therefore, for purposes of the YRWSP projections, the Max Day to Average Day peaking factor for the future water demands was selected to be the actual average over the past 4 years (non-drought years) of 1.7. An evaluation of North Carolina Division of Water Resource's (DWR) Local Water Supply Plans for comparable utilities within the Piedmont region of North Carolina indicates that since 2007, average Max Day to Average Day peaking factors have ranged from 1.4 to 1.8, which supports the 1.7 peaking factor used for YRWSP demand projections within Union County.

Also, using the 1.7 Max Day to Average Day peaking factor for Union County, the corresponding Max Day to Max Month Average Day peaking factor has been subsequently determined to be 1.22 for purposes of the YRWSP water demand projections.

2.3.6. Water Demand Projection Summary

Union County water demands are expected to increase by the Year 2050, based upon continued development (both residential and commercial) resulting from the County's proximity to the greater Charlotte metropolitan area, as well as future service expansion of the Union County water system to meet the needs of current County residents without reliable water sources (e.g. contaminated groundwater wells). Projections indicate that specifically within the Yadkin River Basin Service Area, the maximum month daily average demands will increase from 7.7 mgd in 2013 to 28.9 mgd by the Year 2050. Table 2-3 indicates the projected decadal increases in water demand for Union County's Catawba River and Yadkin River Basin Service Areas, on an annual average daily, maximum month daily average and maximum day basis. Detailed projections for Union County water demand are depicted in Figure 2-2 and Appendix B.

Table 2-3 Union County Projected Water Demands by Decade

Planning Year	Annual Average Day Demand (mgd)		Max Month Avg. Day Demand (mgd)		Max Day Demand (mgd)	
	Catawba	Yadkin	Catawba	Yadkin	Catawba	Yadkin
2010	5.6	4.9	8.0	6.9	9.7	8.4
2013	6.4	5.5	8.9	7.7	10.8	9.4
2020	7.9	7.4	12.6	10.2	15.3	12.5
2030	9.9	10.9	15.4	15.2	18.8	18.6
2040	12.4	15.6	18.8	21.7	23	26.4
2050	15.4	20.8	23.1	28.9	28.1	35.3

2.4. Wastewater Flow Projections

2.4.1. Background

The 2011 Master Plan examined Union County data to establish per capita wastewater flow rates to convert population forecasts to wastewater flow projections. The Master Plan compared water production to wastewater flow ratios to determine wastewater return rates. These wastewater flows were developed by combining a forward looking (based on population projections, per capita wastewater production rates, and estimated maximum month peaking factors) and backward looking (based on historical tap analysis extrapolating forward based on system growth rates) approach. Wastewater flow on a per capita basis is important to determine future residential wastewater flows in the system, and have similarly been employed for purposes of YRWSP evaluations for wastewater flow projections within the Yadkin River Basin Service Area of Union County.

Wastewater flow projections made for the 2011 Master Plan assumed that no public sewer conveyance or wastewater treatment would be projected (beyond existing services in 2011) in the following watersheds: Goose, Duck, Waxhaw, Cane, Polecat, Lynches, Buffalo, Dead Pine, Lanes, Brown and eastern portions of Rocky River, Grassy Branch and Richardson. Additionally, the Master Plan assumed the expansion of the public wastewater collection system to serve surrounding areas south and north of the City of Monroe and areas adjacent to the towns of Wingate and Marshville. The proposed expanded public sewer service areas around the City of Monroe were phased in different planning year horizons.

2.4.2. Per Capita Wastewater Flow

The flow data and account information analyzed for the 2011 Master Plan indicate unit wastewater flows of approximately 241 gallons per day per account in 2009. Using uniform densities per dwelling unit and population equivalency assumptions, the historical unit wastewater flow derived in the Master Plan was approximately 86 gpcd. The Master Plan noted that future sewer construction should be tighter than the present and that historical extrapolated per capita unit wastewater flows are close to the North Carolina Department of Environmental and Natural Resources' (DENR) recommended values. Thus, future flow projections were calculated at 80 gpcd to account for tighter/new sewer installations. Updates and extension of the wastewater flow projections through 2050 for the YRWSP evaluations are similarly based on an 80 gpcd future unit flow projection.

The 2011 Master Plan also included a schedule for conversion from onsite septic to public sewer within the projected service area boundary, under an assumption of approximately 100 percent conversion of houses built pre-1983 during the first 10 years of the Master Plan (through 2021). The Master Plan indicated houses built pre-1983 were not mandated to have a repair area for their septic field within their lots and that such lots were a concern for the County and warranted need for future replacement with County-provided sewer service. The Master Plan wastewater projections staged the septic to public conversion of pre-1983 buildings within the sewer service boundary in two phases, approximately 50 percent by 2015 and 50 percent by 2020. The Master Plan also assumed that by 2030 most of the development on the western side of the County would be served by public sewers, with a small percentage remaining as onsite septic or private systems.

Comparison of the updated YRWSP projections for water demand in Union County indicate that such projections are approximately 93% of the previous water demand projections made in the 2011 Master Plan. As such, wastewater flow projections through 2030 for the YRWSP evaluations were correspondingly reduced to 93% of the Master Plan projections. Wastewater flow projections for these evaluations were also extended from 2030 to 2050 using wastewater flow growth rates equivalent to the projected water demand growth rates in each service area between the years 2030 and 2050. As such, from 2030 to 2050, wastewater flow growth within the Catawba River Basin Service Area and Yadkin River Basin Service Area is projected to grow annually at a rate of 2.23% and 3.27%, respectively. These rates correlate well with the projected wastewater flow to projected growth in water demand from 2030 to 2050, as based upon the County's historical wastewater flow as a percentage of its water demand.

2.4.3. Wastewater Flow Peaking Factors

The County provided historical flow data for each of the major County treatment facilities (Twelve Mile and Crooked Creek); minor County facilities (Olde Sycamore, Tallwood, Grassy Branch) and flows to third party facilities (McAlpine WWTP for 6-Mile flow, City of Monroe). Peak monthly average flows were compared to annual average flows to identify historical Max

Month treatment plant flow ratios. Previous evaluation of historical Max Month to Average Day wastewater flows outlined in the 2011 Master Plan indicated that these peaking factors are unique to each of the wastewater treatment plants and their tributary collection system. The analysis found that ratios ranged between 1.3 and 1.7, with 1.3 being indicative of the larger treatment facilities in the system.

For purposes of the YRWSP evaluations, the major treatment facilities and tributary collection systems were evaluated and flow projections extended through 2050. As such, the 1.3 peaking factor was used for Max Month to Average Day comparisons. Based on an evaluation of historical DWR Local Water Supply Plan and Union County wastewater system data, it was also determined that the average Max Day to Average Day peaking factor for the major County treatment facilities since 2002 has been approximately 2.3, which has been carried forward in the YRWSP evaluations. Based on the 1.3 annual Max Month to Average Day peaking factor and the 2.3 Max Day to Average Day peaking factor previously described , the Max Day to Max Month wastewater flow peaking factor is calculated to be 1.8 (2.3 divided by 1.3). An additional evaluation of historical Local Water Supply Plan data since 2002 indicates that the Min Month to Average Day wastewater flow factor is 0.87, for purposes of evaluating low flow periods.

2.4.4. Wastewater Projections for the Yadkin River Basin Service Area

Table 2-4 summarizes the average day wastewater flows for the base year (2010) and future planning years within the Yadkin River Basin service area, established through the build-out evaluation. Some wastewater flow generated in the Crooked Creek service basin, and all flow generated in the Poplin Road Pump Station service basin is to be pumped to the Catawba River Basin as part of the County's management strategy for its existing 5 mgd grandfathered Catawba River IBT, as further discussed in Section 2.4.5, below. As such, Table 2-5 summarizes the projected average day wastewater flows generated within the Yadkin River Basin Service Area that are subsequently projected to be discharged back to the Yadkin River Basin.

Table 2-4 Union County Projected Wastewater Flow in the Yadkin River Basin Service Area

Yadkin River Basin Service Area – Projected Sewer Flow (mgd) Annual Average Day						
Service Basin	**Base Year (2010)**	**2015**	**2020**	**2030**	**2040**	**2050**
Crooked Creek	1.0	1.1	1.6	1.9	2.7	3.7
Poplin PS	0.9	1.0	1.7	2.3	3.2	4.4
Lake Lee	0.0	0.0	0.1	0.5	0.7	1.0
Richardson Creek	0.0	0.0	0.0	0.2	0.3	0.4
Lake Twitty	0.0	0.2	0.4	1.0	1.4	1.9
Eastside	1.0	1.3	1.6	2.1	2.9	3.9
Misc. Package Plants[1]	0.4	0.4	0.5	0.6	0.7	0.8
TOTAL[2]	**3.3**	**4.0**	**6.0**	**8.5**	**11.8**	**16.0**

Notes:

[1]Miscellaneous package plants include Union County operated facilities (Tallwood Estates WWTP, Grassy Branch WWTP, and Olde Sycamore WWTP) and privately operated facilities to neighborhoods served by Union County water (Country Woods WWTP and Hemby Acres WWTP).

[2]Minor differences in summations due to rounding of individual basin projections

Table 2-5 Union County Projected Wastewater Flow in the Yadkin River Basin Service Area Returned to the Yadkin River Basin

Yadkin River Basin Service Area – Projected Sewer Flow (mgd) Returned to the Yadkin River Basin Annual Average Day						
Service Basin	**Base Year (2010)**	**2015**	**2020**	**2030**	**2040**	**2050**
Crooked Creek	1.0	1.1	1.5	1.5	1.5	1.5
Lake Lee	0.0	0.0	0.0	0.3	0.3	0.5
Richardson Creek	0.0	0.0	0.0	0.1	0.1	0.2
Lake Twitty	0.0	0.2	0.4	1.0	1.4	1.9
Eastside	1.0	1.3	1.6	2.1	2.9	3.9
Misc. Package Plants[1]	0.4	0.4	0.5	0.6	0.7	0.8
TOTAL[2]	**2.4**	**3.0**	**4.1**	**5.5**	**6.9**	**8.8**

Notes:

[1]Miscellaneous package plants include Union County operated facilities (Tallwood Estates WWTP, Grassy Branch WWTP, and Olde Sycamore WWTP) and privately operated facilities to neighborhoods served by Union County water (Country Woods WWTP and Hemby Acres WWTP).

[2]Minor differences in summations due to rounding of individual basin projections

2.4.5. Wastewater Flow Returned to the Catawba River Basin

As part of its management strategy for the existing grandfathered 5 mgd IBT limit from the Catawba River, Union County returns a portion of the wastewater flow generated in its Yadkin River Basin Service Area to the Catawba River Basin to reduce the net effect of water supply transfers into the Yadkin River Basin Service Area from the Catawba. This is currently achieved through the Poplin Road Pump Station which diverts flow from the Poplin PS wastewater service basin to the Twelve Mile Creek WRF which is located in the Catawba River Basin.

Additionally, the 2011 Master Plan calls for improvements to the Crooked Creek WRF to allow for scalping of some wastewater flow generated in the Crooked Creek wastewater service basin to be sent to the Poplin Road Pump Station and subsequently pumped to the Twelve Mile Creek WRF. The Crooked Creek WRF has a max month capacity of 1.9 mgd (approximately 1.5 mgd average annual day), and the Master Plan assumes that all future flow beyond this existing capacity (estimated to be surpassed in 2018) is to be scalped and diverted to the Poplin Road Pump Station.

Future system improvements and additional wastewater service in the Lake Lee and Richardson Creek service basins from 2030 to 2050 will allow a portion of wastewater flow in these areas to be treated at the Twelve Mile Creek WRF, with the remaining flow to be treated at the Monroe WWTP. Table 2-6 reflects the projected annual average day wastewater flow generated in the Yadkin River Basin Service Area that is expected to be returned to the Catawba River Basin.

Table 2-6 Union County Projected Wastewater Flow in the Yadkin River Basin Service Area Returned to the Catawba River Basin via Twelve Mile Creek WRF

Yadkin River Basin Service Area – Projected Sewer Flow (mgd) Returned to the Catawba River Basin Annual Average Day						
Service Basin	**Base Year (2010)**	**2015**	**2020**	**2030**	**2040**	**2050**
Crooked Creek	0.0	0.0	0.2	0.5	1.2	2.2
Poplin PS	0.9	1.0	1.7	2.3	3.2	4.4
Lake Lee	0.0	0.0	0.0	0.3	0.3	0.5
Richardson Creek	0.0	0.0	0.0	0.1	0.1	0.2
TOTAL	**0.9**	**1.0**	**1.9**	**3.1**	**4.9**	**7.3**

Note: Minor differences in summations due to rounding of individual basin projections

2.5. Explanation of Water Balance and Transfer

Of the 28.9 mgd projected water demand in the County's Yadkin River Basin Service Area by the Year 2050, 23 mgd is projected to be served by the new Yadkin River Water Supply Project through a new IBT from the Yadkin River Basin, while the remaining demand is projected to be met by the County's existing grandfathered Catawba River Basin IBT. It is important to note that, while the County's grandfathered IBT from the Catawba is limited to 5 mgd and the amount needed from this IBT in 2050 to meet the system demand is 5.9 mgd, because the County returns a portion of their wastewater discharge generated in the Yadkin River Basin back to the Catawba River Basin, the net IBT from the Catawba to the Yadkin is projected to remain below the existing 5 mgd limit.

Illustration 2-3 depicts the current and proposed water sources and wastewater treatment facilities serving the County's Yadkin River Basin Service Area, along with their corresponding current (2013) and future (2050) flow projections.

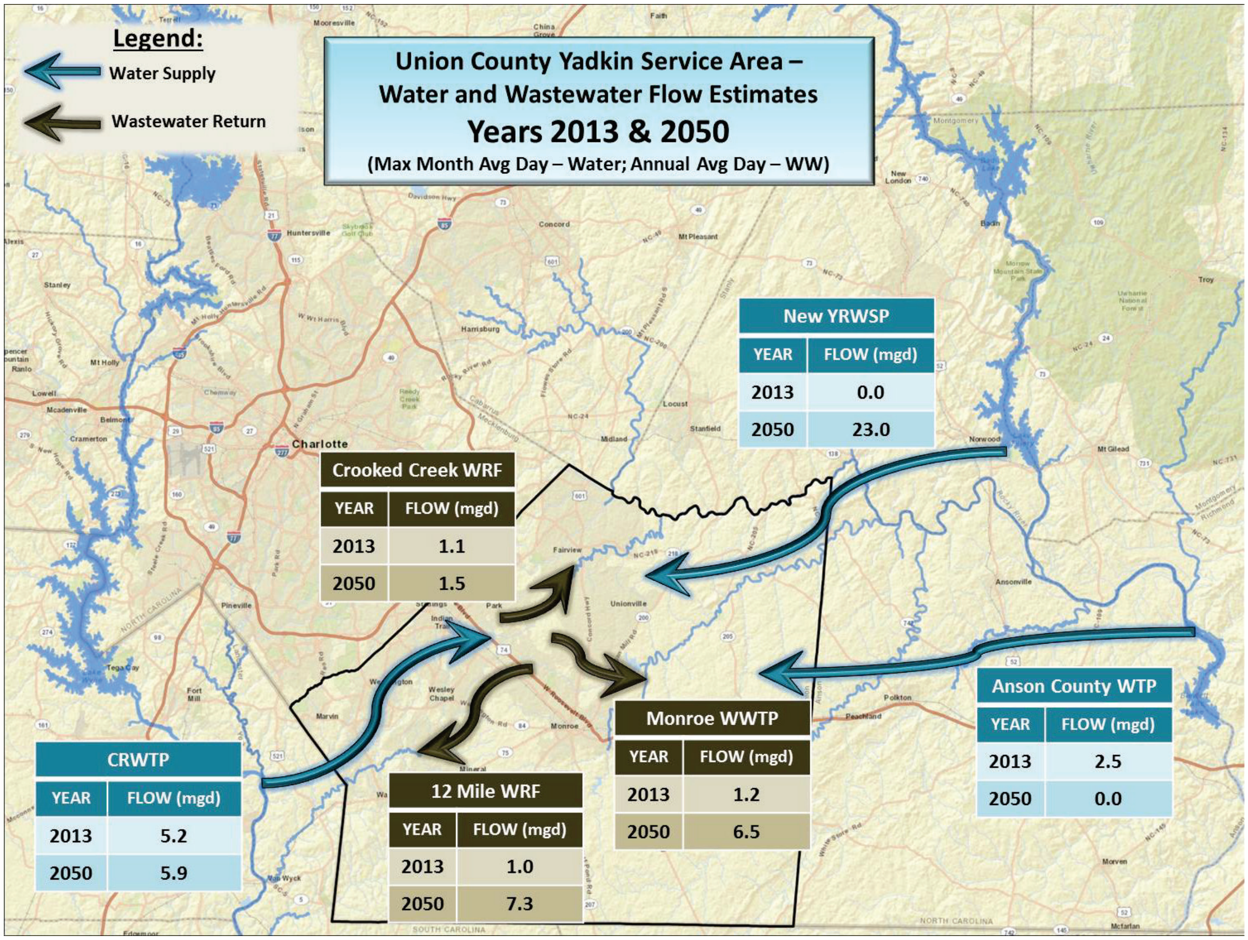

Illustration 2-3 Union County Yadkin River Basin Service Area Projected Water Supply and Demand

As previously reflected in Illustration 1-1, Union County's projected Yadkin River Basin Service Area water demand and anticipated sources of water supply to meet this demand through the Year 2050. Further details of the County's projected water balance and transfer are provided in Figure 2-2 and Appendix B.

2.6. Water Conservation and Demand Management

2.6.1. Union County Water Use Ordinance

In 1992, Union County adopted a Water Conservation Ordinance that outlined conservation measures required when water demand by customers connected to the Union County water system reached a point where continued or increased demand will equal or exceed the treatment and/or transmission capacity of the system or portions, thereof. This ordinance was revised and amended over the years, including 2002, 2007, 2008, and most recently 2009. A new Water Use Ordinance (Ordinance) and an accompanying Water Shortage Response Plan were recently developed to replace and improve on the existing Water Conservation Ordinance. These new documents were approved by the Union County Board of Commissioners and officially adopted on May 4, 2015.

When water demand results in the condition whereby customers cannot be supplied with adequate water to protect their health, safety, or property, then the demand must be substantially curtailed to relieve the water shortage. This Ordinance applies only to potable water supplied through the Union County water system, and not to reuse or reclaimed water. In addition to the water conservation measures outlined in the Ordinance, the County has the authority to establish a rate structure that increases the cost of potable water commensurate with the escalation of water shortage conditions.

The County's Water Use Ordinance is applicable during times of drought, where raw water supply is at risk, and when there are other capacity limitations within the County's water treatment and distribution system due to high demands or system emergencies. The Ordinance has five levels of water shortage conditions, including Stage 0, 1, 2, 3 and 4 Water Shortage Conditions, which are issued with increasing severity according to the applicable water shortage.

Stage 0 is a newly defined stage included in the Water Use Ordinance and limits customer use of spray irrigation systems to a maximum of 3 days per week at all times. Additionally, customers are encouraged to adhere to a list of recommended voluntary water conservation measures.

In a Stage 1 Water Shortage Condition, customers are encouraged to limit spray irrigation to a maximum of 2 days per week and voluntarily conserve water through additional recommended conservation measures. Also, in a Stage 1 Water Shortage Condition, the transport of water outside of Union County is unlawful, with certain listed exclusions.

In a Stage 2 Water Shortage Condition, mandatory limits on spray irrigation are increased to allow each customer a maximum of 2 days per week. Some other outdoor water uses are also prohibited, such as filling new swimming pools and residential vehicle washing, while others are encouraged to be limited, including flushing and hydrant testing or the use of water for dust control.

In the event of a Stage 3 Water Shortage Condition and in addition to the voluntary and mandatory guidelines already in effect, each customer would be permitted use spray irrigation a maximum of 1 day per week. It would also be unlawful to wash public buildings, sidewalks and streets, use water for construction dust control, conduct non-essential water system flushing/hydrant testing, fill any swimming pools/ponds or serve drinking water in food establishments except upon request.

If a Stage 4 Water Shortage Condition is declared, in addition to the restrictions set forth under other stages, water use is further restricted to make it unlawful to use water outside a structure for any purpose other than responding to a fire emergency. Certain exclusions to the restrictions for each stage exist.

A complete copy of the County's previous Water Conservation Ordinance and newly adopted Water Use Ordinance and Water Shortage Response Plan are provided in Appendix E, CD-1.

Since 2009, Union County has remained in a Stage 2 Water Shortage Condition, as defined by the Water Conservation Ordinance. During such time, Union County has imposed mandatory water use restrictions limiting lawn irrigation to no more than two days per week per customer. Such restrictions have been voluntarily imposed by Union County, while not in a drought, primarily due to capacity concerns to meet the system's water demand on peak days. Such restrictions are considered to be very stringent during non-drought periods and have proven successful over the last five years in reducing the County's peak day water demands.

2.6.2. Low Inflow Protocol for the Catawba-Wateree Hydroelectric Project

In addition to the Water Conservation Ordinance, Union County is a party to the 2006 Comprehensive Relicensing Agreement with Duke Energy and the Federal Energy Regulatory Commission (FERC) which requires adherence to the Low Inflow Protocol (LIP) for the Catawba-Wateree Hydroelectric Project by owners of large public water supply intakes located in the reservoirs and main stem of the Catawba River. As joint owner of the Catawba River Water Treatment Plant in Lancaster County, South Carolina, Union County must abide by the restrictions set forth in the LIP during drought conditions. The purpose of this LIP is to establish procedures for reductions in water use during periods of low inflow to the Catawba-Wateree Hydroelectric Project. The LIP was developed on the basis that all parties with interests in water quantity will share the responsibility to establish priorities and to conserve the limited water supply. A copy of the LIP may be found in Appendix E, CD-1.

The LIP provides trigger points and procedures for how the Catawba-Wateree Hydroelectric Project will be operated by Duke Energy, as well as water withdrawal reduction measures and goals for other water users during period of low inflow. During periods of normal inflow, the system is considered to be in a normal condition. During times that inflow is not adequate to meet all of the normal water demands for water and maintain reservoir levels as normally targeted, a Stage 0 – Low Inflow Watch may be issued. If hydrologic conditions continue to worsen, varying stages of the LIP may be declared, based on confirming triggers, and increasing in severity from Stages 1 through 4. The following table summarizes the required water use reduction goals applicable to Union County, based on water use restrictions for customers, as defined by the LIP for the Catawba-Wateree Hydroelectric Project.

Table 2-7 Catawba-Wateree Low Inflow Protocol Water Use Reduction Requirements by LIP Stage

LIP Stage	Water Use Reduction Requirement
Normal	Normal Conditions; no water use reduction required
Stage 0	Low Inflow Watch; no water use reduction required
Stage 1	Request voluntary water use restrictions in accordance with Water Use Ordinance; water use reduction goal of 3-5% from the amount that would otherwise be expected.
Stage 2	Require mandatory water use restrictions in accordance with Water Use Ordinance; water use reduction goal of 5-10% from the amount that would otherwise be expected.
Stage 3	Require increased mandatory water use restrictions in accordance with Water Use Ordinance; water use reduction goal of 10-20% from the amount that would otherwise be expected.
Stage 4	Require emergency water use restrictions in accordance with Water Use Ordinance and restrict all outdoor water use; water use reduction goal of 20-30% from the amount that would otherwise be expected.

2.6.3. Low Inflow Protocol for the Yadkin & Yadkin-Pee Dee River Hydroelectric Projects

The fundamental goal of this LIP, developed as part of the 2007 Relicensing Settlement Agreement for the Yadkin Hydroelectric Project, is to take staged actions in the Yadkin-Pee Dee River Basin needed to delay the point at which available water storage in the Yadkin Hydroelectric Project (operated by Alcoa Power Generating Inc. (APGI), FERC No. 2197) and the Yadkin-Pee Dee Hydroelectric Project (operated by Duke Energy Progress, FERC No. 2206) reservoirs is fully depleted while maintaining downstream flows. This LIP is intended to provide additional time to increase the probability that precipitation will restore streamflow and reservoir water elevations to normal ranges. The amount of additional time that is gained during implementation of this LIP depends on the diagnostic accuracy of the trigger points, the amount of regulatory flexibility available to operate the projects, and the effectiveness of the projects' operators and the water users in working together to implement required actions and achieve significant water use reductions. It is assumed that water users in the Yadkin-Pee Dee River Basin not subject to this LIP must comply with all applicable State and local drought response requirements. A copy of the LIP may be found in Appendix E, CD-1.

This LIP is implemented during periods when there is not enough water flowing into the projects' reservoirs to meet the projects' required minimum instream flows while maintaining reservoir water elevations within normal operating ranges. This LIP provides trigger points and operating procedures that both APGI and Duke Energy Progress are to follow for the projects. This LIP also specifies water withdrawal reduction measures for other water users in portions of the Yadkin-Pee Dee River Basin. Similar to the LIP for the Catawba-Wateree, during periods of normal inflow, the system is considered to be in a normal condition. During times that inflow is not adequate to meet all of the normal water demands for water and maintain reservoir levels as normally targeted, a Stage 0 – Low Inflow Watch may be issued. If hydrologic conditions continue to worsen, varying Low Inflow Condition stages may be declared, based on confirming triggers, and increasing in severity from Stages 1 through 4.

If granted an IBT certificate to transfer water from one of the reservoirs of the Yadkin-Pee Dee River Basin governed by the LIP, Union County would also be required to abide by such LIP requirements. Any designated owner or joint-owner of raw water intake and pumping facilities which withdraw from storage in one of the hydroelectric projects' reservoirs and have an instantaneous withdrawal capacity of one million gallons per day or more are required to abide by the LIP requirements, as stipulated in the LIP for the Yadkin and Yadkin-Pee Dee Hydroelectric Project. The following table summarizes the required water use reduction goals which would be applicable to Union County, based on water use restrictions for customers, as defined by the LIP for the Yadkin and Yadkin-Pee Dee Hydroelectric Projects.

Table 2-8 Yadkin-Pee Dee Low Inflow Protocol Water Use Reduction Requirements by LIP Stage

LIP Stage	Water Use Reduction Requirement
Normal	Normal Conditions; no water use reduction required
Stage 0	Low Inflow Watch; no water use reduction required
Stage 1	Request voluntary water use restrictions in accordance with Water Use Ordinance; water use reduction goal approximately 5% from the amount that would otherwise be expected.
Stage 2	Require mandatory water use restrictions in accordance with Water Use Ordinance; water use reduction goal of approximately 10% from the amount that would otherwise be expected.
Stage 3	Require emergency water use restrictions in accordance with Water Use Ordinance; water use reduction goal of approximately 20% from the amount that would otherwise be expected.
Stage 4	Coordinate with the Yadkin Drought Management Advisory Group (YAD-DMAG) and DWR to determine if additional water use reduction measures can be implemented.

2.7. Interbasin Transfer Management Strategy

2.7.1. Background

Union County is divided into two major watersheds, the Catawba River Basin to the west and the Yadkin-Pee Dee River Basin to the east. The ridge line between these two watersheds runs predominately north-south through the County, with neither water source within the geographical limits of the County. The eastern portion of the County is located within the Rocky River IBT Basin, which a part of the greater Yadkin River Basin. According to interbasin transfer definitions set forth in North Carolina Statute G.S. 143.215.22L, the Rocky River watershed is considered an IBT boundary for water transfers within the Yadkin River Basin and is therefore subject to IBT regulation.

As a result of the County's unique location isolated between two major river basins, regulations for existing and proposed interbasin transfers impact water supply withdrawal and wastewater discharge strategies for current and future planning. Illustration 2-4 reflects the IBT watershed boundaries and location of the County's existing primary water treatment plant.

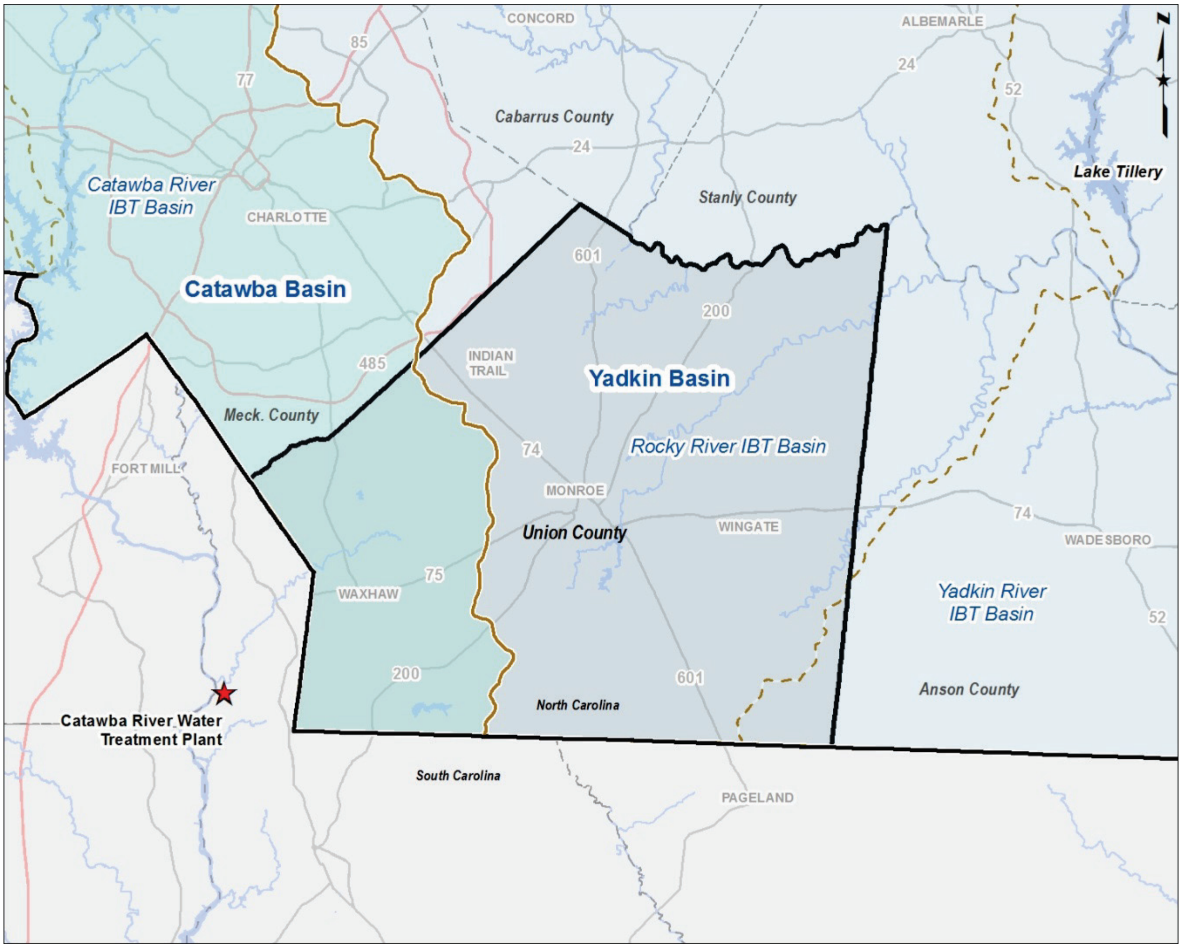

Illustration 2-4 Union County IBT Boundaries

2.7.2. Existing Catawba IBT

One consideration for both current and future water supply and wastewater disposal within Union County is the interbasin transfer limitations for the Catawba River Basin. The North Carolina grandfathered Catawba River IBT amount for the County is 5 mgd. This means that up to 5 mgd may be transferred out of the Catawba River Basin and not returned to the Catawba River Basin for disposal. The Catawba River (through utilization of the CRWSP) is currently the primary water supply for the County. Working within the regulatory limitations of this existing IBT is a primary driver for water supply and wastewater disposal for the County in the foreseeable future. The IBT capacity has a direct impact on the costs for water and wastewater services in the County.

While the 2011 Master Plan recommended that UCPW pursue an increase to their existing 5 mgd grandfathered IBT limit to 10 mgd for water transfers from the Catawba River Basin to the Yadkin River Basin, the County has elected to pursue other water sources within the Yadkin River Basin to avoid the need for an increase in the Catawba IBT. The Master Plan indicated that if the existing Catawba IBT is maintained at the 5 mgd limit, then significant efforts will be needed early in the planning cycle to accelerate the process of securing water from alternative sources for the eastern portion of the County. For purposes of alternatives evaluation for this

EIS, the existing 5 mgd grandfathered Catawba IBT is not proposed to be modified (except for the evaluation of Alternatives 6 and 7, as later described).

2.7.3. Proposed Yadkin IBT

The primary intent of the proposed IBT from the Yadkin River IBT Basin to the Rocky River IBT Basin within Union County is to secure a reliable source of water from the Yadkin River Basin to supply the County's customers that reside in its Yadkin River Basin Service Area, while also seeking to reduce the County's reliance on the existing grandfathered IBT from the Catawba River. Surface water supply alternatives being considered for evaluation as part of this EIS to supply this service area are outlined in Figure 2-3.

For all possible surface water supply alternatives from the Yadkin River Basin being evaluated as part of this EIS, water withdrawn from the Yadkin River Basin is to be measured through flow meters installed for the proposed Union County raw water intake. Subsequently, this raw water is proposed to be treated at a new water treatment plant to be constructed within Union County, at which point a water balance for finished water production, process water use and raw water line losses can be calculated. Finished water billing records for customers within the County's Yadkin River Basin Service Area will then be used to determine billed water within the Service Area, and any unbilled water use (i.e. line flushing) and system losses.

For water supply alternatives from the Yadkin River Basin which originate upstream of the Rocky River confluence with the Pee Dee River, the IBT for the withdrawal is considered to be purely consumptive. Although Union County returns treated wastewater to the Yadkin River Basin through multiple treatment facilities which discharge to tributaries of the Rocky River, and subsequently flow into the Pee Dee River, these returns would not reduce the calculated IBT from withdrawals upstream of the aforementioned confluence.

For water supply alternatives from the Yadkin River Basin which originate downstream of the Rocky River confluence with the Pee Dee River, the IBT for such withdrawals would subsequently be reduced by the projected wastewater returns to the Pee Dee River which would occur upstream of the aforementioned confluence. Such alternatives would, in effect, have a net IBT, that is equal to the projected raw water withdrawals minus the projected treated wastewater returns to the Yadkin River Basin. This principal is commonly referred to as the 'Cork Rule Exception', as described in North Carolina Administrative Code 15A NCAC 02E. 0401(b), where the following are not considered interbasin transfers:

1) The discharge point is situated upstream of the withdrawal point such that the water discharged will naturally flow past the withdrawal point.
2) The discharge point is situated downstream of the withdrawal point such that water flowing past the withdrawal point will naturally flow past the discharge point.

For alternatives being evaluated where this is the case, only the quantity of water withdrawn that is not returned to the Yadkin River Basin upstream of the proposed intake location would be classified as an IBT. Additional discussion on the IBT calculation for each water supply alternative is discussed in the analysis of alternatives to follow.

3.0 ALTERNATIVES ANALYSIS

The Union County water and sanitary sewer service areas are located within the Catawba River Basin and the Rocky River IBT Basin of the Yadkin River Basin. While the County's service areas are within the Catawba and Yadkin River Basins, neither of the rivers' main stems flow through the County as indicated in Illustration 3-1. The Rocky River forms the northern border of the County, but is not currently classified by the State of North Carolina for water supply uses.

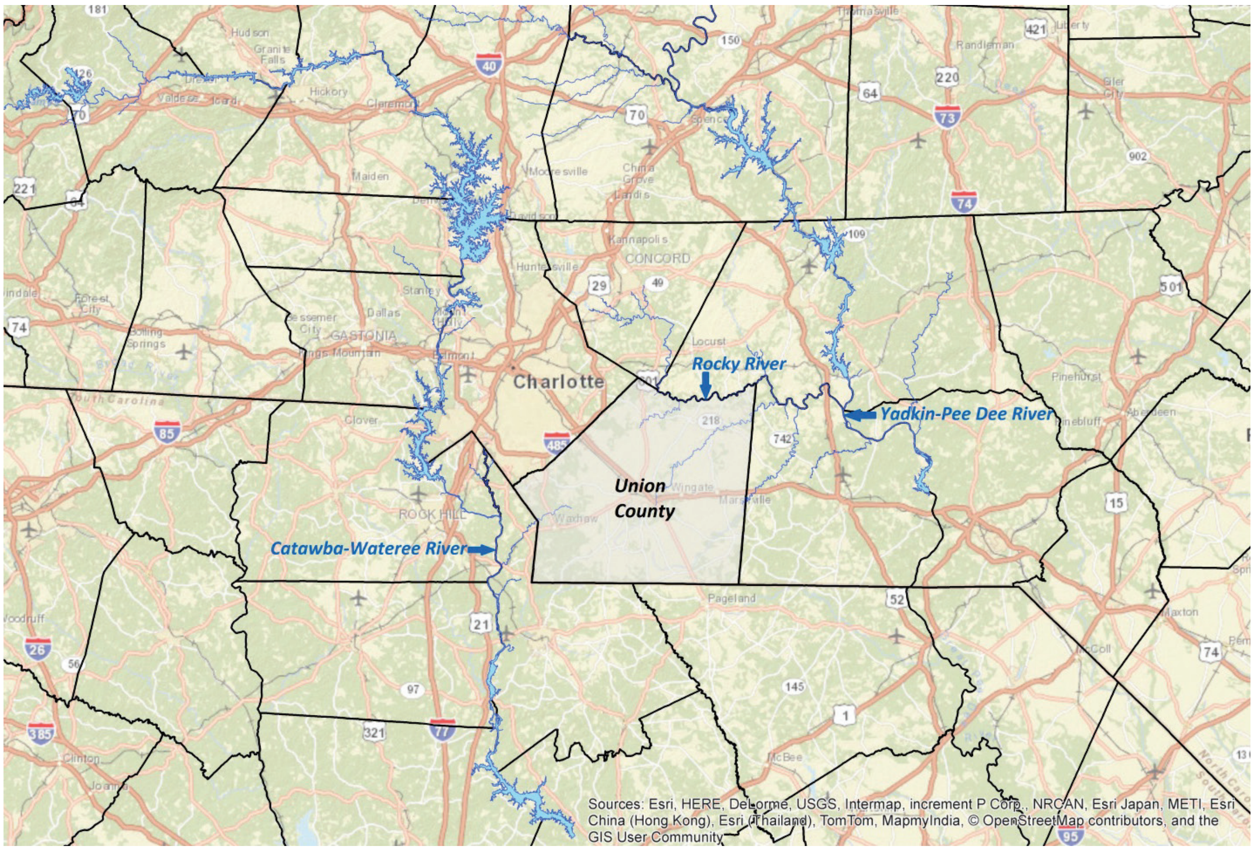

Illustration 3-1 Union County, North Carolina and Surrounding Major Rivers

Union County's location between the two major rivers (Yadkin-Pee Dee and Catawba), and federally regulated (through the Federal Energy Regulatory Commission (FERC)) surface water reservoirs along each river, logically make them the primary sources for potential future water supply within Union County. Illustration 3-2 depicts the FERC regulated reservoirs along the Yadkin-Pee Dee River, operated by Alcoa Power Generating Inc. (APGI) and Duke Energy Progress. Illustration 3-3 depicts the FERC regulated reservoirs along the Catawba River, operated by Duke Energy, Carolinas LLC.

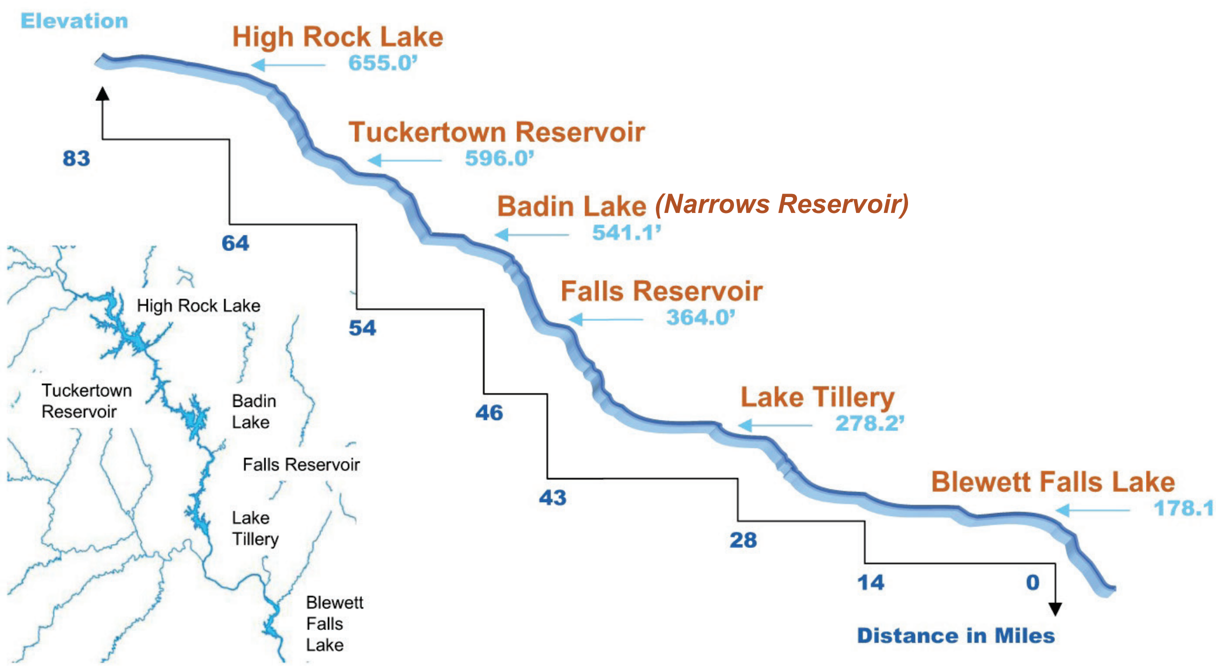

Illustration 3-2 Yadkin-Pee Dee River Basin Reservoirs (CH2MHill, 2006) (Note: W. Kerr Scott Reservoir not shown)

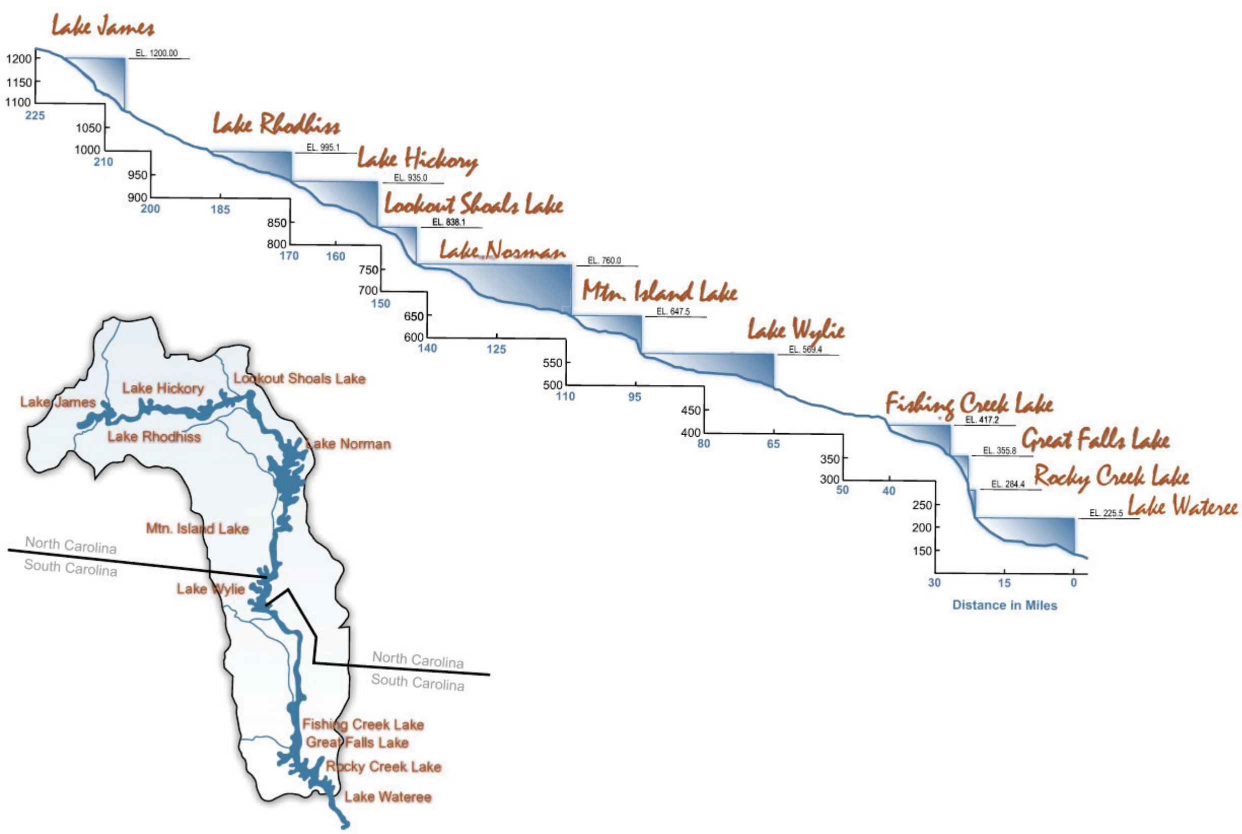

Illustration 3-3 Catawba-Wateree River Basin Reservoirs (CH2MHill, 2004)

As previously discussed and indicated in Figure 1-1, Union County currently has two water service areas: the Catawba River Basin Service Area and the Yadkin River Basin Service Area. Union County is currently seeking to secure a reliable water supply to serve projected near-term and long-term future customer demand in its Yadkin River Basin Service Area within the Rocky River IBT Basin. Water transfers into the Rocky River IBT Basin from either the Yadkin River IBT Basin of the major Yadkin River Basin or from the Catawba River will necessitate an interbasin transfer certificate from the State of North Carolina.

Both the Yadkin-Pee Dee and Catawba Rivers are potential water supply sources to help eliminate the County's projected water supply deficit in its Yadkin River Basin Service Area (Rocky River IBT Basin). Both raw water and finished water alternatives have been identified to address the projected 23 mgd (based on maximum month daily demands) water supply shortfall in this service area by the year 2050. Alternatives for raw water would require raw water intake, pumping, transmission and treatment infrastructure. Alternatives for finished water would require infrastructure for finished water transmission and wholesale purchase agreements with regional water suppliers.

Twelve (12) alternatives for Union County's Yadkin River Water Supply Project, including the No Action Alternative, have been identified for evaluation in this EIS. A total of eight (8) potential surface water alternatives have been identified. Additional non-surface water alternatives have also been identified as potential measures for minimizing the requested interbasin transfer, and are also explored, herein. The following is a summary of the alternatives being evaluated in this EIS:

- **Surface Water Supply Alternatives:**
    - **Alternative 1 -** Pee Dee River raw water supply from Lake Tillery (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
        - **Alternative 1A –** Raw water transmission alignment from Lake Tillery to new WTP in northern Union County primarily following road Right-of-Ways.
        - **Alternative 1B –** Raw water transmission alignment from Lake Tillery to new WTP in northern Union County primarily following power utility easements.
    - **Alternative 2A -** Yadkin River raw water supply from Narrows Reservoir (Badin Lake) (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
    - **Alternative 2B -** Yadkin River raw water supply from Tuckertown Reservoir (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
    - **Alternative 3 -** Pee Dee River raw water supply from Blewett Falls Lake (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.

    - **Alternative 3A –** Raw water transmission alignment from Blewett Falls Lake to new WTP in northern Union County primarily following power and natural gas utility easements.
    - **Alternative 3B –** Raw water transmission alignment from Blewett Falls Lake to new WTP in eastern Union County primarily following US-74 Right-of-Way.
  - **Alternative 4 -** Raw water supply from the main stem of the Pee Dee River (from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
  - **Alternative 5 -** Raw water supply from the Rocky River within Union County (non-IBT alternative) with a new water treatment plant in Union County.
  - **Alternative 6 -** Expansion of the Catawba River Water Supply Project (CRWSP) (modification to existing grandfathered IBT amount for a larger IBT from the Catawba River Basin to the Rocky River IBT Basin of the Yadkin River Basin).
  - **Alternative 7 -** Interconnection with Charlotte Water (IBT from Catawba River Basin to the Rocky River IBT Basin of the Yadkin River Basin).
- **Interbasin Transfer Minimization Alternatives:**
  - **Alternative 8 -** Raw water supply through groundwater withdrawal within Union County with a new water treatment plant in Union County.
  - **Alternative 9 -** Water demand management/conservation.
  - **Alternative 10 -** Direct potable reuse.
  - **Alternative 11 -** Evaluation of water returns (wastewater) from the Rocky River IBT Basin back to the Yadkin River IBT Basin.
  - **Alternative 12 -** No Action Alternative

The surface water supply alternatives being evaluated and their relative locations are illustrated in Figure 2-3. Detailed descriptions for each alternative being evaluated in this EIS follow.

3.1. No-Action Alternative (Alternative 12)

The No Action Alternative (NAA) would not involve additional public water supply by Union County Public Works to the County's Yadkin River Basin Service Area within the Rocky River IBT Basin. While the Union County Public Works water supply would not increase under this alternative, the County's population within this service area is still projected to increase, driven by economic growth and development within the region. Without a reliable water supply source for the Yadkin River Basin Service Area, future water supply within this area would have to be supplied either from the existing Catawba River Water Supply Project, through groundwater wells, or service connections to other water systems within the Rocky River IBT Basin. After expiration of the County's water purchase contract from Anson County, an existing source of available water for this area will no longer be available.

Meeting the water supply demands for future population growth in the Yadkin River Basin Service Area through the Catawba River Water Supply Project is not possible under the limitations of the County's existing grandfathered 5 mgd Catawba River Basin to the Yadkin River Basin. The County is currently approaching this existing IBT limit with transfers of water from the CRWSP to the Yadkin River Basin Service Area's existing customer base, and is projected to reach this limit within the next several years. Supporting long-term projected water demands within this service area with Catawba River Basin water is not possible without a violation of the current IBT limit or significant permit increases to this IBT limit.

Under the NAA, future water demands within the County's Yadkin River Basin Service Area may have to be self supplied by property owners and other facilities (i.e. industries, institutional facilities and commercial businesses) through groundwater wells, which within certain areas Union County has elevated concentrations of contaminants such as arsenic, radon, nitrates and nitrites, as further detailed in the analysis of Alternative 8. Additionally, supporting such projected population growth through individual private groundwater well installations would place an additional strain on the current groundwater supply within the County.

Also, under the NAA, the County may have to rely on connections to other neighboring water systems, which are within the Rocky River IBT Basin, to meet the water demands in the Yadkin River Basin Service Area, without reliance on an IBT. However, such existing and potential connections have not demonstrated an ability to provide the needed capacity to meet Union County projected future demand, due to infrastructure limitations (e.g. Alternative 3) and Rocky River safe yield limitations (e.g. Alternative 5). Neighboring systems in the Rocky River IBT Basin do not have the physical capacity to provide Union County with an adequate supply of water to meet current or future demands in the County's Yadkin River Basin Service Area.

Finally, an inability for Union County to provide reliable public water supply service to the Yadkin River Basin Service Area could result in a need to impose population growth and property development moratoria within the County due to limitations of County services (i.e. water service). The negative effects of such moratoria, as evidenced in other areas where they have been implemented, are often significant and long lasting, slowing or stalling the economic growth of the area and leading to the loss of jobs and businesses. The County's recently adopted Unified Development Ordinance, Water Use Ordinance, Comprehensive Plan, and Comprehensive Water and Wastewater Master Plan are evidence the County has been and continues to proactively plan for future population growth and development, while seeking to control water demands, so that such moratoria is not needed. These plans, however, are built upon the need to secure a reliable public water supply source to serve residents in the County's Yadkin River Basin Service Area. Such a need is not met by the NAA.

3.2. Surface Water Supply Alternatives

3.2.1. Alternative 1 – Yadkin River Basin, Pee Dee River (Lake Tillery)

3.2.1.1. BACKGROUND

Union County, through its Public Works Department (UCPW), recently completed a Comprehensive Water and Wastewater Master Plan (Black & Veatch, December 2011). This Master Plan outlines significant needs for additional water supply in the County's current, and potential, future service areas, and presents alternative scenarios for securing new water supply from the Catawba and/or Yadkin River Basins. UCPW also previously completed an Eastern Union County Water Supply Project Partner Assessment, Conceptual Study, and Preliminary

Permitting and Feasibility Analysis – Executive Summary (2011 EWS Feasibility Analysis) (HDR, 2011) that presented various engineering alternatives for bringing a new water supply into the eastern part of Union County from the Yadkin River Basin.

UCPW recognizes the complexities of delivering additional water supply to its customers due to the County's geography and development patterns (i.e., population centers, proximity to water sources, and river basin boundaries) as well as the regulatory restrictions/hurdles that exist for interbasin transfers. In June 2012, the County entered into a Memorandum of Understanding with the Town of Norwood that outlines the general terms for these two local governments working collaboratively to provide regional water supply solutions to each of their customers. In May 2013, the County and the Town of Norwood completed an Interlocal Intake and Transmission Agreement that provided a framework for bringing raw water supply into Union County's Yadkin River Basin Service Area.

Norwood has an existing raw water intake, raw water pump station and raw water transmission line between its water supply source (Lake Tillery, which is a part of the Yadkin River IBT Basin within the Yadkin River Basin) and its water treatment facility. In order to provide long term reliability in its raw water source for its existing and future customers, Norwood will need to improve its existing raw water intake, raw water pump station and raw water transmission line, which is expected to be costly. Future improvements and expansion of Norwood's existing water treatment facility would be easier and less costly if Norwood's raw water intake and pumping infrastructure were updated without Norwood bearing all of such expense.

By joining with Union County, Norwood can achieve these improvements and this expansion, and meet potentially more stringent future regulation by sharing the capital, operational and maintenance costs thereof with Union County, rather than Norwood absorbing the entire cost.

In order to supply finished water to some of its retail customers in the Yadkin River Basin Service Area, Union County currently purchases water on a wholesale basis from Anson County, North Carolina. Anson County does not currently have sufficient capacity to meet the projected demand of Union County for finished water. In addition, Union County owns jointly with Lancaster County Water and Sewer District, South Carolina, a water treatment facility with an intake in the Catawba River.

While the existing Catawba River Water Supply Project (CRWSP) water treatment facility in South Carolina may have sufficient long term supply to handle the demand for finished water in the portion of Union County's service area within the Catawba River Basin, Union County does not expect to be able to serve all of its existing and projected water demand in the Rocky River IBT Basin of the Yadkin River Basin from its jointly owned water facility on the Catawba River, based on current IBT limitations between major river basins. The CRWSP relies upon authority granted by both South Carolina and North Carolina to draw water from the Catawba River and transfer that water from the Catawba River basin. The CRWSP draws all of its water from an intake located below the Lake Wylie dam in South Carolina. South Carolina permitted the CRWSP to withdraw a total of 100 mgd (combined for Union County and Lancaster County) from the Catawba River. As part of this permit, up to 20 mgd is authorized to be transferred out of the Catawba River Basin to the Yadkin Basin. This permit was renewed in 2013 for an additional 30 years. However, Union County's water transfer from the CRWSP between the Catawba and Yadkin River Basins is further limited by an existing North Carolina grandfathered IBT limit of 5 mgd.

Union County prefers not to rely exclusively on interbasin transfers from the Catawba River Basin to serve the Yadkin River Basin Service Area, and moreover, cannot meet their projected future water demand in the Yadkin River Basin Service Area and stay within their existing North Carolina 5 mgd grandfathered IBT amount from the Catawba River in the near term, or its share of the existing 20 mgd South Carolina IBT in the long-term. Notwithstanding any conservation, water efficiency or water reuse policies that Union County may have presently or in the future, Union County needs a reliable, long term water source to satisfy its water demand in the eastern part of the County. By joining with Norwood, Union County would be able to meet this need.

The availability of raw water services is vital to the public health, welfare and economic growth of Norwood and Union County. Together, Norwood and Union County can achieve improvements to their respective infrastructure, certain economies of scale, a long term secure source of raw water, and other tangible and intangible benefits for their respective finished water customers. Norwood and Union County can establish a water supply and transmission system and a regional and inter-governmental approach for supplying raw water services to Norwood and Union County, without Norwood or Union County yielding any of their respective control over their customer base, service area or water production from their respective water facilities.

For the foregoing reasons, in 2013, Norwood and Union County entered into an Interlocal Intake and Transmission Agreement for the expansion of the raw water intake and raw water pump station of Norwood. The intake and pump station are to be constructed by Union County, at its expense. Additionally, this agreement provides for the installation of a raw water transmission line from the expanded raw water pump station to a new Union County water treatment facility of within Union County, also to be constructed at Union County's expense.

3.2.1.2. RAW WATER INTAKE AND PUMP STATION

The existing Town of Norwood WTP has one raw water intake in Lake Tillery. Lake Tillery is formed by the dam at Duke Energy's Tillery Hydroelectric Plant on the Pee Dee River. The lake extends approximately 15 miles upstream from the dam to Alcoa Power Generating Inc.'s (APGI) Falls Hydroelectric Development and is located between Falls Reservoir (upstream) and Blewett Falls Lake (downstream). The lake forms the boundary between Stanly and Montgomery County in the southeastern Piedmont region of North Carolina, approximately four miles west of Mount Gilead, North Carolina. Construction of the Tillery Development began in 1926, and the power plant was placed into service during 1928. At normal operating levels, Lake Tillery is about 72 feet deep at the dam. The reservoir surface area is 5,260 acres at that level (elevation 278.17' above mean sea level (msl)) and the usable storage with 22 foot drawdown is 88,000 acre-feet. River flows into Lake Tillery are largely controlled by the schedule of upstream releases from APGI's four-development Yadkin Project (Duke Energy, 2014).

Norwood's original intake and raw water pumping station were renovated in 1985 to replace the raw water intake screen, suction pipe and discharge pipe from the pump station to the nearby water treatment plant. The existing intake has a single 30-inch Johnson-type screen with centerline elevation 253.50' and 16-inch suction line that discharges to the raw water pump station, located along the shoreline, at centerline elevation 274.25'. Flow is discharged through a 16-inch main to the Town of Norwood WTP, located approximately 800-feet away from the raw water pump station on Allenton Street at South Strand Drive, in Norwood. There is a minimal elevation difference between the raw water pump station and WTP. Due to the capacity limitations of the existing intake and size and age of the existing Town of Norwood raw water pump station, a new raw water intake and pump station is proposed as part of the Interlocal Intake and Transmission Agreement (Agreement) between Norwood and Union County.

Per the Agreement, the initial capacity of the project is to be designed based upon the projected combined thirty (30) year water demand of Union County and Norwood, except that Norwood is to receive at least 2 mgd maximum daily capacity. Union County would design Norwood's new raw water pumps, ancillary equipment and associated infrastructure so that these pumps and/or infrastructure can be expanded or replaced to supply up to 8 mgd of maximum daily raw water capacity for Norwood.

Union County would be responsible for the construction of the raw water intake infrastructure, which is to be constructed on the property where Norwood's existing raw water intake and pump station are currently located (465 Bay Shore Drive, Norwood, NC 28128), and upon any additional property which may be acquired by Norwood in order to have sufficient land to build the facility. If necessary, during construction and until the raw water intake infrastructure is complete and operational, Union County would make provisions as required to maintain the operation of Norwood's existing raw water intake and pump station or provide an adequate temporary raw water intake sufficient for Norwood to continue to provide finished water to its customers. Union County would also construct the connection of Norwood's raw water pumps to the existing raw water transmission infrastructure of Norwood.

Norwood and Union County would jointly own the expanded raw water intake and the above ground structure housing each of Union County's and Norwood's raw water pumps. Union County would operate, maintain, repair, replace and expand the jointly owned property at Union County's expense, including any repairs or improvements as may be necessary for regulatory compliance. The raw water pumps, appurtenances and related infrastructure within the raw water pump station providing raw water to Union County, would be owned, operated, maintained, repaired, replaced and expanded by Union County, at its expense. The raw water pumps of Norwood within the expanded raw water pump station, as well as the appurtenances and related infrastructure providing raw water to Norwood, would be owned, operated, maintained, repaired, replaced and expanded by Norwood, at its expense, once construction has been completed at Union's County expense. Norwood would continue to own, operate, maintain, repair, replace and expand, as it deems necessary within its discretion, the raw water transmission line from the raw water pump station to Norwood's water treatment facility.

Conceptual estimates for the intake and pumping station indicate the facility should be sized to meet Union County's projected 2050 maximum daily water demands of 28 mgd and up to 8 mgd for the Town of Norwood per their Agreement. Conceptual design for the facility indicates a 48-inch diameter intake line with a 66-inch diameter screen would be needed to meet both the Union County and Town of Norwood combined demand. Under this alternative, the pump station facility would need to include four raw water pumps for Union County and up to three pumps for the Town of Norwood within a dedicated pump room and an adjacent electrical room.

3.2.1.3. RAW WATER TRANSMISSION MAIN

Under the conditions set forth in the Interlocal Intake and Transmission Agreement, Union County would be solely responsible for the raw water transmission infrastructure portion of the project. However, Norwood would be responsible for acquisition of real property interests in Stanly County necessary and/or incidental to the installation and operation of the raw water transmission infrastructure. Union County is to pay for the cost of the raw water transmission infrastructure. Any and all property interests in Stanly County necessary and/or incidental to completion of the Project are to be acquired by Norwood and held in the name of Norwood. Upon determination of the final route for the raw water transmission line(s), Norwood would work to acquire the necessary property, within the approved transmission line route and as specifically approved by Norwood within the municipal limits of Norwood. Union County intends to make reasonable efforts to locate and place the raw water transmission infrastructure in existing rights-of-way, easements or encroachments, when feasible.

Union County would own, operate, maintain, repair, replace and expand, as it deems necessary within its discretion, the raw water transmission line from the raw water pump station to Union's water treatment facility. Norwood, however, is to cooperate and assist in the acquisition of easements or other interests, in order to ensure that Union County is able to construct, own, operate, maintain, repair, replace and expand the raw water transmission line.

There are two proposed raw water transmission main alignments being evaluated for Alternative 1, which lead to three potential site areas being considered for a future Yadkin River Water Treatment Plant in the northeast quadrant of the County. Alternative 1-A predominately utilizes roadway right-of-way corridors through Stanly County, into Union County. This alignment extends approximately 24 miles from the raw water pump station on Lake Tillery to the proposed Site Area A for the Yadkin River Water Treatment Plant. For WTP Site Areas B and C, the alignment extends an additional 8 and 7 miles, respectively. Alternative 1-B utilizes an existing power utility easement that extends northwestward out of Norwood and then southwestward through Oakboro. This alignment length is approximately 26 miles from the raw water pump station on Lake Tillery to the proposed Site Area A for the Yadkin River Water Treatment Plant. For WTP Site Areas B and C, the alignment extends an additional 8 and 7 miles, respectively.

For both alignments, conceptual raw water transmission design indicates the need for parallel 36-inch diameter ductile iron pipe. These two transmission mains have been conceptually sized to accommodate Union County's average 2050 daily demand flow projection (16.5 mgd) in a single 36-inch pipe and the 2050 maximum daily demand (28 mgd) by utilizing both 36-inch pipes. This parallel configuration is proposed to provide redundancy in the raw water transmission infrastructure. The proposed routes are reflected as Alternative 1A and 1B on Figure 2-3. The detailed study corridor for these proposed routes are also reflected in Figure 3-1a.

Alternative 1-A Alignment

WTP Site Area A

The proposed Alternative 1-A route for Union County's raw water transmission main begins in Stanly County at the proposed Raw Water Pump Station on the shores of Lake Tillery near the intersection of Allentown Street and Bayshore Drive in Norwood. The line would extend westward along Allenton Street and then briefly travel northward along Alberta Street to avoid significant underground utility (water, sewer and natural gas) congestion which currently exists along Allenton Street. The alignment would travel westward along a relatively large single-owner property to Story Street. The transmission main would turn southward onto Vincent Street, and then westward on Lily Street. The line would then turn southwestward onto East Whitley Street, following this road out of Norwood where it becomes Whitley Road, eventually merging with Mt Zion Church Road. The line would follow Mt Zion Church Road to Hardy Road, at which point it would travel northwestward along Hardy Road until reaching Plank Road. At the Hardy Road intersection with Plank Road, the line continues in a northwestward direction along Plank Road through Cottonville and then northward toward Aquadale. At the intersection of Plank Road and Rocky Springs Road, the alignment turns westward and briefly follows Rocky River Springs Road, then cutting overland to NC-138. The line would follow NC-138 west toward Oakboro. At the intersection of NC-138 with Richard Sandy Road, just east of Oakboro, the line would briefly travel southward on Richard Sandy Road before turning southwest and traveling overland to American Drive. The line would continue along American Drive, crossing NC-742 and continuing along an existing service drive to Rocky River Road. The line would turn southward and follow Rocky River Road to Old Sandbar Road. The line would then briefly follow Old Sandbar Road westward to NC-205, at which point it follows NC-205 south into Union County, while crossing the Rocky River. The line would continue southward along NC-205 to the proposed Site Area A for the Yadkin River Water Treatment Plant, located just north of New Salem, near Old Kennedy Fork Road.

WTP Site Area B

The proposed Alternative 1-A raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area B is identical to that of Site Area A, described above, except the alignment continues an additional 8 miles to the proposed treatment plant site. The alignment continues southward along NC-205 past Site Area A to NC-218 at New Salem. The alignment turns southwest on NC-218 and travel to Haigler Gin Road, where it would turn onto this road. The alignment follows Haigler Gin Road to the southwest and would travel to Morgan Mill Road (NC-200), where it would turn and continue south on Morgan Mill Road. The line would then turn west off of Morgan Mill Road onto Henry Baucom Road to the proposed Site Area B for the Yadkin River Water Treatment Plant, in the proximity of Henry Baucom and Haigler Baucom Roads.

WTP Site Area C

The proposed Alternative 1-A raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area C is identical to that of Site Area A, previously described, except the alignment continues an additional 7 miles to the proposed treatment plant site. The alignment continues southward along NC-205 past Site Area A, crossing NC-218 at New Salem. The proposed alignment continues south on NC-205, diverging to the southwest onto New Salem Road. The alignment continues to follow New Salem Road to the southwest to the proposed Site Area C for the Yadkin River Water Treatment Plant, in the proximity of Mullis Newsome Road, Baucom Tarleton Road and Lawyers Road. There are several nearby residential communities in the proximity of the proposed site area, including the Cheshire Glen development.

Alternative 1-B Alignment

WTP Site Area A

The proposed Alternative 1-A route for Union County's raw water transmission main to the proposed Yadkin River Water Treatment Plant Site Area A would begin in Stanly County at the proposed Raw Water Pump Station on the shores of Lake Tillery near the intersection of Allentown Street and Bayshore Drive in Norwood. The line would extend westward along Allenton Street and then briefly travel northward along Alberta Street to avoid significant underground utility (water, sewer and natural gas) congestion which currently exists along Allenton Street. The alignment travels westward along a relatively large single-owner property to Story Street. The transmission main would turn southward onto Vincent Street, and then westward on Lily Street. The line would then turn southwestward onto East Whitley Street, following this road to the intersection of North Kendall Street. The alignment follows North Kendal Street (eventually becoming Brickyard Road) northwestward to South Stanly School Road. The alignment briefly follows an existing railroad right-of-way to a power utility easement belonging to Pee Dee Electric. The alignment would then follow this utility easement to the northwest to a point near NC 24/27. At this point, the alignment follows the utility easement to the southwest into Oakboro. The transmission main would continue to follow the easement through Oakboro along 7th Street and then cut overland, near the site of an existing power sub-station, to NC-205. At this point the proposed alignment follows NC-205 south into Union County, while crossing the Rocky River. The line would continue southward along NC-205 to the proposed Site Area A for the Yadkin River Water Treatment Plant, located just north of New Salem, near Old Kennedy Fork Road.

WTP Site Area B

The proposed Alternative 1-B raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area B is identical to that of Site Area A, described above, except the alignment continues an additional 8 miles to the proposed treatment plant site. The additional alignment length from the proposed WTP Site Area A to Site Area B is identical to that as previously described for Site Area B under Alternative 1-A.

WTP Site Area C

The proposed Alternative 1-B raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area C is identical to that of Site Area A, described above, except the alignment continues an additional 7 miles to the proposed treatment plant site. The additional alignment length from the proposed WTP Site Area A to Site Area C is identical to that as previously described for Site Area C under Alternative 1-A.

3.2.1.4. WATER TREATMENT PLANT

Under the provisions stipulated in the Interlocal Intake and Transmission Agreement, Union County is to be solely responsible for the permitting, design, construction and oversight for the Yadkin River Water Treatment Plant and would fund the entire cost of the Yadkin River Water Treatment Plant. The Town of Norwood would be solely responsible for the permitting, design, construction and oversight of the Norwood finished water distribution infrastructure and will fund the entire cost of this infrastructure. Therefore, considerations for only Union County's proposed Yadkin River Water Treatment Plant are addressed by this EIS. It is noted, however, that the approval of any new water treatment plant would have to be approved through a separate permitting process. For purposes of evaluating impacts of the interbasin transfer for this EIS document, the proposed water treatment plant has also been considered.

Three potential site areas for the Yadkin River Water Treatment Plant have been identified within the northeastern portion of Union, which are viable locations for the Yadkin River Water Supply Project - Alternative 1A and 1B. While specific parcels have not been selected, general study areas have been identified as one-mile diameter areas that would be suitable locations for a new water treatment plant, with considerations being given to existing geographic, environmental and physical features. These study areas are designated as Proposed WTP Siting Areas A, B and C, as denoted in Figure 2-3. Selection of a final WTP site will not be completed until formal design of the project, and will be based upon actual availability and suitability of land at the time of project design. As such, specific identification or selection of a preferred site cannot be made at this time. However, it is anticipated the WTP will be located in one of the three identified siting areas evaluated as part of this EIS.

A conceptual level water treatment plant design was developed to better evaluate the potential land area requirements and costs associated with implementing the Yadkin River Water Supply Project. It is important to note that this evaluation is conceptual in its nature and does not seek to identify the exact layout or actual design features of the proposed Yadkin River WTP, nor does it represent a commitment by Union County to use a certain treatment technology for this future facility. Actual details of the facility must be determined at a later date, based on the final WTP site selected and treatment processes required, based on future detailed facility design and water quality characteristics of the actual source water supply, which have not yet been determined.

The proposed facilities must be designed to effectively treat the raw water supply for the selected water source alternative by meeting existing and potential future Safe Drinking Water Act (SDWA) requirements and protecting public health. It is anticipated that this new facility be built in three distinct phases to meet the projected increasing Union County water demands (based on a maximum daily value to determine treatment plant capacities) for the YRWSP through the Year 2050. The proposed project phases are outlined in Table 3-1.

Table 3-1 Yadkin River Water Supply Project – Proposed Water Treatment Plant Capacity

Project Phase	YRWSP Capacity
Phase 1	12 mgd
Phase 2	20 mgd
Phase 3	28 mgd

Raw water quality data was obtained from Monthly Water Quality Study of Lake Tillery, Blewett Falls Lake, and Associated Tailwaters (Progress Energy, 2006). The data illustrates that the raw water supply within the Pee Dee River has moderate total organic carbon (TOC) concentrations from 2.9-4.9 mg/L, average surface water turbidity levels with moderate variations from 10-24 Nephelometric Turbidity Units (NTU), low alkalinity at 21-33 mg/L, low hardness at 21-51 mg/L, pH ranging from 7-8, and seasonally elevated dissolved iron and manganese concentrations.

From a treatability and water quality perspective, lower TOC concentrations are beneficial because organic compounds in the water supply (measured as TOC) can react with chlorine used to disinfect the water to form disinfection by-products (DBPs). DBPs are regulated by the Environmental Protection Agency (EPA) because elevated DBPs have been linked to certain forms of cancer and adverse pregnancy outcomes. Current regulated DBPs include Trihalomethanes (THMs) and Haloacetic Acids (HAA5s). The concentration of DBPs formed is a function of several factors including the concentration of TOC in the water at the point of disinfection injection, the type of organic compounds that make up the TOC, temperature, pH, concentration of disinfectant, type of disinfectant (chlorine, chloramines, ozone, chloride dioxide), and the amount of time the disinfectant is allowed to react with treated water prior to removal for consumptive use.

Low alkalinity and hardness impacts water stability, which can lead to corrosive conditions and leaching of lead and copper from service lines and plumbing fixtures. Lead and copper are both regulated by the EPA under the Safe Drinking Water Act (SDWA). pH can also impact water stability. The addition of primary coagulants such as aluminum and ferric salts can lower the alkalinity and therefore require that additional external sources of alkalinity are needed to assure water stability and optimize disinfection.

Iron and manganese are regulated as secondary drinking water contaminants due to their aesthetic impacts on the water supply, including staining of fixtures and clothes, and tastes and odors. In their reduced forms, iron and manganese remain in solution but, once oxidized, they precipitate. Typically, under anoxic conditions (lack of oxygen) such as in submerged intakes in a stratified lake, iron and manganese are in their reduced soluble forms and must be oxidized in the treatment process to remove these constituents.

Based on the historical raw water quality for the various water supplies, State Drinking Water Act compliance requirements and potential future drinking water resolutions, the following process train was considered for the purpose of conceptually evaluating the proposed water treatment plant:

1. Rapid Mix
2. Coagulation/Flocculation/Sedimentation
3. Ozone
4. Biofiltration
5. Disinfection
6. Chemical Systems
7. Finished Water Storage, Pumping and Transmission
8. Residuals Handling

A description of the basic conceptual level process components is summarized below.

Rapid Mix

The rapid mix unit would provide the required mixing energy for effective chemical mixing and coagulation. It was assumed two 10’ by 10’ concrete tanks with mechanical backmixers would be constructed for the first phase. In Phase 2, the mixers would be upgraded to impart enough mixing energy to treat Phase 2 flows. For the facility build-out, a third rapid mix tank and mixer would be added. A coagulant such as alum or ferric sulfate would be used as a primary coagulant with caustic addition capability to maintain alkalinity.

Flocculation/Sedimentation

The coagulated water from the rapid mix process would then be conveyed to high rate processes such as solids contact clarifier units, each having a capacity up to 8 mgd. For conceptual planning purposes, it was assumed that two units would be needed during the initial WTP construction phase, with an additional unit required in Phase 2 and another in Phase 3. One such option for this technology is a high rate solids contact clarifier which combines flocculation and sedimentation in one basin. Such units consist of a vacuum chamber, basin distribution channel, distribution and collection laterals and settling plates. The vacuum chamber controls the flow into the basin distribution channel and causes the water level to rise and fall on a defined cycle. This pulsation facilitates a complete flocculation reaction. The flocculated water travels through the settling plates and clarified effluent is collected in the laterals located about the plates. Solids are collected periodically via sludge collection piping. To aid with the sedimentation process, coagulant aid polymer would typically be added.

Intermediate Ozone

The use of ozone can be implemented at many places in a water treatment facility. Location varies based on source water quality and existing treatment processes. One option, referred to as intermediate ozonation, occurs just after sedimentation. The settled water is ozonated with ozone generated on-site with liquid oxygen, an ozone generator, and power supply unit. Ozone can be applied via bottom diffusers in a deep contact tank or through a side stream injection system and contactor. Ozone oxidizes complex organic matter found in the raw water and breaks these organics down to smaller compounds that can be removed on biofilters. Ozone can also be used a primary disinfectant to inactivate pathogenic protozoa such as *Giardia* and *Cryptosporidium*. Ozonation also improves the filterability of the water and can oxidize dissolved metals such as iron and manganese. The ozonation system would include liquid oxygen (LOX), ozone generators, power supply units, cooling water, ozone distribution and ozone destruct facilities. For conceptual planning purposes, two ozone contactor units were assumed necessary during the initial WTP construction, with a third unit needed during Phase 3.

Filtration

Granular media filtration follows the ozonation process to remove the remaining particulate matter in the settled water. It also provides another barrier against pathogenic protozoa such as *Giardia* and *Cryptosporidium*. The conceptual WTP layout assumes that the filters would consist of granular filter media, gravel bed, underdrains, filter influent and effluent channels and a backwash system. Typical filtration media would include a layer of sand (6-12 inches) and granular activated carbon (GAC) (24-48 inches). GAC media would be used in the granular media filters and will be operated biologically. Provision for filter aid polymer on top of the filters was also assumed for conceptual WTP planning purposes. For conceptual planning purposes, four filtration units were assumed necessary during the initial WTP construction, with two additional units needed during Phase 2 and another two units in Phase 3.

Post Filtration Treatment

One issue of concern related to the various potential water supply sources is the formation of DBPs. Elevated DBPs (THMs and HAA5s) have historically been experienced in Union County's Yadkin River Basin Service Area with finished water received from the Anson County WTP. This is due, in part, to the finished water TOC levels at the Anson County WTP and due to the extended water age from the long conveyance distance. This concern resulted in Anson County switching from free chlorine secondary disinfection to chloramination in 2009. Adding ammonia to form chloramines prior to finished water conveyance from any of the various sources halts the production of many DBPs.

Two strategies for reducing DBP formation includes implementing treatment processes that reduce the level of TOC prior to the addition of free chlorine or minimizing free chlorine disinfection and utilizing chloramines as a secondary disinfectant. TOC reduction can be accomplished in a number of ways including pretreatment with Powdered Activated Carbon (PAC) or a preoxidant, such as chlorine dioxide; pretreatment with the MIEX® process; or post treatment with granular activated carbon filters. The use of ozone with biofiltration is another strategy employed to reduce DBP production. For the conceptual planning purposes for the new Yadkin River WTP as part of this evaluation, it was assumed that the treatment train would include ozone with biofiltration to reduce TOC and DBPs. As mentioned above, ozone can also be used as a disinfectant to reduce DBP's. For conceptual design purposes it was also assumed that PAC would be provided as a pretreatment chemical for organics removal.

Disinfection

Disinfection is the vital part of the treatment plant to achieve regulatory compliance for the inactivation of *Giardia* and *Cryptosporidium*, and meet residual disinfection requirements in the distribution system. Primary/secondary disinfection can be accomplished by:

- Chlorination/Chlorination
- Chlorination/Chloramination
- Ozonation/Chlorination or Chloramination
- UV/Chlorination or Chloramination

This conceptual WTP planning analysis and associated costs assumes the use of ozone for primary disinfection and chloramines for secondary disinfection. It was assumed the water supply would fall into Bin 1 Classification under the United States Environmental Protection Agency's (EPA) Long Term 2 Enhanced Water Treatment Rule. The purpose of this rule is to reduce disease incidence associated with Cryptosporidium and other pathogenic microorganisms in drinking water. The rule, as published in the Federal Register on January 5, 2006, applies to all public water systems that use surface water or ground water that is under the direct influence of surface water.

Chemical Feed Systems

Chemical feed facilities should, at a minimum, include the storage and metering pumps for PAC, primary coagulant, coagulant aid polymer, sodium hydroxide, filter aid polymer, sodium hypochlorite, fluoride, and orthophosphate. Additional chemicals may be needed based on the raw water quality, treatment goals and disinfection strategy. For the preliminary dosages, assumptions were based on the chemical dosages used at the Anson County WTP to treat similar raw water supplies from the Yadkin-Pee Dee River. For conceptual planning, the proposed chemical feed systems were based on the design WTP flows for each expansion phase. As part of the conceptual WTP layout, these systems are proposed to be housed within a dedicated chemical feed building.

Finished Water Storage

Finished water storage was assumed to consist of prestressed concrete baffled clearwells that have sufficient storage capacity for the demand and operational requirements (such as the necessary filter backwash volume) and to meet the requirements of the Surface Water Treatment Rule with respect to disinfectant contact time (C-t). Two, 2-MG ground level clearwells were included in the conceptual WTP layout, which would be constructed during the initial phase of the WTP construction.

Finished Water Pumping

As discussed in Section 2, Union County's demand for finished water from the proposed Yadkin River WTP is projected to increase throughout the planning period of the project within the County's Yadkin River Basin Service Area and from wholesale water purchases from the Town of Wingate (including Wingate University). Conceptual finished water pump sizing for this evaluation was based on these projected water demand needs. The exact nature of how water will be transmitted from the proposed water treatment plant has not been evaluated as part of this conceptual WTP evaluation.

A finished water pump station is proposed to convey finished water from the clearwells by gravity to vertical cans associated with the finished water distribution pumps. For conceptual planning purposes it was assumed that variable speed vertical turbine pumps would be used to convey finished water to the Yadkin River Basin Service Area.

Residuals Treatment

Residuals make up a small percentage (typically 5-10%) of the treated raw water. The main sources of the residuals are filter backwash, filter-to-waste, and blowdown solids from the sedimentation process. Typically, filter backwash exhibits lower concentrations of total suspended solids (TSS) than do the blowdown solids. Residuals handling can be achieved in three different ways:

- Discharging into the sewer
- Treatment via Settling/Thickening/Dewatering with treated water discharged to a sewer, surface water body, or recycled and solids either land applied or landfilled.
- Lagooning of solids in a large lagoon with periodic disposal.

Discharging into the sewer would require pH adjustment and an equalization tank. Also, there may be a cost associated with sampling, pretreatment, and surcharge fees to the receiving utility. The proposed WTP sites areas currently being evaluated are not adjacent to a public sewer system.

The Settling/Thickening/Dewatering option would require an equalization tank, settling process and a thickening process to increase the solids content. The backwash waste is typically equalized and discharged to a settling basin. For this analysis it was assumed that plate settlers would be used to settle backwash solids. The blowdown was assumed to be combined with the underflow of the plate settlers and thickened in gravity thickeners prior to dewatering. Thickened solids would then be transferred to a thickened solids storage tank where they are kept in suspension until they are transferred to the dewatering units. For this conceptual WTP layout, it was assumed that the dewatering process would be employed to increase the solids content to a level suitable for hauling to a compost or landfill facility. Supernatants from these processes would be returned back to the equalization tank. Due to the extensive land requirements for this method of residuals treatment, lagooning was not considered as a viable option for this project.

Illustration 3-4 depicts a conceptual layout of the proposed Union County Yadkin River WTP with applicable expansion phases indicated by color. It is noted that this layout is conceptual in nature only and is indicative of a typical WTP with the treatment methods previously described. Actual layout of the Yadkin River WTP will vary from that shown, based on final design of the facility, actual WTP site location selected and final treatment train processes to be used.

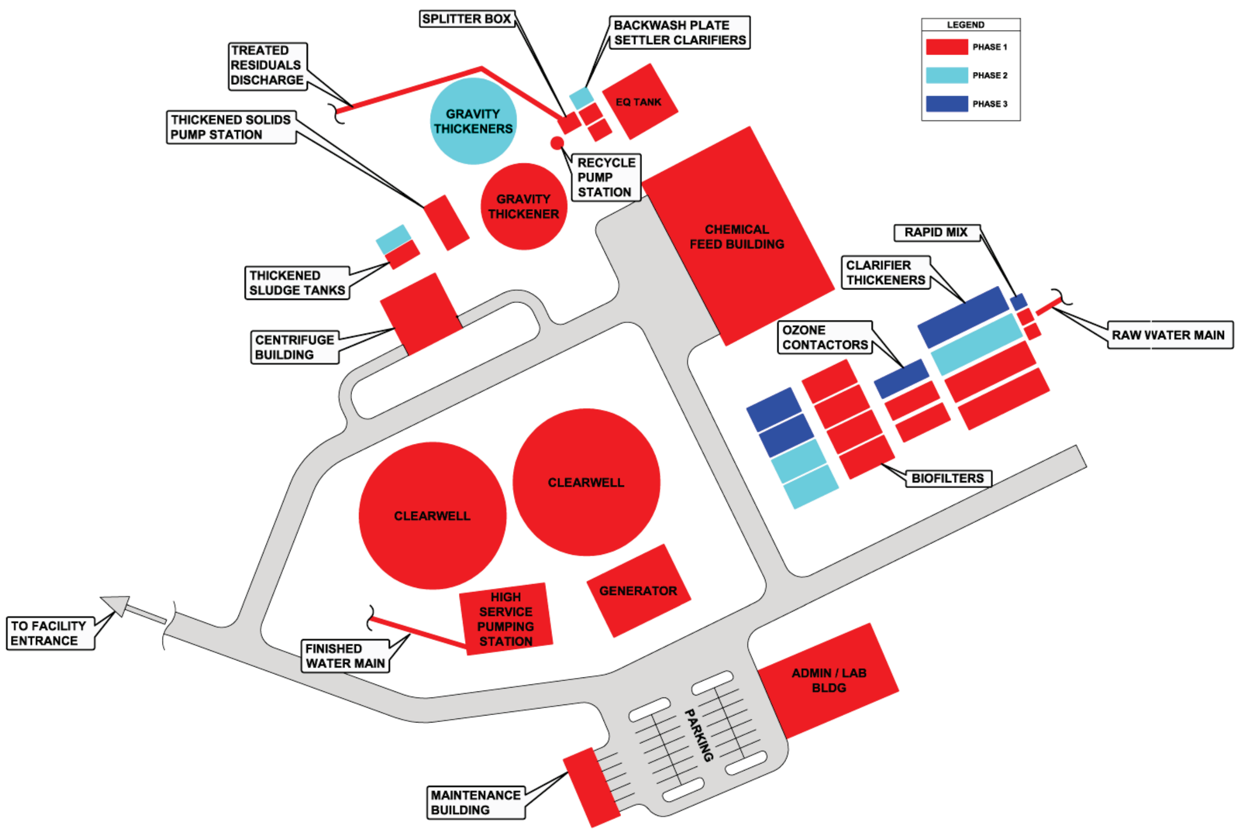

Illustration 3-4 Conceptual Layout for the Proposed Union County Yadkin River Water Treatment Plant
(*Note: This layout is provided for WTP concept visualization purposes only*)

3.2.2. Alternative 2 – Yadkin River Basin, Yadkin River (Narrows and Tuckertown Reservoirs)

3.2.2.1. BACKGROUND

Alternative 2 seeks to evaluate the potential for meeting the needs of Union County's Yadkin River Water Supply Project using the either Narrows Reservoir (Badin Lake; Alternative 2A) or Tuckertown Reservoir (Alternative 2B), both of which are in the Yadkin River IBT Basin of the Yadkin River Basin, as a surface water supply. Because the Yadkin River Water Supply Project will serve customers in Union County's Yadkin River Basin Service Area (Rocky River IBT Basin), the withdrawal of water from the Yadkin River IBT Basin to serve these customers is considered an interbasin transfer, as the withdrawal and use points are within different IBT basins, as defined in North Carolina General Statute 143-215.22L.

In an effort to secure a reliable source of water to serve Union County's Yadkin River Basin Service Area within the Rocky River IBT Basin as part of the Yadkin River Water Supply Project, potential regional partners for a long-term raw water supply were previously evaluated as part of the 2008 Union County Easter Water Supply Preliminary Engineering Report. Of these potential partners, the previous study considered an option for securing either raw or finished water from the City of Albemarle's Narrows Reservoir (Badin Lake) source and US-52 Water Treatment Plant.

The City of Albemarle is located in Stanly County, approximately 12 ½ miles northeast of the northeastern border of Union County with Stanly and Anson County. Albemarle's Public Utilities Department provides electric, water and sewer services for residential, commercial and industrial customers in Albemarle and surrounding areas and serves a population of almost 16,000. As identified in its 2014 North Carolina Local Water Supply Plan, Albemarle sells water to Pfeiffer-North Stanly Water (0.495 mgd), Stanly County (1.433 mgd). Additionally, a water line from Albemarle to the City of Concord is under construction, which will eventually supply the cities of Concord and Kannapolis with finished water from the Yadkin River Basin as part of an IBT Certificate issued in 2007 by the EMC.

The City of Albemarle obtains its drinking water from two surface water sources. The first source is the Narrows Reservoir (Badin Lake) and the second source is the Tuckertown Reservoir. Both of these reservoirs are located along the Yadkin River in the Yadkin River IBT Basin of the Yadkin River Basin. The water from Narrows Reservoir (Badin Lake) is treated to produce drinking water at the City's water treatment plant located on US Highway 52 North. The water from the Tuckertown Reservoir is treated at the Tuckertown Water Treatment Plant, located on NC Highway 49, near the Stanly and Rowan County boundary. The drinking water from both of these water treatment plants is blended together in the water distribution system, although a few users in the northern section of Albemarle get their water solely from the water plant on US-52 (City of Albemarle, 2012).

Alternative 2A seeks to evaluate the option for Union County to partner with the City of Albemarle to secure up to 23 mgd (maximum month daily average demand; equivalent to 28 mgd maximum day demand) of raw water from Albemarle's Narrows Reservoir (Badin Lake) intake, to be transferred by a new raw water transmission main through Stanly County and into Union County to the site of a proposed new North Union Water Treatment Plant, located in the northeastern portion of Union County.

Alternative 2B seeks to evaluate the option for Union County to partner with the City of Albemarle to secure up to 23 mgd (maximum month daily average demand; equivalent to 28 mgd maximum day demand) of raw water from Albemarle's Tuckertown Reservoir intake, to be transferred by a new raw water transmission main through Stanly County and into Union County to the site of a proposed new North Union Water Treatment Plant, located in the northeastern portion of Union County.

3.2.2.2. RAW WATER INTAKE AND PUMP STATION

Alternative 2A - Expand City of Albemarle's Narrows Reservoir (Badin Lake) intake

The City of Albemarle's US-52 WTP is served by a raw water intake in Narrows Reservoir (Badin Lake). This reservoir is formed by the dam at Alcoa Power Generating Inc.'s (APGI) Narrows Hydroelectric Plant on the Yadkin River, at river mile 236.5. The Narrows development is located in Davidson, Stanly and Montgomery counties, North Carolina, between Tuckertown Reservoir (upstream) and Falls Reservoir (downstream). Completed in 1917, the Narrows development was the first of APGI's Yadkin Project developments to be built. The dam impounds a reservoir (Narrows Reservoir or Badin Lake) that has a normal full pool area of

5,355 acres and a drainage area of 4,180 square miles. The normal full pool elevation of Narrows Reservoir (Badin Lake) is 509.8 feet msl.

Narrows Reservoir (Badin Lake) has some storage available and a maximum drawdown capability of approximately 30 feet. During normal operations, the lake typically fluctuates within a 3 foot range. However, available storage at Narrows Reservoir (Badin Lake) may be used during periods of drought in order to help maintain the required minimum downstream releases. Drawdowns during such periods can exceed 3 feet (Alcoa Power Generating Inc., 2014).

In 2014, Albemarle withdrew an average annual daily volume of 3.15 mgd (8.25 mgd maximum day) from Narrows Reservoir (Badin Lake). The maximum permitted withdrawal for this intake is 9 mgd, according to the City's 2014 Local Water Supply Plan. According to this Plan, Albemarle's total water supply demand projected for year 2050 is 8.87 mgd (49 percent of their total water supply available from both the Narrows (Badin) and Tuckertown Reservoir sources.) Based on 2014 data, 53 percent of Albemarle's total water withdrawals were from Narrows Reservoir (Badin Lake). Under the assumption that this ratio remains similar through 2050, it is estimated that by the year 2050 there will be 4.3 mgd of remaining permitted water supply available from Albemarle's Narrows Reservoir (Badin Lake) source, based on the current permitted withdrawal limits.

In order to meet the 2050 projected maximum day demand of 28 mgd for Union County, as well as supply its own customers, Albemarle's permitted withdrawal from Narrows Reservoir (Badin Lake) would need to be increased by at least 23.7 mgd to a total permitted withdrawal of approximately 34 mgd. Such an increase would inherently require a major expansion of Albemarle's existing intake for increased withdrawal capacity for both utilities, or more likely the construction of a new dedicated intake and pump station to meet Union County demand for the YRWSP.

For purposes of Alternative 2A, it has been assumed a new intake and pumping station would be constructed to meet Union County's water needs only and built adjacent to Albemarle's existing raw water intake facility on Narrows Reservoir (Badin Lake). The new facility would be sized for the final phase (Phase 3) of expansion to meet Union County's projected 2050 maximum daily water demands of 28 mgd. Conceptual design for the facility indicates a 42-inch diameter intake line with a 60-inch diameter screen would be needed to meet this demand. Under this alternative, the pump station facility would need to include four raw water pumps within a dedicated pump room and an adjacent electrical room. If the City of Albemarle does desire to update their intake and pumping station jointly with Union County as part of the YRWSP, then the proposed pumping station would consist of the four Union County pumps and three City of Albemarle pumps within a dedicated pumping room and a common electrical room.

Alternative 2B - Expand City of Albemarle's Tuckertown Reservoir intake

The City of Albemarle's Tuckertown WTP is served by a nearby raw water intake in Tuckertown Reservoir. Tuckertown Reservoir is formed by the dam at Alcoa Power Generating Inc.'s (APGI) Tuckertown Hydroelectric Plant on the Yadkin River, at river mile 244.3. The Tuckertown development is located in Rowan, Davidson, Stanly, and Montgomery counties, North Carolina, between High Rock Lake (upstream) and Narrows Reservoir (Badin Lake) (downstream). Completed in 1962, the Tuckertown development was the last of APGI's Yadkin Project developments to be built. The Tuckertown development consists of a dam, powerhouse, and reservoir. Tuckertown Reservoir has a normal full pool area of 2,560 acres and a drainage area of 4,080 square miles. The normal full pool elevation of Tuckertown Reservoir is 564.7 feet msl.

The Tuckertown development is operated as a run-of-river facility. Due to its limited ability to store water, Tuckertown is operated with a normal daily fluctuation of 0 to 3 feet and there is no seasonal drawdown. The maximum drawdown capability at Tuckertown is approximately 3 feet (Alcoa Power Generating Inc., 2014).

In 2014, Albemarle withdrew an average annual daily volume of 2.84 mgd from Tuckertown Reservoir. The maximum permitted withdrawal for this intake is 9 MGD, according to the City's 2014 Local Water Supply Plan. According to this Plan, Albemarle's total water supply demand projected for year 2050 is 8.87 mgd (53 percent of their total water supply available from both the Narrows Reservoir (Badin Lake) and Tuckertown Reservoir sources). Based on 2014 data, 47 percent of Albemarle's total water withdrawals were from Tuckertown Reservoir. Under the assumption that this ratio remains similar through 2050, it is estimated that by the year 2050 there will be 4.2 mgd of additional available water supply from Albemarle's Tuckertown Reservoir source, based on the current permitted withdrawal limits.

In order to meet the 2050 projected maximum day demand of 28 mgd for Union County, as well as supply its own customers, Albemarle's permitted withdrawal from Tuckertown Reservoir would need to be increased by at least 23.8 mgd to a total permitted withdrawal of approximately 32 mgd. Such an increase would inherently require a major expansion of Albemarle's existing intake for increased withdrawal capacity, or more likely the construction of a new dedicated intake and pump station to meet Union County demand for the YRWSP.

For purposes of Alternative 2B, it has been assumed a new intake and pumping station would be constructed to meet Union County's water needs only and built adjacent to Albemarle's existing raw water intake facility on Tuckertown Reservoir. Details of the new facility are similar to those previously described for Alternative 2A. If the City of Albemarle does desire to update their intake and pumping station jointly with Union County as part of the YRWSP, then the proposed pumping station would need to accommodate pumping infrastructure and equipment for both entities as described in Alternative 2A.

3.2.2.3. RAW WATER TRANSMISSION MAIN

Alternative 2A - City of Albemarle's Narrows Reservoir (Badin Lake) Intake to Union County

Similar to Alternative 1, conceptual raw water transmission design indicates the need for parallel 36-inch diameter ductile iron pipe for Alternative 2A to provide necessary redundancy and meet Union County's 2050 water demands. This proposed alignment extends approximately 35 miles from the raw water pump station on Narrows Reservoir (Badin Lake) to the proposed Site Area A for the Yadkin River Water Treatment Plant. For the proposed WTP Site Areas B and C, the alignment extends an additional 8 and 7 miles, respectively. The proposed route is reflected as Alternative 2A on Figure 2-3. The detailed study corridor for this proposed route is also reflected in Figure 3-1a.

WTP Site Area A

The proposed route for Union County's raw water transmission main would begin in Stanly County at the proposed raw water pump station on the shores of Narrows Reservoir (Badin Lake) at the site of the City of Albemarle's existing intake and travel along the same corridor as the City of Albemarle's existing raw water line from Narrows Reservoir (Badin Lake) to their US-52 Water Treatment Plant, before being directed through Stanly County and into Union County to a proposed new water treatment plant location. This existing City of Albemarle intake site is located at the end of Pumphouse Road, adjacent to the railroad trestle crossing over Narrows Reservoir (Badin Lake) at the Stanly-Montgomery County Line, northwest of New London. The proposed Union County raw water transmission main would follow the path of Albemarle's raw water line easement, which roughly follows Old Whitney Road southwest to Mountain Creek Road, and continues southwest to Airport Road. At Airport Road, the proposed alignment turns west and travels to US-52, near the City of Albemarle's US-52 Water Treatment Plant.

From the existing water treatment plant, the Union County raw water line would continue and turn westward, cross US-52 and follow Bethany Road to Old Salisbury Road where it would then turn southward and travel along Old Salisbury Road to Mann Road. At this intersection, the line will briefly travel westward on Mann Road before turning southward onto Charlie Road to extend to Pennington Road. The line will follow Pennington Road (eventually becoming Laurel Street) south to the intersection with Concord Road (NC-73). The line would follow NC-73 southeast to Church Street in Albemarle and turn southward to West Main Street. The proposed alignment follows West Main Street southwestward to St. Martin Road (NC-1963). The line would then follow St. Martin Road south into Oakboro, where the road becomes East First Street. The line would continue to follow East First Street to the intersection of South Main Street (NC-742), where it would then cross South Main Street and briefly follow Railroad Street westward to West Second Street (NC-205). The line would then travel south along NC-205 to the Union County line where it would cross the Rocky River. The line would continue south along NC-205 in Union County to the proposed Site Area A for the Yadkin River Water Treatment Plant, located just north of New Salem, near Old Kennedy Fork Road.

WTP Site Area B

The proposed Alternative 2-A raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area B is identical to that of Site Area A, described above, except the alignment would continue an additional 8 miles to the proposed treatment plant site. The additional alignment length from the proposed WTP Site Area A to Site Area B is identical to that as previously described for Site Area B under Alternative 1-A.

WTP Site Area C

The proposed Alternative 2-A raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area C is identical to that of Site Area A, described above, except the alignment would continue an additional 7 miles to the proposed treatment plant site.

The additional alignment length from the proposed WTP Site Area A to Site Area C is identical to that as previously described for Site Area C under Alternative 1-A.

Alternative 2B - City of Albemarle's Tuckertown Reservoir Intake to Union County

Similar to Alternative 2A, conceptual raw water transmission design indicates the need for parallel 36" diameter ductile iron pipe for Alternative 2B to provide necessary redundancy and meet Union County's 2050 water demands. This proposed alignment extends approximately 35 miles from the raw water pump station on Tuckertown Reservoir to the proposed Site Area A for the Yadkin River Water Treatment Plant. For the proposed WTP Site Areas B and C, the alignment extends an additional 8 and 7 miles, respectively. The proposed route is reflected as Alternative 2B on Figure 2-3. The detailed study corridor for this proposed route is also reflected in Figure 3-1a.

WTP Site Area A

The proposed route for Union County's raw water transmission main would begin in the northernmost part of Stanly County at the proposed raw water pump station on the shores of Tuckertown Reservoir at the site of the City of Albemarle's existing intake and Tuckertown Water Treatment Plant. This site is located near the intersection of NC-49 and NC-8 northeast of Richfield. The line would extend south along NC-8 and then follow US-52 south once NC-8 merges with US-52 in New London. The line would extend south along US-52 to the north side of the City of Albemarle and the existing City of Albemarle US-52 Water Treatment Plant. The line would then turn westward and follow Bethany Road to Old Salisbury Road where it would then turn southward and travel along Old Salisbury Road to Mann Road. At this intersection, the line would briefly travel westward on Mann Road before turning southward onto Charlie Road to extend to Pennington Road. The line would follow Pennington Road (eventually becoming Laurel Street) south to the intersection with Concord Road (NC-73). The line would follow NC-73 southeast to Church Street in Albemarle and turn southward to West Main Street. The proposed alignment follows West Main Street southwestward to St. Martin Road (NC-1963). The line would then follow St. Martin Road south into Oakboro, where the road becomes East First Street. The line would continue to follow East First Street to the intersection of South Main Street (NC-742), where it would then cross South Main Street and briefly follow Railroad Street westward to West Second Street (NC-205). The line would then travel south along NC-205 to the Union County line where it would cross the Rocky River. The line would continue south along NC-205 in Union County to the proposed Site Area A for the Yadkin River Water Treatment Plant, located just north of New Salem, near Old Kennedy Fork Road.

WTP Site Area B

The proposed Alternative 2-B raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area B is identical to that of Site Area A, described above, except the alignment would continue an additional 8 miles to the proposed treatment plant site. The additional alignment length from the proposed WTP Site Area A to Site Area B is identical to that as previously described for Site Area B under Alternative 1-A.

WTP Site Area C

The proposed Alternative 2-B raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area C is identical to that of Site Area A, described above, except the alignment would continue an additional 7 miles to the proposed treatment plant site. The additional alignment length from the proposed WTP Site Area A to Site Area C is identical to that as previously described for Site Area C under Alternative 1-A.

3.2.2.4. WATER TREATMENT PLANT

City of Albemarle's Existing US 52 WTP and Narrow Reservoir (Badin Lake) Raw Water Intake

The City of Albemarle's US-52 Water Treatment Plant is located at the intersection of US Highway 52 and Bethany Road. Construction began on this facility in the late 1940's. In the early 1960's the facility was expanded from four to eight filters. In the early 1970's the front concrete clear well was added. This facility has a permitted capacity of 10 mgd. There is a raw water reservoir located at the facility, which can store approximately 25 million gallons for treatment. A pump station located at the end of Pumphouse Road pumps the raw water from Narrows Reservoir (Badin Lake) to the plant for treatment. The facility has three potable water storage concrete clear wells with a total volume of 4.5 million gallons. There is an elevated tank located at the facility, which can hold 200,000 gallons. There are 12 pumps of various sizes, which pump the potable water into the distribution system.

Based on the current capacity of this existing treatment plant and the significant expansion and capacity increase that would be required to supply Union County with finished water as part of the Yadkin River Water Supply Project, it is impractical to for Union County to purchase finished water from the City of Albemarle's US-52 Water Treatment Plant. For Alternative 2B, Union County is instead evaluating the potential for transmission of raw water directly from Narrows Reservoir (Badin Lake) to a new water treatment plant which would be owned and operated by Union County in the northeast portion of Union County.

City of Albemarle's Existing Tuckertown WTP and Tuckertown Reservoir Raw Water Intake

The City of Albemarle's Tuckertown Water Treatment Plant is located near the bridge on Highway 49, which crosses the Tuckertown Reservoir, near the Rowan and Stanly County line. Construction on this facility was completed in 1992. This facility has a permitted capacity of 6 mgd. There is a raw water reservoir located at the facility, which can store approximately 35 million gallons for treatment. A pump station located at the site pumps the raw water from the Tuckertown Reservoir. A potable water ground storage tank with a 4 million gallon capacity is located on site. Due to the elevation of this site all the water produced by Tuckertown flows to Albemarle by gravity and is not pumped.

Based on the current capacity of this existing treatment plant and the significant expansion and capacity increase that would be required to supply Union County with finished water as part of the Yadkin River Water Supply Project, it is impractical to for Union County to purchase finished water from the City of Albemarle's Tuckertown Water Treatment Plant. For Alternative 2B, Union County is instead evaluating the potential for transmission of raw water directly from Tuckertown Reservoir to a new water treatment plant which would be owned and operated by Union County in the northeast portion of Union County.

Proposed Yadkin River Water Treatment Plant

For both Alternative 2A and 2B, Union County proposes to build a new water treatment plant in the northeastern portion of Union County to serve its customers in the Rocky River IBT Basin of the Yadkin River Basin. The proposed water treatment plant siting areas (Proposed Water Treatment Plant Site Areas A, B and C), details and required capacity for Alternatives 2A and 2B are the same as that presented for Alternative 1.

3.2.3. Alternative 3 – Yadkin River Basin, Pee Dee River (Blewett Falls Lake)

3.2.3.1. BACKGROUND

Alternative 3 seeks to evaluate the potential for meeting the needs of Union County's Yadkin River Water Supply Project using Blewett Falls Lake, which is located in the Yadkin River IBT Basin of the Yadkin River Basin, as a surface water supply. Because the Yadkin River Water Supply Project will serve customers in Union County's Yadkin River Basin Service Area (Rocky River IBT Basin), the withdrawal of water from the Yadkin River IBT Basin to serve these customers is considered an interbasin transfer, as the withdrawal and use points are within different IBT basins, as defined in North Carolina General Statute 143-215.22L.

Water transfers made under this alternative, however, may be subject to the Cork Rule Exception which states that water transferred from one basin to another but then returned to the original basin and subsequently transported past the original withdrawal point are not considered transfers except for the volume of water that is consumed through human consumption, irrigation and subsurface disposal via septic systems. North Carolina Administrative Code 15A NCAC 02E. 0401(b) specifically addresses the "Cork Rule", where the following are not considered interbasin transfers:

1. The discharge point is situated upstream of the withdrawal point such that the water discharged will naturally flow past the withdrawal point.
2. The discharge point is situated downstream of the withdrawal point such that water flowing past the withdrawal point will naturally flow past the discharge point.

The Cork Rule Exception would apply to this alternative since water would be withdrawn from the Pee-Dee River, then transported to the Rocky River IBT Basin in Union County, and subsequently discharged back into the Rocky River. These wastewater discharges would emanate from the Monroe WWTP and the Crooked Creek WRF, Tallwood WRF, Grassy Branch WRF and Olde Sycamore WRF, owned and operated by Union County and the County Woods WRF and Hemby Acres WRF which are privately owned and operated facilities that provide wastewater service to areas that receive water services from Union County. The Rocky River discharges back into the Pee Dee River, upstream of the proposed raw water intake on Blewett Falls Lake for this alternative.

An IBT certificate is required for surface water transfers in excess of 2 mgd between defined IBT basins. Prior indication from DENR during the development of the 2011 Eastern Water Supply Feasibility Analysis (HDR, 2011), is that Union County's approved grandfathered IBT amount for transfers from the Yadkin River IBT Basin to the Rocky River IBT Basin (as a result of the existing Union County water supply from Anson County) will likely be 4 mgd. Annual average daily Union County wastewater returns to the Rocky River IBT Basin, which subsequently flows back into the Pee Dee River above Blewett Falls Lake are projected to be 8.8 mgd by the year 2050, while the estimated transfer of finished water from the Yadkin River IBT Basin to the Rocky River IBT Basin is projected to be 23 mgd (max. month daily average basis), for Alternative 3. The resulting IBT, using the Cork Rule Exception, is projected to be 14.2 mgd by the year 2050 (finished water transfer minus wastewater return), thereby exceeding the anticipated grandfathered IBT amount. Given this consideration, an IBT certificate will still be necessary to meet the water demands of the Yadkin River Water Supply Project for this alternative.

Currently, Union County receives approximately 2 mgd of potable water per day (average annual daily basis) from Anson County and has a contract with Anson County to receive up to a total of 4 mgd. However, the initial term of this contract expired in 2012. The contract includes a provision for up to four (4) auto-renewing terms of five (5) years beyond the initial term if no notice is given to the other party. The next renewal is scheduled for 2017. This existing supply is pumped through a 24-inch finished water line to the Anson/Union County line. Until 2009, Union County maintained a 40+ year old water booster pumping station at the County line at US-74 which conveyed 1 mgd through a 12-inch main connected to the County's distribution system within the Rocky River IBT Basin of the Yadkin River Basin, providing water to rural areas and isolated subdivisions, in addition to the Town of Wingate, within the service area. These sub-service areas include New Salem, Wingate, a food processing facility in Marshville, and domestic service along Belk Mill/Camden Road. The Town of Marshville has a separate supply from Anson County for its own system within the town limits.

Infrastructure improvements to the finished water transmission system started in 2009 and included the addition of two booster pumping stations (US-74 Pump Station and Olive Branch Pump Station) and approximately 36,000 feet of 24-inch transmission main. These improvements now allow for the conveyance of up to 4 mgd of finished water from the Anson County WTP. Additional pipeline improvements in Union County and minor modifications to the Olive Branch Pump Station and Highway 74 Pump Station would be required to facilitate the conveyance of any additional flow from the Anson County WTP.

To meet the projected future water demands of Union County in the eastern portion of the county, major improvements to the existing water supply infrastructure between Anson and Union County would be required, beyond those previously identified. Alternative 3 seeks to evaluate the infrastructure requirements needed for Union County to partner with Anson County to obtain additional raw water supply from Blewett Falls Lake to meet the needs of the Yadkin River Water Supply Project. Infrastructure improvements needed for this alternative include raw water intake expansion and additional raw water pumping capacity at Blewett Falls Lake, construction of a new water treatment plant in northeastern or eastern Union County, construction of a new raw water transmission main from Blewett Falls Lake to the proposed water treatment plant site and additional finished water conveyance infrastructure in Union County.

3.2.3.2. RAW WATER INTAKE AND PUMP STATION

The existing Anson County WTP has two raw water intakes in Blewett Falls Lake, including one primary intake and a recently constructed emergency intake. Blewett Falls Lake is formed by the dam at Duke Energy's Blewett Falls Hydroelectric Plant on the Pee Dee River. The Blewett Falls Hydroelectric Development is located in Richmond and Anson counties, downstream of Lake Tillery, approximately six miles west of Rockingham, North Carolina. The Blewett Falls Dam is located approximately 17 miles north of the North Carolina / South Carolina state line. The Blewett Falls impoundment, also known as Blewett Falls Lake, extends approximately 11 miles upstream from the dam. Construction of the Blewett Falls Development began in 1905 and was completed in June 1912. Blewett Falls Lake has a reservoir surface area of 2,866 acres at a normal pool elevation of 178.1' msl and a usable storage capacity of 30,893 acre-feet. The Blewett Falls development is licensed for a drawdown of 17 feet, but generally operates with drawdowns of 2 to 4 feet (Duke Energy, 2014).

Anson County's primary intake and raw water pumping station (Normal RWPS) were constructed with the original water treatment plant in 1967. The existing intake has a weir elevation at 166' msl and the bottom of the existing raw water pumping station is set at 161' msl. Located along the shoreline, water from the lake discharges over the weir and into the wetwell of the Normal RWPS. The Normal RWPS has a firm pumping capacity of 16 mgd and includes one 8 mgd pump, two 6 mgd pumps, and one 4 mgd pump. Each of these pumps are vertical turbine pumps. Flow is discharged through a 24-inch main to the existing rapid mix facilities at the Anson County Water Treatment Plant (WTP). There is an elevation difference of approximately 350-feet between the Normal RWPS and WTP.

Anson County recently completed construction of a new emergency intake in Blewett Falls Lake along with an Emergency RWPS and transmission main. The emergency intake is located in a deeper portion of the lake and includes a single Hendrick tee screen, 42-inches in diameter and 146-inches long with a capacity of 19 mgd based on a maximum approach velocity of 0.5 fps across the screen. The screen is located approximately 3,100 feet offshore and is connected to a 36-inch HDPE intake line that is tied to the new Emergency RWPS located at the shore. The Emergency RWPS consists of two horizontal split case submersible pumps, each with a capacity of 16 mgd. These pumps discharge to a 24-inch transmission main that discharges to the wetwell of the Normal RWPS. From this point, a new 30-inch raw water transmission has been constructed parallel to the existing 24-inch raw water transmission main and both lines run to the WTP. These two pumping stations have been designed to operate in series to limit the head on the horizontal split case pumps in the Emergency RWPS. A centrifugal pump design with series pumping was selected to limit construction cost since this intake is for emergencies and when the lake level is lowered to perform routine maintenance.

This emergency intake was constructed due to a FERC requirement that mandates that Duke Energy Progress lower the lake elevation to 167' msl annually to refurbish the splash boards at the dam. Lowering the lake to 167' msl would impair Anson County's ability to withdrawal raw water using its current intake during these repair periods. These improvements received an expedited FERC approval because they were permitted as emergency facilities. This project received a nationwide permit from the US Army Corps of Engineers and the NEPA/SEPA process was followed to receive American Recovery and Reinvestment Act (ARRA) funding for the project. The project received a Categorical Exclusion for Secondary and Cumulative Impacts.

Implementation of this alternative to meet the needs of the Yadkin River Water Supply Project would require significant improvements to the existing raw water conveyance facilities, if Union County were to partner with Anson County for additional water supply. The existing Normal RWPS is approximately 40 years old and is inadequate to meet the long-term water supply needs. The design of the intake does not provide for a guaranteed supply when Duke Energy Progress needs to conduct annual maintenance or if long-term drought conditions prevail. This structure is relatively small and there are only four pump slots with a small wet well beneath the pumps.

The Emergency RWPS has been designed for limited use and requires series pumping with the existing Normal RWPS. To meet long-term water supply needs, a new RWPS would need to be constructed that would include a submerged wetwell and vertical turbine pumps. This can be constructed adjacent to the recently constructed Emergency RWPS. Under this scenario, it is recommended that the emergency intake be converted to a permanent intake. The existing 36-inch intake line with a larger tee screen could provide a raw water supply capability of about 27 mgd. This would be inadequate to meet the combined Union County needs (~28 mgd of raw water) and the projected 2050 Anson County needs (~12 of raw water mgd) as derived from their 2014 NC Local Water Supply Plan. However, it should be noted that approximately 10 mgd of this requirement is based on projected sales with existing wholesale customers and future wholesales. Anson County's projected finished water demand through 2050 is a modest 2 mgd, while projected wholesales are 9.8 mgd. Anson County could maintain their existing intake and Normal RWPS to increase the withdrawal capability to approximately 43 mgd (16 mgd + 27 mgd) but careful coordination would be needed with Duke Energy Progress to assure that their maintenance activities did not occur during peak demand periods. This would also provide less reliability during drought conditions.

Based on the existing conditions and limitations of Anson County's existing raw water intake facilities, it is proposed under Alternative 3 to construct a new raw water pumping station adjacent to the existing Anson County Emergency Intake and Pumping Station property at Blewett Falls Lake. A new intake and pumping station would be needed because the existing Anson County facilities do not have sufficient capacity to serve Union County's projected future water supply needs. The new intake and pumping station under this alternative would be sized for the final phase (Phase 3) of expansion to meet projected 2050 maximum daily water demands of 28 mgd. Conceptual design for the facility indicates a 42-inch diameter intake line with a 60-inch diameter screen would be needed to meet this demand. Under this alternative, the pump station facility would need to include four raw water pumps within a dedicated pump room and an adjacent electrical room.

3.2.3.3. RAW WATER TRANSMISSION MAIN

Existing Anson County Transmission Main into Union County

Anson County's high service pumping station (HSPS) conveys potable water through approximately 45,000 linear feet of 24-inch water main along US-74 to a 1 MG elevated water storage tank in Wadesboro. The capacity is limited both by the HSPS and the 24-inch transmission main. Anson County had previously planned to parallel the existing 24-inch main with a second 24-inch main to provide additional system reliability. However, this system improvement has not been constructed and there are no current plans to do so. From the Wadesboro tank, potable water is conveyed by gravity approximately 72,000 linear feet through 12- and 24-inch transmission mains to the Union County Highway 74 Booster Pump Station at the County line. While the two transmission mains are sized to deliver approximately 12.5 mgd, based on a maximum velocity of 5 feet per second, the current capacity to Union County is limited to less than 4 mgd due to Anson County's prior commitments to other utilities, lack of system redundancies and pressure limitations.

As a result of these limitations, and the associated costs and impacts required to upgrade existing Anson County water transmission and treatment infrastructure, this alternative proposes to install a new raw water transmission main from the Anson County raw water intake on Blewett Falls Lake through Anson County and into Union County to the site of a proposed new Union County water treatment facility. Two options for the proposed transmission main route are considered for this alternative. One proposed route (Alternative 3A) parallels gas and power line easements in Anson County, while a second proposed route (Alternative 3B) parallels existing roadways to minimize easements. The proposed routes are reflected as Alternative 3A and 3B on Figure 2-3. The detailed study corridor for these proposed routes are also reflected in Figure 3-1b.

Alternative 3A - US- 74 to Gas/Power Line Easement into Northeast Union County near New Salem

Similar to other alternatives, conceptual raw water transmission design indicates the need for parallel 36-inch diameter ductile iron pipe for Alternative 3A to provide necessary redundancy and meet the Union County's 2050 water demands. This proposed alignment extends approximately 29 miles from the raw water pump station on Blewett Falls Lake to the proposed Site Area A for the Yadkin River Water Treatment Plant. For the proposed WTP Site Areas B and C, the alignment extends an additional 8 and 7 miles, respectively. The proposed route for Alternative 3A would seek to utilize existing gas and power line easements in Anson County to minimize disturbances to private property and major traffic corridors.

WTP Site Area A

The proposed route for Union County's raw water transmission main to the proposed Site Area A for the Yadkin River Water Treatment Plant would begin in Anson County at the proposed Raw Water Pump Station and site of the existing Anson County raw water intake on the shores of Blewett Falls Lake at the end of Filtration Plant Road, northeast of Lilesville. The line would extend westward along Filtration Plant Road and then briefly travel southward along Clark

Mountain Road, where it would turn westward onto a Duke Energy Progress power line easement and adjacent gas line easement. The line would continue to follow these easements in a northwest direction through Anson County, crossing NC-109, US-52, and NC-742 near the northeastern corner of Union County. At Pine Log Road, the proposed alignment turns westward and cross overland, crossing Blonnie Ross Road to Fish Road, where it then continues westward along Fish Road. The proposed alignment continues along Fish Road towards New Salem. Just north of the intersection of NC-205 and NC-218 in New Salem, the main would briefly travel overland to NC 205 and Old Kennedy Ford Road to the proposed Site Area A for the Yadkin River Water Treatment Plant.

Through correspondence with Duke Energy, they have indicated that their corporate transmission line crossing guidelines do not allow water transmission lines to be run within electric transmission line rights-of-way at angles greater than 30 degrees from the perpendicular line to the electric transmission right-of-way. As such, this alternative, which proposes to run the raw water transmission main parallel to the utility easement for an extended length, would not possible, unless it is run adjacent to the utility easement on privately owned property outside the easement boundary.

WTP Site Area B

The proposed Alternative 3-A raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area B is identical to that of Site Area A, described above, except the proposed alignment continues southward along Fish Road to NC-218 at New Salem. The additional alignment length from this point to Site Area B is identical to that as previously described for Site Area B under Alternative 1-A, and is approximately an additional 8 miles, as compared to the alignment to Site Area A for Alternative 3-A.

WTP Site Area C

The proposed Alternative 3-A raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area C is identical to that of Site Area A, described above except the proposed alignment continues southward along Fish Road to NC-218 at New Salem. The proposed alignment turns westward onto NC-218 and immediately turns south onto NC-205. The additional alignment length from this point to Site Area C is identical to that as previously described for Site Area C under Alternative 1-A, and is approximately an additional 7 miles, as compared to the alignment to Site Area A for Alternative 3-A.

Alternative 3B - US-74 to East Union County near Marshville

Similar to other alternatives, conceptual raw water transmission design indicates the need for parallel 36-inch diameter ductile iron pipe for Alternative 3B to provide necessary redundancy and meet Union County's 2050 water demands. This proposed alignment extends approximately 30 miles from the raw water pump station on Blewett Falls Lake to the proposed Site Area D for the Yadkin River Water Treatment Plant. The proposed route for Alternative 3B would follow the existing Anson County WTP to Union County finished water distribution line along US-74. It should be noted that this proposed route would follow a heavily traveled traffic corridor and travel through several heavily populated areas (particularly Wadesboro) and would likely impact many adjoining properties and businesses along this corridor.

WTP Site Area D

The proposed route for Union County's raw water transmission main to the proposed Site Area D for the Yadkin River Water Treatment Plant would begin in Anson County at the proposed Raw Water Pump Station and site of the existing Anson County raw water intake on the shores of Blewett Falls Lake at the end of Filtration Plant Road, northeast of Lilesville and would follow the general route of the existing finished water line currently used by Anson County to supply Union County and Marshville with water. The proposed Union County raw water line would extend westward along Filtration Plant Road and then travel southward along Clark Mountain Road to the intersection with Vintage Road. At this intersection, the line would travel west along Vintage Road to Hailey's Ferry Road, where it would briefly travel southward to meet US-74. The line would turn west at the intersection of Hailey's Ferry Road with US-74 and then follow US-74 west in Anson County through Lilesville, Wadesboro, Polkton, and Peachland, into eastern Union County. This line would briefly continue west on US-74 in Union County and then turn south at Marshville Water Plant Road. The line would follow Marshville Water Plant Road to Hasty Road. At this intersection, the line would travel west along Hasty Road to the proposed Site Area D for the Yadkin River Water Treatment Plant, located just southeast of Marshville.

3.2.3.4. WATER TREATMENT PLANT

Existing Anson County Water Treatment Plant

The Anson County WTP was originally constructed in 1967 with a treatment capacity of 8 mgd. The original plant consisted of rapid mix facilities, two flocculators, four conventional sedimentation basins, eight dual media anthracite/sand gravity filters, a 0.5 million gallon (MG) finished water clearwell, and assorted chemical feed facilities. Additional clearwell capacity (0.5 MG) was added in 1976. The plant was expanded to a 16 mgd facility in 1992-1993 by adding two Superpulsators® (flocculation/sedimentation) and eight additional filters. Chemical feed capabilities at the plant include alum, fluoride, polymer, lime, caustic, powdered activated carbon, hypochlorite, and orthophosphate. The plant also includes an office, SCADA system, and a small laboratory.

Potable water generated at the plant is conveyed via finished water pumps at the plant approximately 3 miles through a 24-inch transmission main to a ground level storage tank. The Finished Water Pump Station contains three 8 mgd pumps. The ground level storage tank provides gravity supply to Richmond County and provides suction to a High Service Pump Station (HSPS) that conveys potable water to customers in Anson County. The HSPS contains three 6 mgd pumps for a firm capacity of 12 mgd, with the largest pump out of service.

Based on previous projections, the estimated 2050 peak day demand is 40 mgd (28 mgd Union County plus 12 mgd Anson County (including wholesales). With the current capacity of the Anson WTP set at 16 mgd, an additional treatment capacity of 24 mgd would be needed to meet peak day demands. Satisfying the Union County demands, as well as the demands of Anson County and its other wholesale customers would clearly require a major expansion of the existing Anson County Water Treatment Plant. Such an expansion would be very challenging to accomplish given site constraints at the plant and the need to maintain plant operations during construction. The current site is limited, as the plant is built on a knoll with the surrounding topography dropping off significantly outside the current plant boundaries. A more viable approach would be to maximize the capacity of the current plant through process rerating prior to constructing new facilities to achieve the balance of the capacity required and to allow for future expansion capability. However, it is unlikely such a partnership between Union County and Anson County could be established, as previous discussions and negotiations on the topic have been unsuccessful.

Alternative 3A - Proposed Yadkin River Water Treatment Plant in Northern Union County

Due to the challenges and impracticality in expanding the existing Anson County Water Treatment Plant to provide additional capacity to Union County, Union County proposes to build a new water treatment plant within Union County to serve its customers in the Rocky River IBT Basin of the Yadkin River Basin. For the raw water transmission main route of Alternative 3A, the proposed water treatment plant location for this alternative would be located in the northeastern quadrant of Union County. The three potential treatment plant site are the same as those presented for Alternative 1 (Proposed Water Treatment Plant Site Areas A, B and C).

Alternative 3B - Proposed Yadkin River Water Treatment Plant in Eastern Union County

For the raw water transmission main route of Alternative 3B, the proposed water treatment plant location for this alternative would be located in the eastern portion of Union County, just south of Marshville and US-74. Based on the recommendations of the 2011 EWS Feasibility Analysis, a proposed water treatment plant site was identified in the eastern portion of the county south of Marshville.

For purposes of evaluation of Alternative 3B, a potential water treatment plant location (Proposed Water Treatment Plant Site Area D) is located just south of US-74 in the proximity of Hasty Road near the intersection with Landsford Road. This proposed site area consists primarily of forested land and a small amount of agricultural cropland. Based on the 2011 EWS Feasibility Analysis, the maximum site elevation for this area was identified as 530-feet msl. It is proposed that this site area would include similar treatment capacity, technology and infrastructure as those proposed in Alternative 1.

3.2.4. Alternative 4 – Yadkin River Basin (Pee Dee River)

3.2.4.1. BACKGROUND

Alternative 4 seeks to evaluate the potential for meeting the needs of Union County's Yadkin River Water Supply Project using the Pee Dee River, as a surface water supply. This alternative proposes the installation of a new raw water intake located just downstream of the confluence of the Rocky River with the Pee Dee River, south of Lake Tillery. Because the Yadkin River Water Supply Project will serve customers in Union County's Yadkin River Basin Service Area (Rocky River IBT Basin), the withdrawal of water from the Pee Dee River (within the Yadkin River IBT Basin) to serve these customers is considered an interbasin transfer (IBT), as the withdrawal and use points are within different IBT basins, as defined in North Carolina General Statute 143-215.22L. Water transfers made under this alternative, however, may be subject to the Cork Rule Exception, as the Rocky River discharges back into the Pee Dee River, just upstream of the proposed raw water intake location for this alternative. North Carolina Administrative Code 15A NCAC 02E. 0401(b) specifically addresses the “Cork Rule”, where the following are not considered interbasin transfers:

1. The discharge point is situated upstream of the withdrawal point such that the water discharged will naturally flow past the withdrawal point.
2. The discharge point is situated downstream of the withdrawal point such that water flowing past the withdrawal point will naturally flow past the discharge point.

An IBT certificate is required for surface water transfers in excess of 2 mgd between defined IBT basins. Annual average daily Union County wastewater returns to the Rocky River IBT Basin are projected to be 8.8 mgd by the year 2050. The estimated transfer of finished water from the Yadkin River IBT Basin to the Rocky River IBT Basin is projected to be 23 mgd (max. month daily average basis), for Alternative 3. The resulting IBT, using the Cork Rule Exception, is projected to be 14.2 mgd by the year 2050 (finished water transfer minus wastewater return), thereby exceeding the anticipated grandfathered IBT amount. Given this consideration, an IBT certificate will still be necessary to meet the water demands of the Yadkin River Water Supply Project for this alternative.

The Pee Dee River downstream of the confluence with the Rocky River is a Class WS-V, B, water resource, as classified by DENR, which classifies each water body in the state according to its uses. WS classified waters are used for aquatic life propagation; survival, and maintenance of biological integrity (including fishing and fish); wildlife; secondary contact recreation; and agriculture as well as a source of water supply for drinking, culinary, or food-processing purposes. DENR has five water supply classifications ((WS-I, WS-II, WS-III and WS-IV) with four classifications for use as public potable water supplies (WS-I, WS-II, WS-III and WS-IV) dependent on the types of discharges and amount of development within the watershed. WS-I water supplies are designated for those watersheds with maximum protection for water supplies and are located within natural and undeveloped watersheds, and WS-IV watersheds are used as sources of water supply where a WS-I, WS-II or WS-III classification is not feasible and are generally in moderately to highly developed watersheds. WS-V watersheds are protected as water supplies which are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or waters formerly used for public water supply. Class WS-V waters are not allowed for use as a new public water supply source. The Pee Dee River at the confluence with the Rocky River is classified as WS-V water and drains to the Class WS-IV water of the Pee Dee River just upstream of Blewett Falls Lake. Thus, reclassification of this water body would be required for the proposed intake location of Alternative 4, to allow the use of these waters for public water supply.

3.2.4.2. RAW WATER INTAKE AND PUMP STATION

The proposed raw water intake for this alternative would be located along the Pee Dee River, approximately ½ mile downstream of the Rocky River confluence with the Pee Dee River, near the Anson-Richmond-Montgomery County line. The proposed intake and raw water pump station would be located in Anson County, approximately 3 miles northeast of Ansonville, with a raw water transmission line extending through Anson County and into northeastern Union

County to the proposed site of a new water treatment plant. Union County would have to develop a partnership for Anson County to secure any property or easements needed for the raw water intake, pump station and transmission main located within Anson County, on Union County's behalf.

The Pee Dee River is approximately 500 to 550 feet wide (as estimated from aerial imagery and GIS mapping) at the proposed intake location. Land surrounding the river at the proposed intake location is primarily agricultural cropland or pasture land and forested areas. The northern boundary of the Pee-Dee National Wildlife Refuge is located approximately 1 ½ miles south of the proposed intake and pump station. The river depth at this location fluctuates on a daily basis, in response to upstream releases by Duke Energy Progress from Lake Tillery. There are two U.S. Geological Survey (USGS) stream gages on the Pee Dee River in the general vicinity of the proposed intake for Alternative 4. Period of record historical data from March, 2009 to June, 2015 at USGS station 0212378405 (Pee Dee River at Highway 731 below Lake Tillery near Norwood, NC), located approximately five miles upstream of the proposed Alternative 4 intake location, indicates an average maximum daily depth of 8 feet, average minimum daily depth of 3.3 feet and average mean daily depth of 4.9 feet. Similarly, period of record historical data from August, 2011 to June, 2015 at USGS station 02126375 (Pee Dee River at the Pee Dee Refuge near Ansonville, NC), located approximately four miles downstream of the proposed Alternative 4 intake location, indicates an average maximum daily depth of 10.3 feet and average minimum daily depth of 4.6 feet (mean gage data not available).

USGS stream level gaging station 02126375 (Yadkin-Pee Dee River at the Pee Dee National Wildlife Refuge near Ansonville) most closely approximates the conditions upstream at the proposed Alternative 4 intake site. The gaging station is currently active and has recorded historical data dating back to August 5, 2011. The station is relatively new and does not have historical data from past low flow (drought) periods. The station has coordinates of Latitude 35°06'11.58", Longitude 80°02'45.36" (NAD83) and a drainage area of 6,134 square miles. The gage datum is 175.63 feet above NAVD88. For the period of record (August, 2011 to June, 2014), the approximate mean gage height was seven feet. Illustration 3-5 shows the historical period of record data for this gaging station. Based on these nearby upstream and downstream gages, the average river depth at the proposed intake location of Alternative 4 is estimated to be between 4 and 10 feet, fluctuating each day in response to discharges from Lake Tillery.

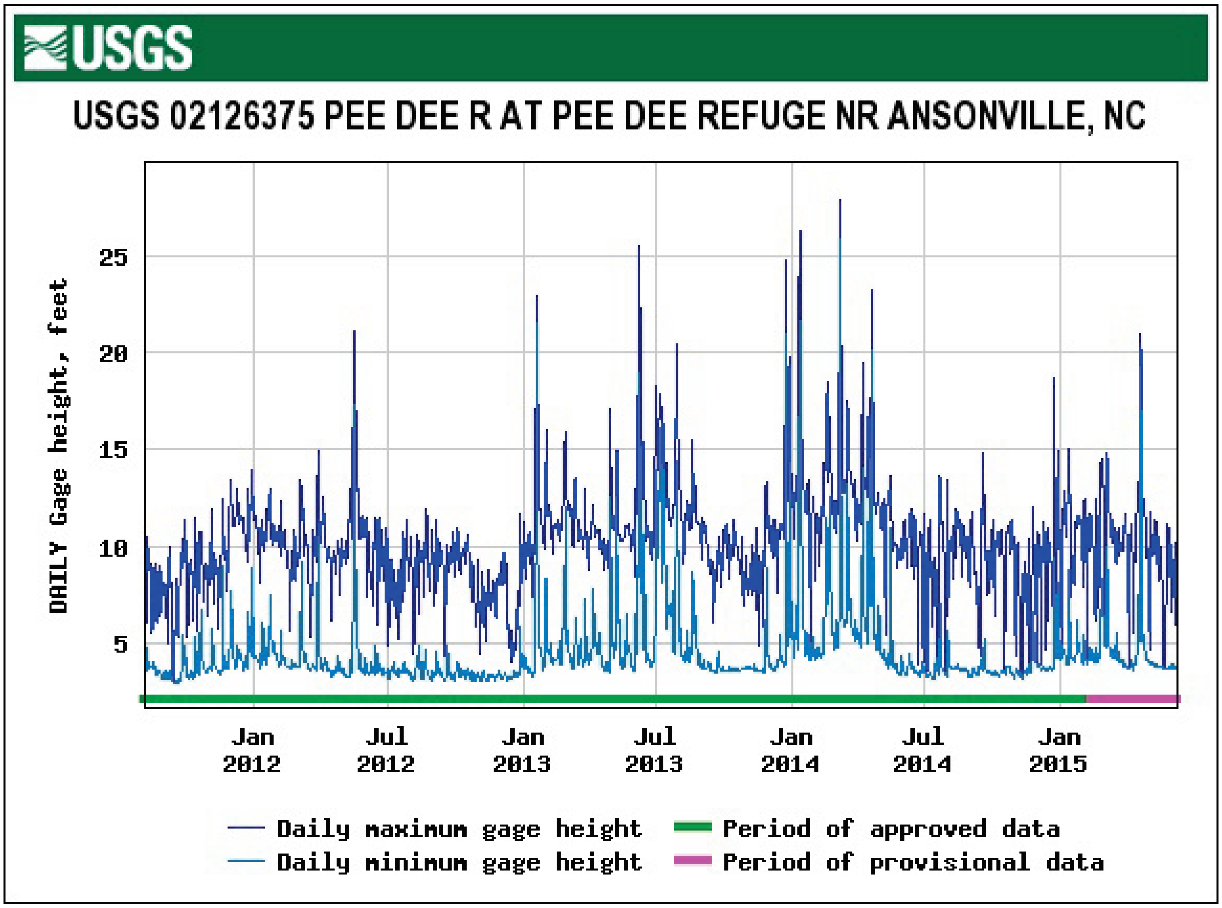

Illustration 3-5 USGS Gage Height Data Downstream of Proposed Alternative 4 Intake Location

Two potential options for a raw water intake are proposed for this location under Alternative 4. Option A would consist of a traditional raw water intake and pumping station, with the pumping station located outside of the 100-year floodplain. The intake and pumping station of Option A must be sized for the final phase (Phase 3) of expansion to meet projected 2050 maximum daily water demands of 28 mgd. Conceptual design for the facility indicates a 42-inch diameter intake line with two 36-inch diameter screens would be needed to meet this demand. Under this option, the pump station facility will need to include four raw water pumps within a dedicated pump room and an adjacent electrical room.

Option B would consist of three Ranney collector wells and pumping stations within each well built vertically above the 100-year flood plain elevation. Under this option, a Ranney collection well is proposed to be built for each phase of expansion (three total phases) and sized to meet the demand of that phase (12, 20 and 28 mgd maximum daily demand for Phases 1, 2 and 3, respectively). Two raw water pumps are proposed to be installed with each collector well structure, for a total of six pumps installed in the three collector wells. The lateral collectors for each structure must be sized based on the results of a hydrogeological study which would be required during detailed facility design.

If a new intake and pump station were to be constructed on the main stem of the Pee Dee River, they would need to be designed to operate within a wide range of river levels, which is typical of “run-of-river” raw water intakes. Subsequently, the design for this type of facility differs from those on reservoirs. The intake facility must also be designed to prevent the pumps from being damaged by debris and sediment in the river that can enter the pump station. Additionally, protective measures would be needed to prevent fish entrainment. The pump station structure would need to be sized to add future pumps to avoid the construction of a second facility. Furthermore, the raw water pump station needs to be designed so that it operates during a 100 year flood event. The proposed raw water pipeline would need to be designed to carry raw water from the pump station at the river to a pre-treatment settling (terminal) reservoir at the water treatment plant. Requirement for this terminal reservoir are further discussed in the water treatment plant requirements outlined in Section 3.2.4.4.

3.2.4.3. RAW WATER TRANSMISSION MAIN

Similar to other alternatives, conceptual raw water transmission design indicates the need for parallel 36-inch diameter ductile iron pipe for Alternative 4 to provide necessary redundancy and meet Union County’s 2050 water demands. This proposed alignment will extend approximately 21 miles through Anson County from a new raw water intake and pump station on the Pee Dee River to the proposed Site Area A for the Yadkin River Water Treatment Plant. For the proposed WTP Site Areas B and C, the alignment extends an additional 8 and 7 miles, respectively. The proposed route is reflected as Alternative 4 on Figure 2-3. The detailed study corridor for this proposed route is also reflected in Figure 3-1b.

WTP Site Area A

The proposed route for the this raw water transmission main to the proposed Site Area A for the Yadkin River Water Treatment Plant would begin in Anson County at the proposed raw water pump station located on the Pee Dee River, approximately ½ mile downstream of the confluence of the Rocky River with the Pee Dee River. The line would extend westward to Pinkston River Road where it would then travel southward along Pinkston River Road to Dunlap Road. The line would travel westward along Dunlap Road to US-52 and then travel southward along US- 52 towards Ansonville. The proposed alignment turns west along Fries Boulevard and briefly travels overland before reconnecting with Fries Boulevard. At the intersection with Plank Road, the proposed alignment turns northward and travels along Plank Road to the intersection of Randall Road. At this intersection, the line would travel northwestward along Randall Road which eventually becomes Rocky Mount Church Road. The line would turn westward and travel along Burnsville Church Road to NC -742 and then travel northward along NC -742 to Pine Logging Road, where it would turn westward. The proposed alignment follows Pine Logging Road and then crosses overland to Fish and travels westward along Fish Road. Just north of the intersection of NC-205 and NC-218 in New Salem, the line would cross overland to NC-205 and Old Kennedy Ford Road to the proposed Site Area A for the Yadkin River Water Treatment Plant.

WTP Site Area B

The proposed Alternative 4 raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area B is identical to that of Site Area A, described above, except the proposed alignment continues southward along Fish Road to NC-218 at New Salem. The additional alignment length from this point to Site Area B is identical to that as previously described for Site Area B under Alternative 1-A, and is approximately an additional 8 miles, as compared to the alignment to Site Area A for Alternative 4.

WTP Site Area C

The proposed Alternative 4 raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area C is identical to that of Site Area A, described above except the proposed alignment continues southward along Fish Road to NC-218 at New Salem. The alignment would turn westward onto NC-218 and immediately turn south onto NC-205. The additional alignment length from this point to Site Area C is identical to that as previously described for Site Area C under Alternative 1-A, and is approximately an additional 7 miles, as compared to the alignment to Site Area A for Alternative 4.

3.2.4.4. WATER TREATMENT PLANT

For this alternative, Union County proposes to build a new water treatment plant in the northeastern portion of Union County to serve its customers in the Rocky River IBT Basin of the Yadkin- River Basin. The proposed water treatment plant siting areas (Proposed Water Treatment Plant Site Areas A, B and C), details and required capacity for Alternative 4 are the same as that presented for Alternative 1. However, Alternative 4 will also require the construction of a pre-treatment settling (terminal) reservoir for raw water storage for this riverine water source.

Historically, the DENR Public Water Supply Section has recommended that five days of off-stream storage is prudent for any run-of-river intake and further recommends that the off-stream storage reservoir be lined. Intakes in regulated reservoirs typically do not require such a terminal reservoir at the water treatment plant. However, up to thirty days of off-stream storage can sometimes be required for run-of-river intakes, based on detailed hydrologic conditions analysis. Therefore, such intakes typically require a significantly larger land area at the water treatment plant to accommodate this additional feature. Additional property would have to be acquired for Alternative 4, so this terminal reservoir could be constructed to store and polish raw water being pulled from this riverine source. Given the reservoir control along the Pee Dee River from the Lake Tillery regulated discharge and reservoir sizes required for other similar regulated run-of-river intakes, it is estimated that 20 days of water storage (maximum daily demand) would likely be needed, at a minimum. Based on 30 foot depth and considering changes in depth and dimensions of the terminal reservoir, the minimum estimated reservoir footprint for Alternative 4 is 60 acres.

3.2.5. Alternative 5 - Yadkin River Basin (Rocky River)

3.2.5.1. BACKGROUND

Alternative 5 seeks to evaluate the potential for meeting the needs of Union County's Yadkin River Water Supply Project using the Rocky River as a surface water supply. Because the Yadkin River Water Supply Project will serve customers in Union County's Rocky River IBT Basin service area, the withdrawal of water from the Rocky River to serve these customers would not be considered an interbasin transfer (IBT), as the withdrawal, consumption and return points are within the same IBT basin, as defined in North Carolina General Statute 143-215.22L.

The Rocky River is currently not classified for water supply by the State of North Carolina because no use as a source of water supply for drinking, culinary, or food-processing purposes has been designated for this river. A Rocky River Water Supply Feasibility Study was prepared for Union County by CH2MHill in September of 2004. The purpose of this study was to 1) investigate the feasibility, quantity, and cost of developing the Rocky River as a water supply source for Union County from an engineering and technology standpoint and 2) identify the permitting and regulatory requirements necessary to re-classify the Rocky River as a municipal water source and construction of a new water treatment plant and supporting infrastructure. Due to growth in the Rocky River IBT Basin and IBTs in the upper reaches of this river basin, the base flow in the river is also increasing as a result of increased wastewater discharge, which may create a potential water supply source for the lower portions of the river (CH2MHill, 2004).

The Rocky River is currently a Class C water resource and would need to be re-classified to Water Supply (WS) status before being utilized as a municipal water source. DENR classifies each water body in the state according to its uses. The Rocky River is currently classified as Class C waters, which means it is used for aquatic life propagation; survival, and maintenance of biological integrity (including fishing and fish); wildlife; secondary contact recreation; and agriculture. WS waters are protected for all Class C uses plus as a source of water supply for drinking, culinary, or food-processing purposes. DENR has five water supply classifications with four classifications for use as public potable water supplies dependent on the amount of development and types of discharges within the watershed. WS-I water supplies are located within natural, undeveloped watersheds, and WS-IV watersheds would have the greatest amount of development. WS-V watersheds are protected as water supplies which are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or waters formerly used for public water supply. Given the development in the Rocky River headwaters and the presence of the major wastewater treatment plants in the watershed, it is likely that the Rocky River would be classified as a WS-IV watershed (CH2MHill, 2004); however, DENR would need to make a formal recommendation to the EMC and the EMC would, in-turn, make the final determination. Major steps needed to reclassify the Rocky River include:

1) Union County requesting DENR to reclassify the Rocky River
2) DENR performing instream sampling and reviewing watershed characteristics to determine potential water supply classification
3) DENR seeking permission from the NC Environmental Management Commission (EMC) to process the reclassification
4) DENR leading the reclassification process
5) Local governments in the watershed developing water supply protection ordinances for the Rocky River, including buffer requirements.

The amount of water available for withdrawal is dependent on 1) natural hydrologic variability, 2) environmental regulatory requirements, 3) planned withdrawals and discharges in the watershed, and 4) physical design constraints for a run of river intake. The regulatory requirements for reclassifying the Rocky River to a water supply must be considered, as well as the potential water supply available for withdrawal during low flow conditions along the northeastern end of Union County. As the Rocky River is very wide and shallow, it would likely require a low profile dam for reliable operation of a water supply intake, making this alternative subject to scrutiny for impoundment considerations, as well as potential impacts to the endangered Carolina Heelsplitter mussel habitat in tributaries of the Rocky River. The mussel larvae attach to a fish host, and thus it is important to ensure that any habitat alteration that would occur with construction of the dam would not impact the fish host (CH2MHill, 2004). As such, other raw water intake options, such as Ranney Collector Wells could be considered. However, the yield of such alternate intake options is currently unknown.

The Rocky River is located in the Piedmont Physiographic Province in South Central North Carolina. The River begins near the Town of Mooresville in Iredell County, and flows approximately 91 miles through Iredell, Cabarrus, Mecklenburg, Union, Stanly and Anson Counties to the confluence of the Pee Dee River. At its confluence with the Pee Dee, the Rocky River drains 1,413 square miles. Major tributaries to the Rocky River include: Clarke Creek, Mallard Creek, Coddle Creek, Irish Buffalo Creek, Dutch Buffalo Creek, Goose Creek, Long Creek, Richardson Creek, and Lanes Creek (CH2MHill, 2004).

3.2.5.2. RAW WATER INTAKE AND PUMP STATION

The 2004 CH2MHill Feasibility Study indicated the proposed intake should be located adjacent to the NC Highway 205 bridge crossing over the Rocky River. The drainage area at this location is approximately 744 square miles. Based on USGS low flow estimates at Stanfield, the natural 7Q10 flow is estimated as 23 cfs or 14.8 mgd. The Study indicated that the major tributary between Stanfield and NC Highway 205 is Crooked Creek, with an estimated 7Q10 flow of 0 cfs. 7Q10 is the seven-day, consecutive low flow, with a ten year return frequency. It is the lowest stream flow for seven consecutive days that would be expected to occur once in ten years. Additionally, the Study estimated that some of the wastewater discharged within the Rocky River Subbasin upstream would be available at the proposed surface water intake.

The Study assumed that flows from future flows from the Water and Sewer Authority of Cabarrus County (WSACC) Rocky River Regional Wastewater Treatment Plant would readily be available for withdrawal under low flow conditions, and estimated that approximately 21 mgd of flow would be available for surface water withdrawal at NC Highway 205 in excess of the natural 7Q10 in 2020, 26 mgd in 2030 and 38 mgd in 2050. However, projections for future wastewater flow from the WSACC that could be available for downstream water supply were based upon Black & Veatch's 2002 Water and Wastewater Master Plan for WSACC (CH2MHill, 2004). Actual population growth experienced for WSACC's service area through 2010 was approximately 15% lower than the projected growth, per NC Division of Water Resources Local Water Supply Plans. As such, it is approximated that only 18 mgd, 22 mgd and 32 mgd of flow in excess of the natural 7Q10 may be available for water supply in 2020, 2030 and 2050, respectively. This potential available supply is inherently dependent upon future service area growth for WSACC and increasing wastewater discharges into the Rocky River, upstream of a proposed Union County raw water intake.

However, the SEPA minimum criteria threshold for consideration of a site-specific field study to establish flow requirements downstream of a public water supply intake is 20 percent of the 7Q10. Based on the estimated 7Q10 value presented above of 23 cfs, or 14.8 mgd, any withdrawal that exceeds 4.6 cfs, or 2.9 mgd, would require additional scrutiny. Therefore, projecting stream flows available for off-stream public water supply use based on the increase of wastewater discharges associated with growth should be done cautiously given the number of uncertainties, such as the accuracy of growth projections, assimilative capacity, and in-stream flow requirements.

As a future water supply from the Rocky River is highly contingent upon factors outside of Union County's direct control (i.e. future wastewater flows from another upstream regional utility), this alternative does not lend itself to providing Union County with a reliable surface water source in which to meet the needs of its current and future customers in the Rocky River IBT Basin of the Yadkin River Basin.

The Rocky River, in the vicinity of the proposed intake location near Highway 205, is several hundred feet wide and shallow, which is typical of the river in the northeastern end of Union County. The 2004 Study suggested that a low profile dam may be needed across the Rocky River to ensure adequate depth in the river at the proposed water supply intake. A "V" notched weir would also be needed in the intake structure to maintain the natural 7Q10 flows in the river during low flow conditions.

On May 17, 2000, DENR performed a time-of-travel (TOT) study on the Rocky River. As part of this study, flow and cross-sections were measured at various locations along the river. At NC Highway 205, the flow was 147 cfs, and the average depth across the river was approximately one foot. A similar study was completed in March 2000, during which the flow at NC Highway 205 was 304 cfs, and the average depth was 1.4 feet. Due to these shallow depths, a low profile dam is likely needed to ensure adequate depth for the raw water intake (CH2MHill, 2004). The 2004 Feasibility Study indicated the slope of the river is very flat so that a two-foot high dam located just downstream of NC Highway 205 would impact the river 2,400 feet upstream. Revised estimates for Alternative 5 of the Union County YRWSP indicate a low profile dam approximately 3 feet tall and 200 feet long would be necessary at this location to support a new raw water intake. The estimated area of inundation for such a dam structure is 20.2 acres, affecting approximately 1.25 miles of the upstream river reach. Alternately, the use of a Ranney collector well intake could be considered. However, yields from such an intake in the Rocky River at this location are currently unknown, although it is anticipated that at least three such collector well intake structures would be required at this site.

If a new intake and pump station were to be constructed on the Rocky River, they would need to be designed to operate within this wide range of river levels, which is typical of "run-of-river" raw water intakes. Similar to Alternative 4, the design for this type of facility differs from those on reservoirs. As previously discussed for Alternative 4, design consideration must be given to protection of the facility from debris and sediment, fish entrainment, operation during a 100 year flood event, etc. Also, the proposed raw water pipeline would need to be designed to carry raw water from the pump station at the river to a pre-treatment settling (terminal) reservoir at the water treatment plant. Therefore, the run-of-river intake in the Rocky River, as proposed under Alternative 5, would require a significantly larger land area at the water treatment plant to accommodate this additional feature, as compared to the other lake-based intake alternatives. Details of this reservoir are further discussed with the Alternative 5 water treatment facility requirements as discussed in Section 3.2.5.4.

Two intake options are proposed for this location under Alternative 5. Option A would consist of a low profile dam, intake, and pumping station. Option B would consist of three Ranney collector well structures. As previously discussed, it is estimated the dam for Option A would need to be approximately 200 ft in length and approximately 3 feet tall. The low profile dam will include a v-notch weir capable of allowing the minimum regulated flow to pass downstream. The intake would consist of two flat screens located at the front of a concrete diversion channel that will lead to a collection well at the pump station. Each screen should be sized for 16.5 mgd (YRWSP 2050 average annual daily demand) with a combined maximum day capacity of 28 mgd. As the raw water pumping station would be located inside of the 100 year flood plain, it would have to be constructed vertically, above the flood plain. Under this option, the pump station facility would need to include four raw water pumps within a dedicated pump room and an adjacent electrical room.

Option B would consist of three Ranney collector wells and pumping stations within each well built vertically above the 100-year flood plain elevation. Under this option, a Ranney collection well is proposed to be built for each phase of expansion (three total phases) and sized to meet the demand of that phase (12, 20 and 28 mgd maximum daily demand for Phases 1, 2 and 3, respectively). Two raw water pumps would be installed with each collector well structure, for a total of six pumps installed in the three collector wells. The Ranney collector well and lateral collectors would require a hydrogeological study as part of the future facility design to determine if sufficient river yield is available and the required size of each system. Similar to Option A, as the Ranney collection wells would be located inside of the 100 year flood plain, they would have to be constructed vertically, above the flood plain.

3.2.5.3. RAW WATER TRANSMISSION MAIN

Similar to other alternatives, conceptual raw water transmission design indicates the need for parallel 36-inch diameter ductile iron pipe for Alternative 5 to provide necessary redundancy and meet Union County's 2050 water demands. The proposed alignment extends approximately 3 miles from the raw water pump station on the Rocky River to the proposed Site Area A for the Yadkin River Water Treatment Plant. For WTP Site Areas B and C, the alignment extends an additional 8 and 7 miles, respectively. The proposed route is reflected as Alternative 5 on Figure 2-3. The detailed study corridor for this proposed route is also reflected in Figure 3-1b.

WTP Site Area A

The proposed route for Union County's raw water transmission main would begin in Union County at a proposed raw water intake and pump station on the Rocky River at the Union-Stanly County line at NC-205. The raw water transmission line would follow NC-205 south to the proposed Site Area A for the Yadkin River Water Treatment Plant, located just north of New Salem, near Old Kennedy Fork Road.

WTP Site Area B

The proposed Alternative 5 raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area B is identical to that of Site Area A, described above, except the proposed alignment continues an additional 8 miles to the proposed treatment plant site. The additional alignment length from the proposed WTP Site Area A to Site Area B is identical to that as previously described for Site Area B under Alternative 1-A.

WTP Site Area C

The proposed Alternative 5 raw water transmission line alignment to the proposed Yadkin River Water Treatment Plant Site Area C is identical to that of Site Area A, described above, except the proposed alignment continues an additional 7 miles to the proposed treatment plant site. The additional alignment length from the proposed WTP Site Area A to Site Area C is identical to that as previously described for Site Area C under Alternative 1-A.

3.2.5.4. WATER TREATMENT PLANT

For this alternative, Union County proposes to build a new water treatment plant in the northeastern portion of Union County to serve its customers in the Rocky River IBT Basin of the Yadkin River Basin. The proposed water treatment plant siting areas (Proposed Water Treatment Plant Site Areas A, B and C), details and required capacity for Alternative 5 are the same as that presented for Alternative 1. However, Alternative 5 would also require the construction of a pre-treatment settling (terminal) reservoir, similar to that described for Alternative 4, for raw water storage for this riverine water source.

As previously stated, the DENR Public Water Supply Section has recommended a minimum of five days of off stream storage is prudent for any run-of-river intake. Additional property would have to be acquired for Alternative 5, so this terminal reservoir could be constructed to storage and polish raw water being withdrawn from this riverine source. While Alternative 4 has sufficient reservoir control along the Pee Dee River from the Lake Tillery regulated discharge to necessitate only the minimum five day reserve water supply, the Rocky River source for Alternative 5 does not have similar levels of regulated flow control. As such, this source is much more susceptible to low flow events, and necessitates a larger terminal reservoir for reserve water storage.

Due to the Rocky River's unregulated and unrestricted flow regime (not part of a chained reservoir system) and historic susceptibly to low flow periods, it is estimated a 30 day minimum water storage volume (maximum daily demand) would be needed for this alternative. Based on a 30 foot depth and considering changes in depth and dimensions of the terminal reservoir, the minimum estimated reservoir footprint for Alternative 5 is 90 acres. Without significantly more detailed hydrologic conditions analysis, it is unknown if this would be a feasible long-term supply without a significantly sized reservoir. Based on review of historical recorded Rocky River flows, it is evident that flow within this water body can be, and certainly has been less than the amended 7Q10 flow. For purposes of conceptual design and cost estimates, it has been assumed that a 90 acre terminal reservoir would be required for Alternative 5, to provide 30 days of reserve raw water storage at the County's maximum daily demand projection for the Year 2050 (28 mgd).

3.2.6. Alternative 6 – Catawba River Basin (Catawba River)

3.2.6.1. BACKGROUND

Alternative 6 seeks to evaluate the potential for meeting the needs of Union County's Yadkin River Water Supply Project using the Catawba River, as a surface water supply. This alternative proposes the expansion of the Catawba River Water Treatment Plant (CRWTP) for the Catawba River Water Supply Project (CRWSP) (Union County's existing joint venture with Lancaster County, South Carolina) to provide finished water to Union County's Rocky River IBT Basin in the Yadkin River Basin Service Area. This alternative would utilize the existing raw water intake, treatment facilities, and finished water distribution mains, each with required expansions, to serve as the sole source of finished water supply within Union County.

Currently, the CRWSP provides finished water to all of Union County's Catawba River Basin Service Area, as well as a portion of the County's Yadkin River Basin Service Area. The County is able to transfer Catawba River Basin water into the Rocky River IBT Basin of the Yadkin River Basin through an existing grandfathered North Carolina IBT of up to 5 mgd. Additionally, there is an IBT limit imposed by South Carolina through the surface water withdrawal permit for the CRWSP for the transfer of up to 20 mgd (combined limit for Union County, NC and Lancaster County, SC) of water out of the Catawba River Basin to the Yadkin River Basin. Projected water demands in this service area, however, indicate that the County will reach the existing North Carolina grandfathered IBT limit (5 mgd) by 2020. In order to meet projected water demands in the Rocky River IBT Basin service area through the County's Catawba River water supply (Alternative 6), a significant increase to the grandfathered IBT limit is required. Such an increase would require a new IBT Certificate from the North Carolina Environmental Management Commission for water transfers from the Catawba River Basin to the Yadkin River Basin (Rocky River IBT Basin). Additionally, projected water demands indicate that the County will exceed the 20 mgd South Carolina IBT limit between 2040 and 2050, which would require modification to this permitted transfer of water outside of the Catawba River Basin, and would not afford any IBT capacity to Lancaster County as a joint venture partner in the CRWSP.

Water transfers made under this alternative may be subject to the Cork Rule Exception which states that water transferred from one basin to another but then returned to the original basin and subsequently transported past the original withdrawal point (via discharge upstream of the withdrawal) are not considered transfers except for the volume of water that is consumed through human consumption, irrigation and subsurface disposal via septic systems. North Carolina Administrative Code 15A NCAC 02E. 0401(b) specifically addresses the "Cork Rule", where the following are not considered interbasin transfers:

1. The discharge point is situated upstream of the withdrawal point such that the water discharged will naturally flow past the withdrawal point.

2. The discharge point is situated downstream of the withdrawal point such that water flowing past the withdrawal point will naturally flow past the discharge point.

The Cork Rule Exception would apply to this alternative since water would be withdrawn from the Catawba River, transported to the Rocky River IBT Basin in Union County, and discharged back into the Catawba River via wastewater discharges emanating from County's Twelve Mile Water Reclamation Facility (WRF). Under this alternative, some wastewater generated in the Rocky River IBT Basin is, and will continue to be, diverted back to the Twelve Mile WRF in the Catawba River Basin, through the County's Poplin Road Pump Station, planned scalping at the Crooked Creek WRF, and future diversion of some wastewater flow in the Richardson Creek and Lake Lee Basins. The Twelve Mile WRF discharges into Twelve Mile Creek, which subsequently discharges into the Catawba River just upstream of the Catawba River Water Treatment Plant raw water intake.

An increase above 2 mgd to a grandfathered interbasin-transfer allowance generally requires an IBT Certificate. Union County's approved grandfathered IBT amount for transfers from the Catawba River Basin to the Yadkin River Basin is 5 mgd. Annual average daily wastewater returns from the Yadkin River Basin back to the Catawba Basin are projected to be 7.3 mgd by the year 2050, while the estimated transfer of finished water from the Catawba River Basin to the Yadkin River Basin is projected to be 28.9 mgd (max. month daily average basis), for Alternative 6. The resulting IBT, using the Cork Rule Exception, is projected to be 21.6 mgd by the year 2050 (finished water transfer minus wastewater return), thereby exceeding the grandfathered IBT amount by more than the 2 mgd limit. Given this consideration, an IBT certificate will still be necessary to meet the water demands of the County's Rocky River IBT Basin for this alternative.

3.2.6.2. EXISTING FACILITIES

The CRWSP is a Joint Venture wholly owned and operated by the two joint venturers, Lancaster County Water & Sewer District in South Carolina and Union County in North Carolina. In 1991 the two joint venturers determined that, by joining together to construct a new water treatment plant for their mutual benefit, rather than each separately constructing its own new water plant, certain economies of scale and a long term secure source of high-quality potable water could be achieved, resulting in long term savings and other tangible benefits for their respective customers.

The raw water intake, pumping station, reservoir, reservoir pumping station and treatment plant construction were completed in 1993 and started delivering drinking water to each county in late April of 1993. The original plant treatment capacity was 12 mgd. In 1998 the plant was expanded to a capacity of 18 mgd. In 2003, another expansion was completed bringing the plant capacity to 36 mgd.

As it exists today, the primary components of this supply include:

- Raw Water Intake and Pumping Station on the Catawba River
- 100 million gallon raw water reservoir

- Reservoir Pumping Station
- Water treatment facilities and finished water storage
- Finished Water Pumping Station
- Dual 24- and 42-inch diameter transmission mains to the Union County Sims Road Tank
- County-Wide Transmission Main (42/36-inch) serving Union County

The CRWSP is currently in the conceptual planning stages of another expansion. Based upon current demand projections, additional plant capacity will be needed sometime between 2018 and 2022. Once completed, Union County's portion of the treatment capacity will be 27 mgd. Other improvements currently being permitting for construction at this facility include a new river pump station and intake, a new 92-acre off-stream reservoir (1.094 billion gallon storage capacity), and reservoir pump station to provide a drought buffer during periods of low flow in the Catawba River.

3.2.6.3. PROJECTED DEMANDS

Finished water demand projections were developed in order to assess the raw water, treatment and finished water conveyance improvements needed for this alternative and include demands for both the County's Catawba River Basin Service Area and Yadkin River Basin Service Area. For the purposes of this evaluation, the projected demands are as follows:

Table 3-2 Catawba River Water Supply Projected 2050 Maximum Daily Demands

Entity	Year 2050 Demand (MDD)
Union County	64 mgd
Lancaster County	25 mgd
Total Demand	**89 mgd**

The demand projections for Lancaster County were developed from previous projections provided in the February 2010 Preliminary Engineering Report (Hobbs, Upchurch & Associates, P.A. & Marziano and McGougan, P.A., 2010). Lancaster County projections were presented through 2030 in the 2010 Preliminary Engineer Report, and a linear regression was used to project water demands to 2050 for purposes of this alternative evaluation.

Expansion of the existing CRWTP and raw water supply will be required to meet these projections. An assessment of each of the required improvements to meet a capacity of 89 mgd is summarized below.

3.2.6.4. RAW WATER INTAKE, PUMPING STATION AND TRANSMISSION MAIN

The CRWTP maintains a run of the river intake below the confluence of Twelve Mile Creek and the Catawba River and above the discharge of Resolute Forest Products (formerly Bowater Inc.), near Van Wyck, South Carolina.

The major Raw Water Intake and Pumping Station components along with required improvements to treat a future demand of 89 mgd are summarized in the Table 3-3. The CRWSP is currently permitting a proposed intake expansion which will be located approximately

100 feet downstream from the current intake and includes a new intake and river pump station facility.

Table 3-3 Catawba River Water Treatment Plant Raw Water Intake and Pumping Station Required Improvements

Existing Facilities	Description	Capacity
Intake	Three 42-Inch Static Screens	18 mgd each/54 mgd Total Capacity
Raw Water Pumping Station	Three Vertical Turbine Pumps	18 mgd each/36 mgd Firm Capacity

Proposed Facility Additions	Description	Capacity
Intake	Three 48-Inch Static Screens	23 mgd each
Raw Water Pumping Station	Three Vertical Turbine Pumps	23 mgd each
Raw Water Transmission Bypass Piping	Two 48-Inch Transmission Mains, 2,000 LF	Total Capacity– 100 mgd

3.2.6.5. RAW WATER RESERVOIR AND RESERVOIR PUMPING STATION

The raw water reservoir is being proposed for expansion from a capacity of approximately 0.1 billion gallons (BG) to 1.094 BG of storage to provide the facility with a drought buffer in the event of prolonged low flow periods in the Catawba River. The reservoir design is complete with projected construction completion in 2018. Sizing of the reservoir expansion was developed by Black and Veatch. The following is an excerpt from the November 6, 2009 design memorandum prepared by Black and Veatch:

> *Provisions in the IBT permit recommend permittees enter into an agreement with Duke Power Company, to have the company release water from Lake Wylie into the Catawba River when stream flows are less than the referenced minimums. This allows the permittee to withdraw an amount equal to the additional release from Duke Power Company during the low flow periods. The plant owners have entered into such an agreement, allowing them to withdraw up to 71 cfs/day (45 mgd) during low flow periods. The Duke water release is based upon the Catawba-Wateree Low Inflow Protocol (LIP). This protocol identifies drought triggers that may impact the water release by Duke Power. If stage 4 conditions were to occur, Duke would not be held to the release agreement and the water available to CRWTP for withdrawal may be reduced. In general, the Catawba River stream flow should be maintained above 1,200 cfs* (Black & Veatch, 2009).

Black and Veatch evaluated USGS flow data from the year 2000 to 2008 to determine the maximum number of consecutive dry days per year where stream flows were below 1,200 cfs in order to determine required storage capacity during drought periods. Storage capacity was determined by multiplying the number of dry days obtained by required daily flows based on the following demand conditions:

- Maximum Recorded Peak Daily Demand (34 mgd) times the maximum consecutive dry days per year between 2000 and 2008 average (15 days) - 510 million gallons.
- Minimum or Drought Conservation Demand (15 mgd) times the maximum number of consecutive dry days during drought conditions (49 days) – 735 million gallons.
- Projected Future Daily Demand (46.4 mgd) from the HDR/Duke Energy Water Supply Study Report for the Catawba-Wateree Hydroelectric Relicensing Project, April 2006, times the average consecutive dry days (15 days). - 696 million gallons.

Including an additional 5 percent above the largest storage requirement of 735 million gallons, to account for unusable volume and a safety factor, the required reservoir capacity was estimated by Black and Veatch to be 800 million gallons. However the topography of the site is such that it economically offers a greater storage capacity of approximately 1 billion gallons. Additional dikes or saddle dams would otherwise be required to expand the reservoir capacity beyond this amount. Considering this, the reservoir has been designed and is being permitted for the most cost effective volume of 1 billion gallons (Black & Veatch, 2009).

For the proposed 2050 expansion to 89 mgd, it is anticipated that the average day demand will be approximately 52 mgd assuming a peak factor of 1.7. This is consistent with the last demand condition described above indicating the proposed reservoir with 1 BG of capacity will provide sufficient storage to meet the previous agreed to constraints. These constraints will certainly have to be revisited in the future when the plant is expanded incrementally.

The reservoir expansion will also include replacement of the existing reservoir pumping station and transmission main which will be inundated when the new reservoir is complete. The design conditions listed in Table 3-4 were identified in the Black and Veatch memorandum (Black & Veatch, 2009).

Table 3-4 Catawba River Water Treatment Plant Reservoir Pumping Station Design Criteria

Item	Design Criteria
Pump Type	Multi-Stage Vertical Turbine Pumps
Number of Pumps	Initial – 2 operating, 1 standby – 23,100 gpm, 700 HP each 2050 Demand Condition – Add one additional

As part of the reservoir expansion, new conveyance piping is proposed from the new reservoir to the water treatment plant connection point. The design recommends a 48-inch diameter main to achieve a raw water capacity of 60 mgd with a second 48-inch diameter pipe installed to achieve a 100 mgd build-out. For this analysis, it was assumed that the second 48-inch diameter pipe would be installed.

3.2.6.6. WATER TREATMENT FACILITY

In order to meet the future demands several improvements will be required at the WTP. These are summarized in the Table 3-5.

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Table 3-5 Catawba River Water Treatment Plant Additional Improvements Required

WTP Improvement	Description
Rapid Mix	Dual compartment mechanical backmix facilities
Coagulation/ Flocculation/ Sedimentation	Six , 10 mgd Superpulsators
Filtration	Eighteen filter cells
GAC Contactors	Twelve post filter GAC contactors and low lift pumping station
High Service Pumping Station	Six, 13 mgd vertical turbine pumps
Chemical Feed Equipment	New chemical building
Storage	One, 3 million gallon clearwell
Residuals Thickening	Three 80' diameter gravity thickener
Residuals Dewatering	Dewatering Building including residuals storage, polymer system, dewatering feed pumps and three 300 gpm centrifuges (ultimate capacity)

As indicated previously, the current plant capacity is 36 mgd. For Alternative 6, an additional 53 mgd expansion of existing facilities would be required to meet the combined 2050 demands of 89 mgd for Union County's Catawba and Yadkin River Basin Service Areas, as well as Lancaster County. Under this alternative, it is anticipated that expansion would occur in three phases with Phase 1 consisting of a proposed 18 mgd expansion to 54 mgd. The second and third expansion phases would also increase the plant capacity approximately 18 mgd each phase for an ultimate capacity of 90 mgd.

3.2.6.7. FINISHED WATER TRANSMISSION MAIN

The CRWTP has existing 24-inch and 42-inch parallel finished water transmission mains into Union County. These mains are capable of delivering up to 27 mgd to the County, based on the current CRWTP plant capacity of 18 mgd, plus an additional future capacity of 9 mgd. To meet the projected future water demands (64 mgd by the year 2050 (max. month daily average)) of the County's customers in both the Catawba and Yadkin River Basins, these existing transmission mains would need to be paralleled with additional mains capable of delivering an additional 37 mgd or more.

The existing route for finished water transmission from the CRWTP to Union County begins at the CRWTP in Lancaster County, SC near the town of Van Wyck. The 42-inch ductile iron main travels northeastward along Steel Hill Road through the Town of Van Wyck, across US Highway 521, following Niven Road to the intersection of Rehobeth Road. The 24-inch ductile iron main travels eastward along SC-75, south of Van Wyck, crosses US Highway 521, and travels along East Rebound Road to the intersection of Rehobeth Road at the Lancaster County – Union County line. The 24-inch main then travels northward along Rehobeth Road into Union County to the intersection of Niven Road. At this point both the 42-inch and 24-inch mains travel in parallel eastward along Rehobeth Road and continue to follow this road to the north and intersection with Sims Road. At this location, Union County owns two finished water storage tanks (4 million gallon capacity and 2 million gallon capacity). For the proposed Alternative 6 raw water transmission alignment, the route would follow the northern route of the existing 42-

inch main, previously described. The proposed expanded finished water transmission route into Union County's Yadkin River Basin Service Area is reflected as Alternative 6 on Figure 2-3. The detailed study corridor for this proposed route is also reflected in Figure 3-1c.

From these tanks, the 24-inch transmission main continues northward along Rehobeth Road into the western portion of the County's Catawba River Basin water service area (Pressure Zones 821 and 873), including the municipalities of Waxhaw, Marvin, and Weddington. The 42-inch transmission main continues from the Sims Road storage tanks eastward along Sims Road and then eastward along Old Waxhaw-Monroe Road. The main continues to follow Old-Waxhaw-Monroe Road northeastward, crossing over Waxhaw Road (NC-75), where the road then becomes Rocky River Road. The 42-inch main briefly continues along Rocky River Road to a pump station located at the intersections of Rocky River Road with Watkins Road and Price Shortcut Road, at which point the transmission mains are reduced in size and branched in multiple directions. The two main lines leaving the pump station are a 24-inch service line to the north along Price Shortcut Road and a 16-inch service line traveling north along Rocky River Road. The 16-inch line continues along Rocky River Road to US Highway 74 (W. Roosevelt Blvd.), where it then travels westward along US-74. The 42-inch main and its associated branches serve eastern portion of the County's Catawba River Basin service area and western portion of the Yadkin River Basin service area (Pressure Zones 853 South and 853 West), including the municipalities of Mineral Springs, Wesley Chapel, Indian Trail, Stallings, Lake Park and Hemby Bridge.

Pressure Zones 730, 762 and 853 East in the Yadkin River Basin service area are currently served by the County's water supply from Anson County. However, under Alternative 6, these pressure zones and future development in the Yadkin River Basin service area would need to be served with Catawba River water provided from the CRWTP. As such, the 16-inch water service line traveling along US-74 would need to be increased in size or paralleled with a larger line that could extend further into the northern and eastern portion of the County to serve these additional pressure zones.

3.2.7. Alternative 7 – Catawba River Basin (Mountain Island Lake)

3.2.7.1. BACKGROUND

Alternative 7 seeks to evaluate the potential for meeting the needs of Union County's Yadkin River Water Supply Project using the Catawba River, as a surface water supply. This alternative proposes the purchase of finished water from Charlotte Water and subsequent transfer of this water into Union County's Rocky River IBT Basin in the Yadkin River Basin service area. This alternative would utilize Charlotte Water's existing facilities in the Catawba River Basin, to serve Union County's customers in the Rocky River IBT Basin (Yadkin River Basin).

Currently, the Catawba River Water Treatment Plant (CRWTP) in Lancaster County, SC, provides finished water to all of Union County's Catawba River Basin service area, as well as a portion of the County's Rocky River IBT Basin (Yadkin River Basin) service area. The County is able to transfer Catawba River Basin water into the Rocky River IBT Basin of the Yadkin River Basin through an existing grandfathered North Carolina IBT of up to 5 mgd. Additionally, there is a 20 mgd IBT limit for CRWTP for the transfer of water from South Carolina to North Carolina between these two basins. Projected water demands in this service area, however, indicate that the County will reach the existing North Carolina grandfathered IBT limit (5 mgd) by 2020. In order to meet projected water demands in the Rocky River IBT Basin service area through water supplied from Catawba River Basin sources, a significant increase to the grandfathered IBT limit is required. Such an increase would require a new IBT Certificate from the North Carolina Environmental Management Commission for water transfers from the Catawba River Basin to the Yadkin River Basin (Rocky River IBT Basin).

Currently, Union County provides water to its customers in the Rocky River IBT Basin from both the Catawba River source and finished water purchased from Anson County (Yadkin River source). However, the initial contract term with Anson County expired in 2012 and is currently under an auto-renewing cycle, with the next renewal scheduled for 2017. Should either party choose give termination notice during the auto-renewing period, the contract may be voided. As such, Alternative 7 assumes that the Anson County water supply will cease, in favor of supplying the Rocky River IBT Basin with finished water solely from Charlotte Water's Catawba River Basin sources. However, utilization of the 5 mgd grandfathered North Carolina IBT from the CRWTP is assumed to continue, in addition to water supplied by Charlotte Water in the Rocky River IBT Basin.

Water transfers from Charlotte Water to Union County made under this alternative would not be subject to the Cork Rule Exception since water would be withdrawn from the Catawba River by Charlotte Water at either their Lake Norman or Mountain Island Lake intakes, transported to the Rocky River IBT Basin in Union County, and discharged back into the Catawba River via wastewater discharges emanating from the County's Twelve Mile Water Reclamation Facility (WRF). Under this alternative, some wastewater generated in the Rocky River IBT Basin is, and will continue to be, diverted back to the Twelve Mile WRF in the Catawba River Basin, through the County's Poplin Road Pump Station, planned scalping at the Crooked Creek WRF, and future diversion of some wastewater flow in the Richardson Creek and Lake Lee Basins. However, the Twelve Mile WRF discharges into Twelve Mile Creek, which subsequently discharges into the Catawba River downstream of Charlotte Water's raw water intakes. However, as previously discussed for Alternative 6, the portion of water supplied to Union County from their existing Catawba River Water Treatment Plan would qualify for the Cork Rule Exception, as the Twelve Mile Creek discharge point is upstream of Catawba River Water Treatment Plant.

An IBT certificate is required for surface water transfers in excess of 2 mgd between defined IBT basins. Union County's approved grandfathered IBT amount for transfers from the Catawba River Basin to the Yadkin River Basin is 5 mgd. Wastewater returns from the Yadkin Basin back to the Catawba Basin are projected to be 7.3 mgd by the year 2050, while the estimated transfer of finished water from the Catawba Basin to the Yadkin Basin is projected to be 28.9 mgd (max. month daily average basis), for Alternative 7. Of this 28.9 mgd, 16.6 mgd is projected to be needed from Charlotte Water, with the remaining 12.3 mgd being supplied from Union County Catawba River Water Treatment Plant. Accounting for the Cork Rule Exception, if 12.3 mgd is supplied from the Catawba River Water Treatment Plant by the year 2050 and 7.3 mgd is projected to be returned to the Catawba River via the Twelve Mile WRF, the net IBT from this source is equal to 5 mgd (withdrawals minus returns), which is within the County's existing grandfathered limit. Therefore, it is projected that the full 16.6 mgd purchased from Charlotte Water by the year 2050 would require an IBT certificate equal to 16.6 mgd, as the Cork Rule Exception would not apply to this water purchase.

According to their 2014 North Carolina Local Water Supply Plan, Charlotte Water withdrew an average annual daily amount of water equal to 18.3 mgd from Lake Norman (Lee Dukes Water Treatment Plant) and 82.9 mgd from Mountain Island Lake (Franklin and Vest Water Treatment Plants), for a combined average daily withdrawal of 101.2 mgd. Charlotte Water's available water supply from Lake Norman is 55 mgd and 108 mgd from Mountain Island Lake (163 mgd total supply), based on average annual daily values, per its existing permits with the Federal Energy Regulatory Commission (FERC). Charlotte Water's water demand projections, as stated in the 2014 NC Local Water Supply Plan, indicate an average annual daily water demand of 169.49 mgd (168.5 mgd internal demand plus 0.99 mgd of wholesales)) by the year 2050 and a total water supply of 188 mgd (163 mgd existing surface water supply plus 25 mgd projected future surface water supply (increased Lee Dukes WTP capacity) from the Catawba River). These projections indicate that Charlotte Water's demand as a percent of water supply will be approximately 90% by 2050.

Future water sales from Charlotte Water to Union County, as described for Alternative 7, would require approximately 12 mgd (average annual daily value), based on 2050 demand projections for the County. By 2050, Union County's demand would represent slightly less than 7 percent of the overall Charlotte Water demand. The additional water demand of Union County would increase Charlotte Water's projected demand to 97% (182 mgd) of its future water supply of 188 mgd. This could require expansion of Charlotte Water's intake(s), water treatment facilities and distribution system, to meet the increased system demand by adding Union County as a wholesale customer. Additionally, Charlotte Water would likely be required to petition FERC for additional withdrawal capacity from Lake Norman and/or Mountain Island Lake.

3.2.7.2. RAW WATER INTAKE AND PUMP STATION

Charlotte Water currently has raw water intakes in two surface water reservoirs in the Catawba River Basin. The raw water intake associated with the Lee Dukes WTP in Huntersville, NC is located in Lake Norman. Constructed in 1996, this intake is a platform type, gravity flow intake with four submerged screens and two 60-inch raw water mains. Currently, only one of these raw water mains is used, with the second line planned for future expansion. The raw water lines extend approximately one mile to the site of the Lee Dukes WTP. The intake flow capability is currently 25 mgd through four 70-inch screens. The installation of four additional 70-inch screens and the use of the second 60-inch raw water main would allow a future flow capability of up to 50 mgd.

Charlotte Water's Catawba River Pump Station on Mountain Island Lake includes raw water intakes and pumping facilities associated with the Franklin and Vest WTPs in Charlotte, NC. Originally constructed in 1918, with subsequent upgrades completed in 1937, 1947, 1965 and 1999, this facility is one of the largest of its kind in the State of North Carolina. The primary intake at this facility includes a submerged channel and wetwell with four bar racks, traveling water screens and vertical suction pumps. There are multiple raw water mains associated with the facility including 54-inch, 60-inch, and 120-inch mains. This facility currently has a firm pumping capacity of 180 mgd with four 60 mgd pumps. The addition of two more 60 mgd pumps would increase the firm pumping capacity of this facility to 286 mgd.

For purposes of Alternative 7, it is assumed that water supplied to Union County through finished water wholesales would be withdrawn at Mountain Island Lake through the Catawba River Pump Station. Infrastructure enhancements for Charlotte Water's existing raw water intakes and pump stations may be necessary for finished water wholesale to Union County, but are not addressed in these evaluations or included in the cost analysis.

3.2.7.3. FINISHED WATER TRANSMISSION MAIN

Charlotte Water has several 16-inch finished water transmission mains which approach the Mecklenburg-Union County Line. Of these mains, the northernmost main is the most logical tie-in point for Union County to supply water to their Rocky River IBT Basin service area. Charlotte Water's main extends along NC 218 (Fairview Road). The proposed tie-in location for Union County would be just southeast of the intersection of Whitmore Lane with Fairview Road, near Mint Hill, on the east side of I-485. To meet the projected future water demands of the County's customers in both the Rocky River IBT Basin, it is anticipated that Charlotte Water's existing 16-inch finished water main would need to be increased in size or paralleled to extend to Union County's finished water distribution system. The proposed extension of this finished water main into Union County would extend through the Goose Creek Watershed and the Town of Fairview. It is anticipated that, under this alternative, the main would extend along NC 218 through the Rocky River IBT Basin service area, with additional mains branching off of this primary line at US 601 to extend north and south along this major roadway.

The proposed finished water transmission route into Union County's Yadkin River Basin Service Area is reflected as Alternative 7 on Figure 2-3. The detailed study corridor for this proposed route is also reflected in Figure 3-1d.

3.2.7.4. WATER TREATMENT PLANT

Charlotte Water has three existing water treatment plants to treat their sources of raw water. The Lee S. Dukes WTP (formerly called North Mecklenburg WTP) in Huntersville, NC treats raw water withdrawn from Lake Norman. This facility is located approximately 1 mile from the Lake Norman intake and is the newest Charlotte Water water treatment facility. Water from Lake Norman is gravity-fed to this treatment plant, which was opened in 1998. Growing water demand in this part of Mecklenburg County required the construction of this plant, which was built to allow for future expansion. The current capacity of this plant is 25 mgd. Eventually, this plant may be able to produce up to 108 mgd.

Water from Mountain Island Lake is pumped from the Catawba River Pump Station to three reservoirs at Franklin Water Treatment Plant. The raw water is then gravity-fed to both the Franklin facility and to Vest Water Treatment Plant. The Franklin Water Treatment Plant was built in 1959 and has since been upgraded five times due to population growth and technological advances that ensure continued delivery of the highest quality drinking water. Its current capacity is 181 mgd.

A long-standing landmark in the Charlotte-Mecklenburg community, the Vest Water Treatment Plant was built as a result of a drought in the 1920's. The plant, which is also supplied by Mountain Island Lake, was the only treatment plant in the Charlotte-Mecklenburg area until 1959 when the Franklin Water Treatment Plant opened. Since the 1920's, the Vest WTP has been upgraded twice. During 2009 and 2010, Charlotte Water worked on multiple projects at the Vest Water Treatment Plant, including building upgrades, water line enhancements and water storage tank reconditioning. The current capacity of this facility is 36 mgd.

For purposes of Alternative 7, it is assumed that water supplied to Union County through finished water wholesales would be provided from the Franklin and/or Vest treatment facilities, using Mountain Island Lake as the source water. Infrastructure enhancements and finished water delivery issues within Charlotte Water's existing system for finished water wholesale to Union County are not addressed in these evaluations or the cost analysis. It is possible that enhancements at these water treatment facilities may be required to meet the additional demand placed on Charlotte Water's system through finished water transfers to Union County under this alternative.

3.3. Interbasin Transfer Minimization Alternatives

3.3.1. Alternative 8 – Groundwater supply

3.3.1.1. GENERAL

The premise of Alternative 8 is to evaluate the potential for development of a Union County municipal groundwater supply that could serve as an alternative or supplemental source of water for the Yadkin River Water Supply Project. The intent of the evaluation is to identify the considerations, challenges and infrastructure requirements needed to develop a groundwater well network to minimize the quantity of an interbasin transfer for surface water transfers from the Yadkin River IBT Basin to the Rocky River IBT Basin.

Prolonged drought, allocation of surface water flow, and increased demands on groundwater supplies resulting from population growth have been and continue to be factors driving studies to evaluate groundwater resources in the Piedmont and Blue Ridge Provinces of North Carolina. Urbanization and certain aspects of agricultural production have also caused increased concerns about protecting the quality of groundwater in this region. Illustration 3-6 reflects the extent of these two provinces (Daniel III & Dahlen, 2002).

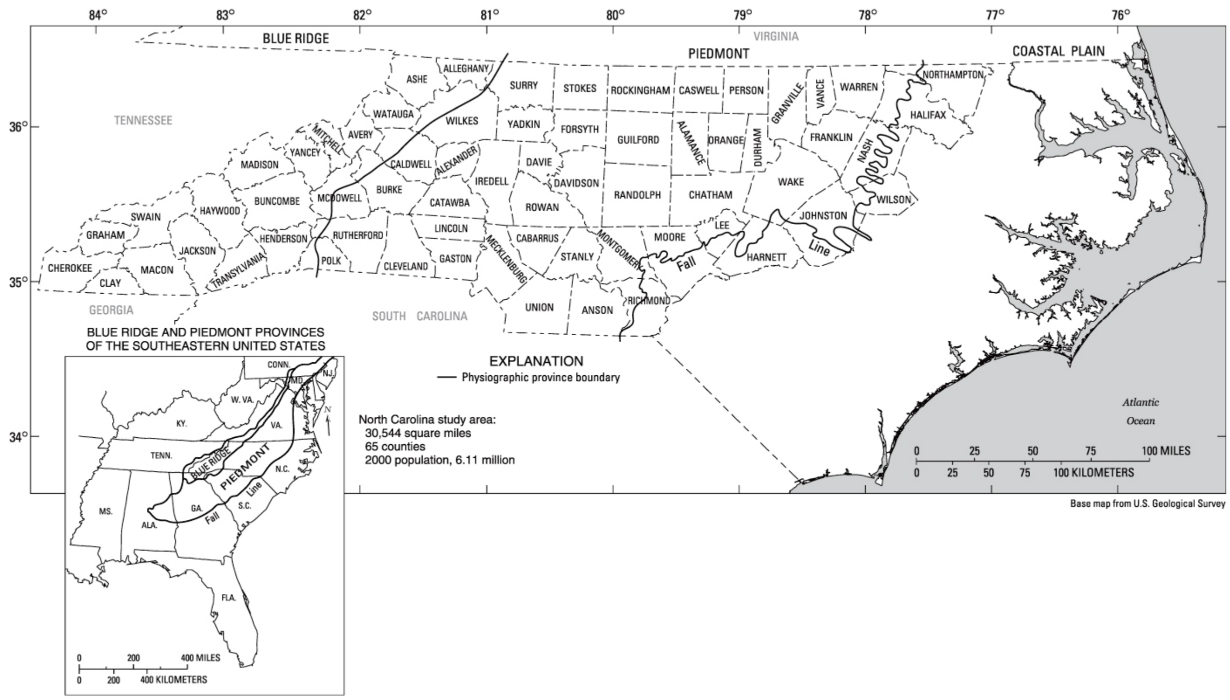


Illustration 3-6 Locations of the Blue Ridge and Piedmont Provinces of North Carolina (Daniel III & Dahlen, 2002).

Groundwater in the Blue Ridge and Piedmont has not traditionally been considered as a source for large supplies, primarily because of readily available surface water supplies, and the fact that groundwater in the Piedmont and Blue Ridge Provinces occurs in a complex, generally heterogeneous geologic environment. Reluctance to use groundwater for large supplies derives from the reputation of aquifers in these provinces for producing low yields to wells, and the few high-yield wells that are drilled seem to be scattered in areas distant from where they are needed. Because the aquifers in these provinces are shallow, they also are susceptible to contamination by activities on the land surface (Daniel III & Dahlen, 2002).

Groundwater was used by about 34 percent of the population in the 65 counties of the Piedmont and Blue Ridge Provinces in 2005. The percentage of the total population in the Piedmont and Blue Ridge supplied by groundwater was about 47 percent between 1960 and 1980 and then decreased to about 32 percent in 1990 (Daniel III & Dahlen, 2002). The percentage of the population in the region served by groundwater was about 41 percent in 2000 and about 34 percent in 2005. These decreases are attributed primarily to the high rates of population growth associated with the five metropolitan areas of Raleigh, Durham, Greensboro, Winston-Salem, and Charlotte, known collectively as the “Piedmont Crescent” that are served primarily by surface water based municipal supplies (Harden, Chapman, & Harned, 2009).

Based on US Geological Survey’s October 2009 report on 2005 water use, groundwater (fresh, not saline) use in North Carolina was approximately 700 mgd, which was equivalent to 6% of the total water supply for the state. Approximately 156 mgd was used for public water supplies (non-individual household), equivalent to 22% of the total groundwater use in the state and only 17% of the total municipal public water supply (National Groundwater Association, 2012).

3.3.1.2. HYDROGEOLOGY

In North Carolina, groundwater does not typically occur in vast underground lakes, pools, or rivers. Groundwater actually occurs and flows through empty spaces between soil grains and rock fractures (NCDENR, 2012). Rock fractures, however, may not always convey or store large quantities of water. Because of the complex distribution of fractures in almost every type of rock, no single method can unambiguously map fractures and their capacity for fluid movement. The USGS, however, conducts research to develop field techniques and interpretive methods for characterizing fluid movement and chemical migration in fractured-rock aquifers (U.S. Geological Survey, 2002).

Most of the Piedmont and Blue Ridge Provinces is underlain by a complex, two-part, regolith-fractured crystalline rock aquifer system. Thickness of the regolith throughout the area is highly variable and ranges from 0 to more than 150 feet. The regolith consists of an unconsolidated or semiconsolidated mixture of clay and fragmental material ranging in grain size from silt to boulders. Because porosities range from 35 to 55 percent, the regolith provides the bulk of the water storage within the Blue Ridge and Piedmont ground-water system. At the base of the regolith is the transition zone where saprolite grades into unweathered bedrock. The transition zone has been identified as a potential conduit for rapid ground-water flow. If this is the case, the transition zone also may serve as a conduit for rapid movement of contaminants to nearby wells or to streams with channels that cut into or through the transition zone. How rapidly a contaminant moves through the system largely may be a function of the characteristics of the transition zone. The transition zone is one of several topics identified during the literature review and data synthesis, for which there is a deficiency in data and understanding of the processes involved in the movement of groundwater to surface water (Daniel III & Dahlen, 2002).

Metamorphic and igneous crystalline rocks underlie most of the Blue Ridge and Piedmont. Union County is considered to be in the Carolina slate belt (CS). Boundaries for this region include the Gold Hill, Charlotte, Milton belts on the northwest and the Coastal Plain on the southeast. Dominant hydrogeologic units within the Carolina slate belt include argillite (ARG), metavolcanic-epiclastic (MVE), metavolcanic-undifferentiated (MVU) in southwestern half of belt and metavolcanic-felsic (MVF), ARG, MVU, metaigneous-felsic (MIF), and metaigneous-intermediate (MII) in the northeastern half of belt (Daniel III & Dahlen, 2002). The Carolina slate belt has an areal extent of 5,012 square miles, representing 18.3 percent of the total regional geozone area in the Piedmont and Blue Ridge Provinces of North Carolina. This geozone includes magmatic-arc rocks east of the Central Piedmont suture of low metamorphic grade. The majority of Union County falls within this regional geozone as indicated in Illustration 3-7 (Harden, Chapman, & Harned, 2009).

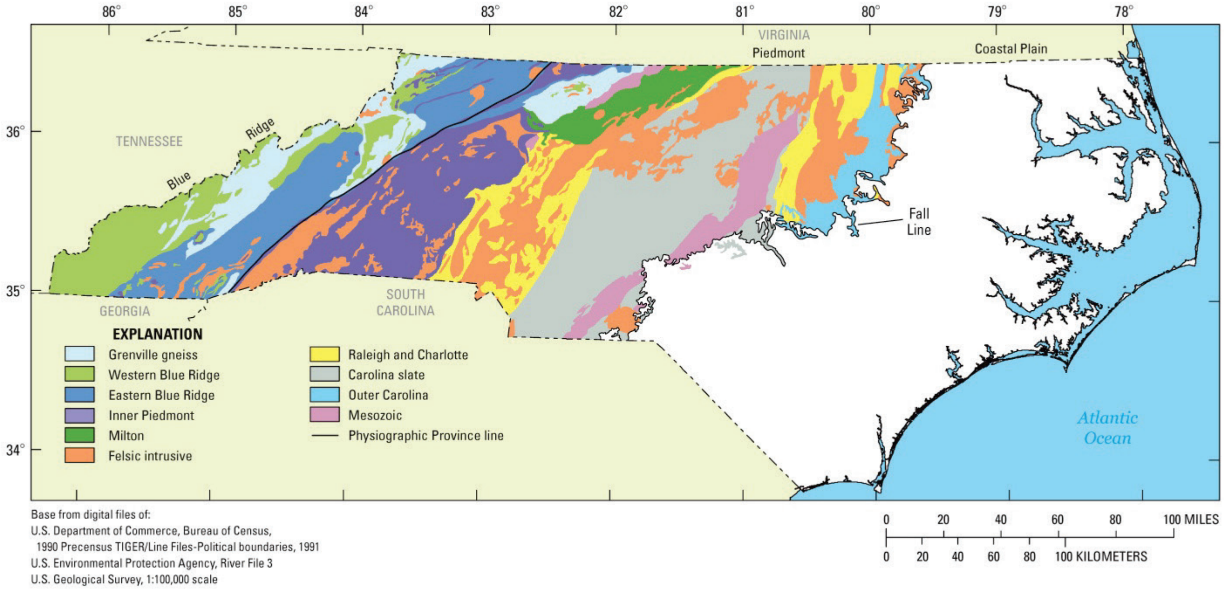


Illustration 3-7 Regional Geozones in the Piedmont and Blue Ridge Provinces of North Carolina (Harden, Chapman, & Harned, 2009).

Primary rock formations in Union County include met sedimentary rocks, specifically argillite. Argillite is classified as fine-grained, thinly laminated rock having prominent bedding plane and axial plane cleavage and locally includes beds of mudstone, shale, thinly laminated silt-stone, conglomerate, and felsic volcanic rock. It is estimated that 6.4% of Blue Ridge and Piedmont Provinces of North Carolina are comprised of argillite (Daniel III & Dahlen, 2002).

3.3.1.3. GROUNDWATER CYCLE

Under natural conditions, groundwater in the bedrock fractures and intergranular pore spaces of the regolith is derived from infiltration of precipitation. Water enters the groundwater system in the recharge areas, which generally include the entire land surface above the lower parts of stream valleys. Following infiltration, water slowly moves downward through the unsaturated zone to the water table, which is the top of the saturated zone. Water then moves laterally through the saturated zone and discharges naturally as seepage springs on steep slopes and as bank and channel seepage into streams, lakes, or swamps. The depth of the water table varies from place to place and from time to time depending on the topography, climate, growing season, and properties of the water-bearing materials. Topography likely has the greatest influence on the depth of the water table in a specific area with the other effect superimposed to cause short-term fluctuations (Daniel III C. C., 1990).

Contrary to popular belief, the water table is not a consistent, flat surface. Actually, the water table typically mimics the over lying land topography. The topography of the Piedmont Province consists of low, well-rounded hills and long, northeast-trending valleys and ridges. The surfaces of many ridge tops and inters ream divides are relatively flat and are thought to be remnants of an ancient erosional surface of low relief. Water moves more slowly through the denser clay and rock of the Piedmont and Blue Ridge regions, so well yields tend to be lower than areas such as the Coastal Plain (Huffman & Miner, 1996).

Seasonal changes in water levels can be related to seasonal changes in the use of water by vegetation and the rate of soil moisture evaporation. During the growing season, vegetation intercepts and consumes large amounts of water before it reaches the water table, especially from mid-April through October. During the same period, warmer temperatures contribute to higher rates of soil moisture losses through evaporation. As a result, the water table declines gradually throughout the summer and fall months and is usually lowest in the late fall. It is at this time of year that the groundwater system has the least amount of water in storage. The long steady rains, lower temperatures, and low transpiration losses during the winter and early spring months favor the recharge of groundwater. Barring unusual weather conditions (i.e. drought, tropical activity, etc.), the water table will rise and fall cyclically on an annual basis and at a given time each year will be approximately the same level (Daniel III C. C., 1990).

While North Carolina generally has abundant water resources, groundwater characteristics in the regolith-bedrock aquifer system of the State are complex and poorly understood (Daniel III & Dahlen, 2002). The regolith is composed of fine-grained material and water moves through it slowly, but water in storage per unit volume will often exceed that contained in the bedrock fractures. Although the fractures in the bedrock contain little water in storage, they offer little restriction to the flow of water through them. In the Piedmont, two rather disparate aquifers (regolith and bedrock) are joined as a single hydraulic system, yet behave quite differently in reaction to pumping stresses. In the Piedmont, pumping of the bedrock wells sometimes results in dewatering the upper part of the bedrock aquifer in the vicinity of a well, thus causing the bedrock aquifer to be subject locally to unconfined conditions. Water that replenishes the bedrock fractures must be supplied from the regolith. Because of the low hydraulic conductivity of the regolith, it may not be able to deliver to the bedrock fractures the same volume of water that is being withdrawn by a well, particularly if pumping continues for a long period at a rate greater than recharge. Water levels in a well will then continue to decline until the fractures in the vicinity of the well are dewatered and well yield declines. Usually only at modest pumping rates or where there are extensive fracture systems in the bedrock will equilibrium in the movement of water from the regolith to the bedrock fractures be reached (Daniel III C. C., 1990). Illustration 3-8 depicts the principle components of the groundwater system in the Blue Ridge and Piedmont Provinces of North Carolina).

As a general rule, the abundance of fractures and size of fracture openings in the crystalline bedrock decreases with depth. At depths below 750 ft, the pressure of the overlying material holds fractures closed, and the porosity can be less than 1 percent. Because of its higher porosity, the regolith functions as a reservoir that slowly feeds water downward into fractures in the bedrock as indicated in Illustration 3-9. These fractures form an intricate interconnected network of pipelines that transmit water to springs, wetlands, streams, and wells (Daniel III & Dahlen, 2002).

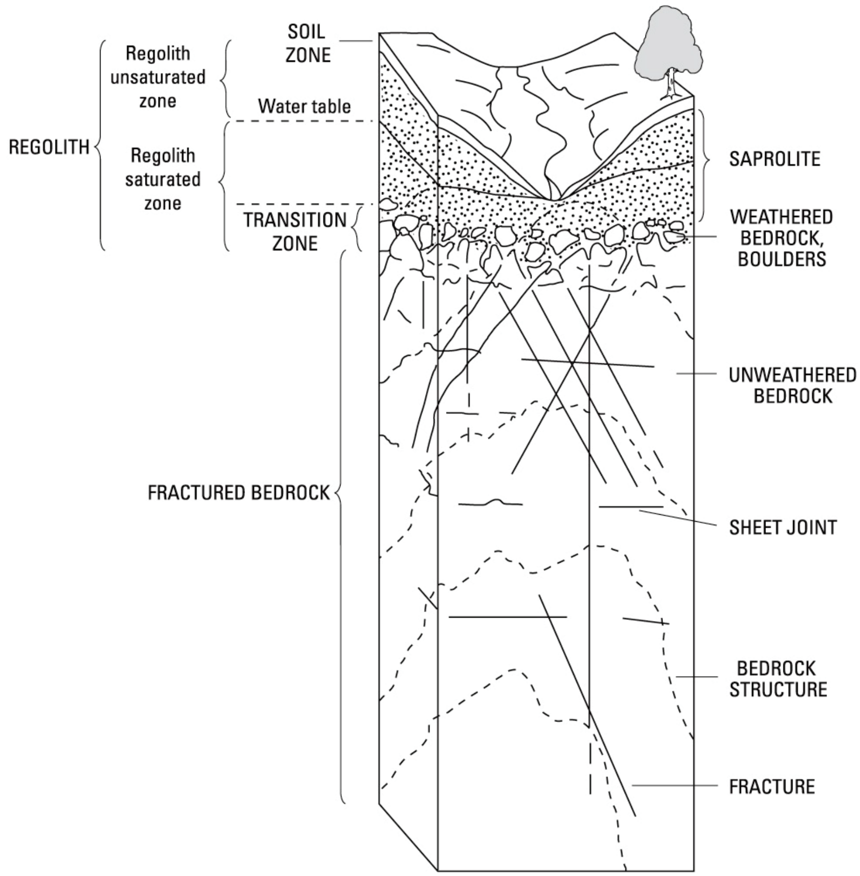


Illustration 3-8 Principal components of the groundwater system in the Blue Ridge and Piedmont Provinces of North Carolina (Daniel III & Dahlen, 2002).

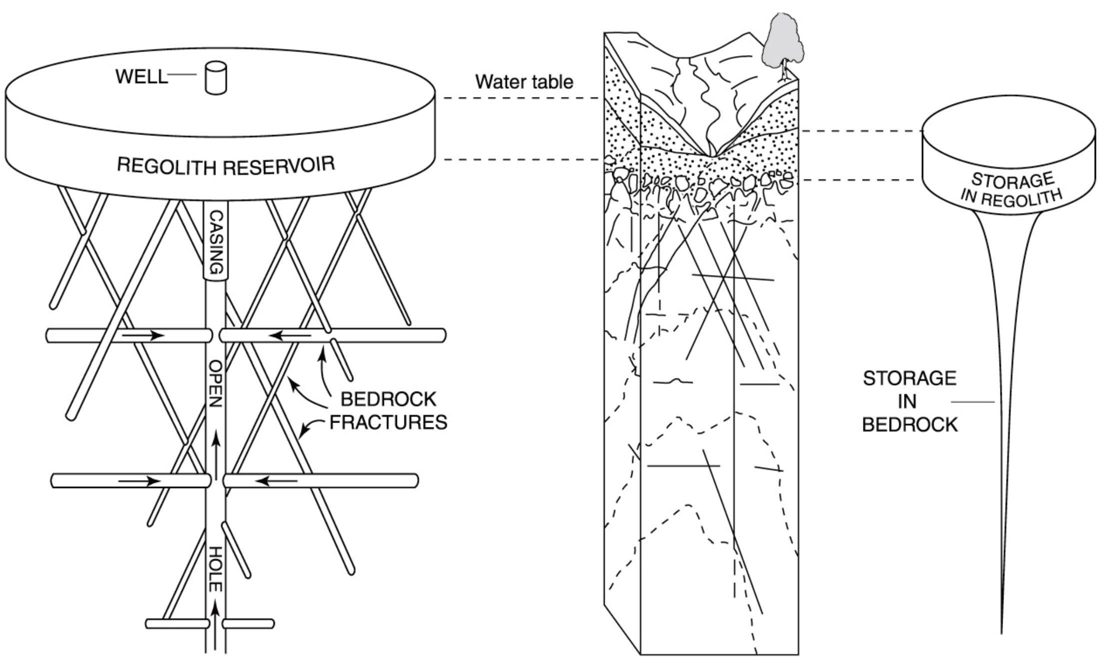


Illustration 3-9 Reservoir-pipeline Conceptual Model of the Blue Ridge-Piedmont Groundwater System and the Relative Volume of Groundwater Storage Within the System (Daniel III & Dahlen, 2002).

3.3.1.4. GROUNDWATER YIELD AND RECHARGE

Yield

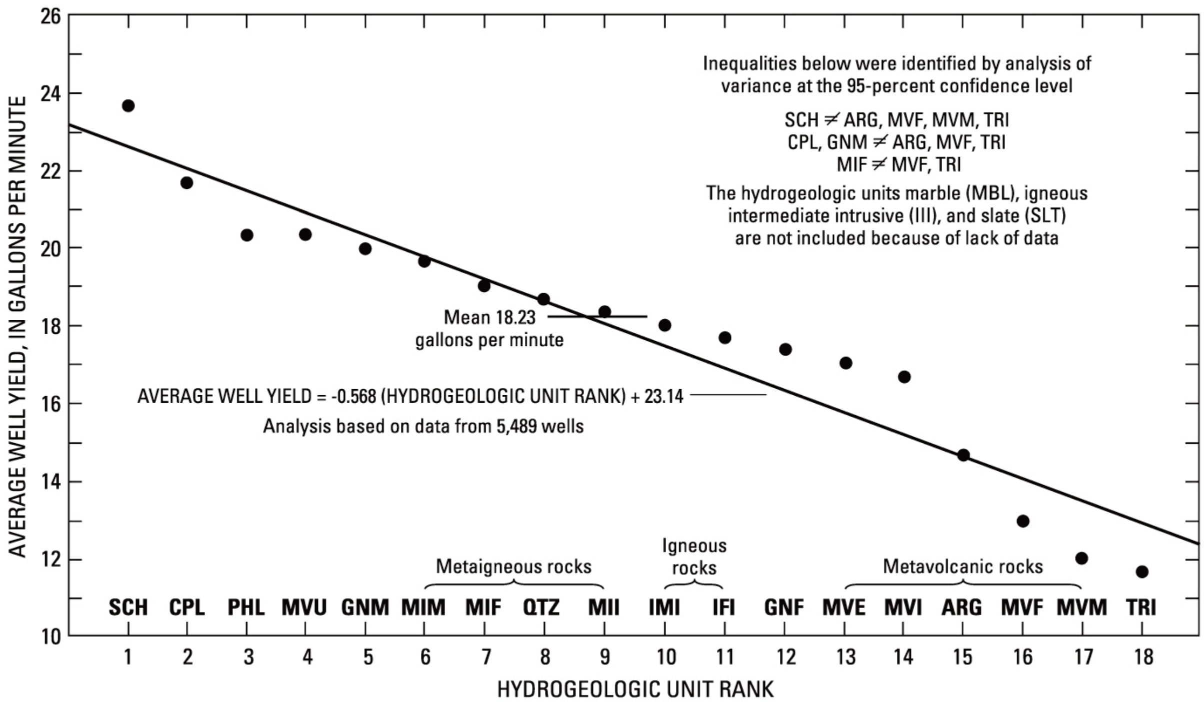
Small supplies of water that are adequate for domestic needs can be obtained from the regolith through large-diameter bored or dug wells. However, most wells, especially where moderate supplies of water are needed, are relatively small in diameter and are cased through the regolith and finished with open holes, often of substantial depth, drilled into the bedrock. Being deeper, bedrock wells generally have much higher yields than regolith wells because they have a much larger available drawdown (Daniel III & Dahlen, 2002).

Nearly all ground-water storage in the Blue Ridge and Piedmont ground-water system is in the regolith. The quantity stored in the bedrock is small by comparison. Ground-water levels decline during the summer and early fall when atmospheric conditions enhance evaporation and plants transpire substantial quantities of water, and rise during the winter and early spring when plants are dormant (Daniel III & Dahlen, 2002).

Based on average thicknesses of saturated regolith, the average quantity of available groundwater in storage in the Piedmont is calculated to be 0.55 million gallons per acre (Mgal/acre) beneath hills and ridges, 0.77 Mgal/acre beneath slopes, and 1.22 Mgal/acre beneath valleys and draws. Overall, the average quantity of groundwater available in the Piedmont is calculated to be 0.73 Mgal/acre. However, well yields in sedimentary basins (principally the Deep River Triassic basin, but also including the parts of the Carolina slate belt) in the Piedmont Province are among the lowest in the State (Daniel III & Dahlen, 2002).

The sustainable yield of aquifers in the Blue Ridge and Piedmont Provinces can be difficult to determine. Although the porosity of the regolith can be sufficient to store large quantities of water, it is difficult to determine whether the water in storage is available to supply bedrock wells during periods of limited recharge such as droughts. Data are not readily available to estimate aquifer boundaries and storage coefficients; both types of information are needed to determine the volume of water in storage (Daniel III & Dahlen, 2002).

In Union County, which consists primarily of argillite formations, well yields for wells of average construction are estimated to be approximately 15 gpm, as indicated in Illustration 3-10. Such yields are on the lower end of the spectrum from well yields in various hydrogeologic units within the Blue Ridge and Piedmont Provinces of North Carolina.



EXPLANATION

Hydrogeologic unit[a]			Hydrogeologic unit[a]		
Rank	Symbol		Rank	Symbol	
1	**SCH**	Schist	10	**IMI**	Igneous, mafic intrusive
2	**CPL**	Coastal Plain basement	11	**IFI**	Igneous, felsic intrusive
3	**PHL**	Phyllite	12	**GNF**	Gneiss, felsic
4	**MVU**	Metavolcanic, undifferentiated	13	**MVE**	Metavolcanic, epiclastic
5	**GNM**	Gneiss, mafic	14	**MVI**	Metavolcanic, intermediate
6	**MIM**	Metaigneous, mafic	15	**ARG**	Argillite
7	**MIF**	Metaigneous, felsic	16	**MVF**	Metavolcanic, felsic
8	**QTZ**	Quartzite	17	**MVM**	Metavolcanic, mafic
9	**MII**	Metaigneous, intermediate	18	**TRI**	Triassic sedimentary rocks

Illustration 3-10 Average yield of wells of average construction in the hydrogeologic units of the Blue Ridge and Piedmont Provinces of North Carolina (Daniel III & Dahlen, 2002)

Recharge

Precipitation recharges groundwater. Typical precipitation rates across North Carolina are heaviest in the mountains and along the coast. Illustration 3-11 indicates that in the Piedmont, annual precipitation ranges averages between 44 and 48 inches, which is the lowest of the regions within the state (U.S. Department of the Interior, 2001). Additionally, precipitation in the central Piedmont is typically the lowest in all of the Piedmont and Blue Ridge Provinces (Daniel III & Dahlen, 2002). Groundwater supplies can be depleted if more water is discharged than recharged. For example, during periods of dry weather, recharge to the aquifers decreases. If too much groundwater is pumped during these times, the water table can fall and wells may go dry (U.S. Department of the Interior, 2001). Assuming that ground-water discharge is equal to ground-water recharge, the average ground-water recharge in the 11 selected Blue Ridge-

Piedmont drainage basins averages 3.3 in/yr (24 percent of average annual streamflow) in the Rocky River Basin (Daniel III & Dahlen, 2002).

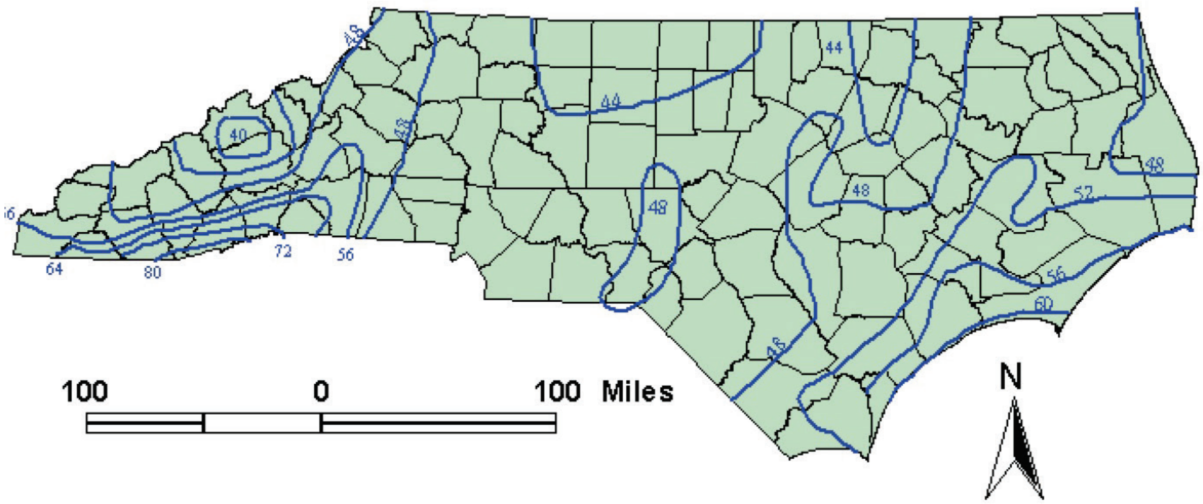


Illustration 3-11 Annual average precipitation in North Carolina (NCDENR, 2012)

The highest ground-water recharge occurs in the cooler, non-growing season during the months of January through March, and the lowest ground-water recharge occurs at the height of the growing season during the months of June through September. Seasonality in ground-water recharge is caused primarily by seasonal variations in the rate of evapotranspiration. Seasonal patterns in precipitation have less effect on recharge. In fact, long-term records indicate that precipitation in North Carolina is rather evenly distributed during the year, and the wettest months are commonly June and July, near the low point of seasonal ground-water recharge (Daniel III & Dahlen, 2002).

North Carolina Requirements

North Carolina Administrative Code (NCAC) Title 15A Subchapter 18C defines rules related to the protection of public water supplies in North Carolina. Section 15A NCAC 18C .0402 defines well construction and protection requirements for water supply wells and yield determination. Of important note, wells must be located so that the drawdown of any well does not interfere with the required yield of another well. Additionally, the combined yield of all wells of a water system must provide in 12 hours pumping time the average daily demand for the system.

While North Carolina regulations require a 24-hour production test be performed on public supply wells prior to acceptance, the Town of Cary's study for a groundwater supply network proved that well yields from the short-term 24-hour tests were considerably greater than the actual long-term yields obtained during actual well production. In the Piedmont, yields during the short-term aquifer tests and yield tests are supported in large part by dewatering the rock fractures. These are apparent yields and are usually considerably higher than the long-term sustained yield. Sustained yield, the true test of the site selection factors, is best determined from long-term monitoring and can take years to establish (Daniel III C. C., 1990).

3.3.1.5. WATER QUALITY

Background

Management of ground-water supplies can be difficult because the most permeable parts of the regolith-bedrock aquifer system typically are shallow and unconfined and, therefore, vulnerable to contamination from numerous human activities at land surface. In addition, the aquifers commonly are hydraulically connected to streams and lakes, and contamination of the aquifers in the interstream areas may eventually lead to contamination of surface-water bodies (Daniel III & Dahlen, 2002).

Because fractures in the bedrock decrease in size and abundance with depth, contamination of these aquifers is difficult to remediate, especially if the contaminant is heavier than water. The situation is even more acute if the contaminant has low solubility in water. Contaminants that settle or move into deeper parts of fractured-rock aquifers tend to become trapped as fracture widths become narrower and ground-water velocities diminish. The surface tension of dense, insoluble contaminants may be sufficient to hold the contaminants in place in narrow fractures (Daniel III & Dahlen, 2002).

Water-quality problems result from natural geochemical processes as well as human activities. The mineral composition of rocks can be reflected in the chemical composition of groundwater as weathering and dissolution release soluble components. Objectionable concentrations of iron and manganese often occur in water from wells completed in mafic igneous and metaigneous rocks. Hydrogen sulfide often is present in water from slates, shales, and other rocks containing disseminated sulfide minerals. Hardness may reach objectionable levels in water from rocks containing carbonates or other calcium-magnesium-bearing minerals. Other water-quality problems related to natural geochemical processes result from the duration of water-rock contact, seasonal variations in recharge (and accompanying changes in the water table), and the presence of trace metals, radon, radium, and uranium in the rocks and soils (Daniel III & Dahlen, 2002).

Radon

The crystalline rocks of the Piedmont consist, in part, of granite, granitic gneiss, and other felsic rocks that contain small to moderate amounts of uranium, which, through the process of radioactive decay, is a source of radon gas. One of the pathways for radon gas migration into households is through groundwater and aeration of the water at faucets and showerheads. In addition to radon, high concentrations of dissolved radium and uranium nuclides have been detected in a few locations in ground-water supplies tapping crystalline and sedimentary rocks of the Piedmont (Daniel III & Dahlen, 2002).

Arsenic

Arsenic contamination of groundwater is a global problem affecting human health. In 2009, a study completed by researchers at Duke University's Nicholas School of the Environment evaluated the extent and concentration of arsenic in well water specifically in Union County, North Carolina. The results of the evaluation show arsenic concentrations above the EPA's maximum contaminant level (MCL) of 10ppb in 22 out of 64 households tested (34%). Based on these results the study found it to be evident that arsenic contamination of drinking water in Union County is an issue of concern (Merola, 2009). This finding is further confirmed by numerous reports within the County of wells contaminated by arsenic and by the concerted effort on the part of Union County's Public Works Department to provide public water service to households with contaminated groundwater wells.

In modern times, the non-occupational arsenic exposure of primary concern is through the ingestion of contaminated drinking water. Public water sources are required to test not only for arsenic but for a host of other potential contaminants on a regular basis. Private drinking wells are also technically required to comply with these standards, although many existing individual households do not meet such criteria. North Carolina's health recommendation for arsenic in drinking water is 0.02 ppb, while the MCL is 10 ppb. Union County is considered to fall within the high arsenic risk area for arsenic contamination in groundwater as identified by Illustration 3-12 (Merola, 2009).

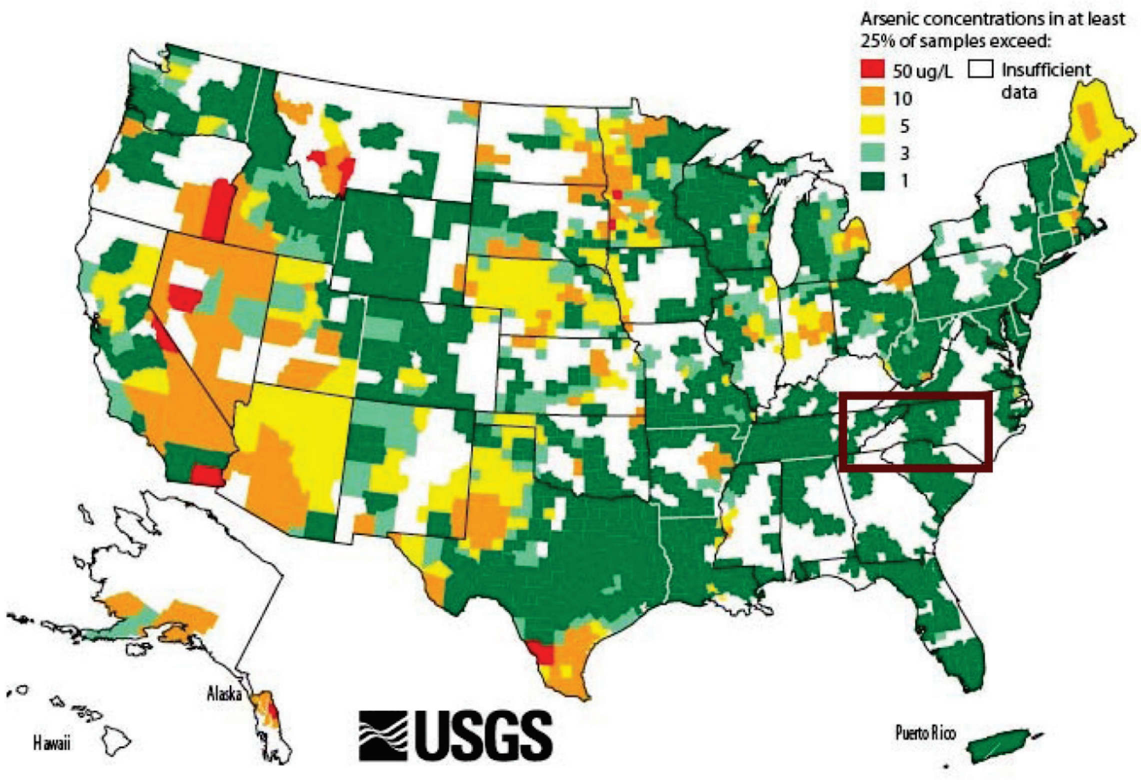


Illustration 3-12 Elevated arsenic concentrations in groundwater across the United States by County, where concentration in at least 25% of samples exceed 1 ppb (1 µg/L) (Merola, 2009)

The presence of arsenic in water and soil is directly related to the geology of the area. Arsenic is released to local aquifers from arsenic containing minerals in the underlying strata. The areas within the Piedmont region of North Carolina possess these minerals and there is a risk of human exposure from the consumption of contaminated well water (Merola, 2009).

Exposure to arsenic has serious consequences for health. Symptoms of acute arsenic exposure include: nausea, vomiting, bloody urine, abdominal pain, severe diarrhea, anuria, shock, convulsions, coma, and death. High concentrations of arsenic need to be present for these symptoms to manifest themselves. The levels that would potentially be present in North Carolina would likely not be high enough to cause these acute symptoms, however chronic effects of arsenic would be of concern. Chronic exposure can lead to skin lesions, peripheral vascular disease, hypertension, Blackfoot disease, and various forms of cancer, commonly including but not limited to: bladder, liver, lung, kidney and skin cancer (Merola, 2009).

Based on the geology of the region, the Union County study indicated there was a probability of 0.022 to 0.382 within the majority of the County that an individual household was likely to have arsenic levels above the EPA's Minimum Criteria Level of 10 ppb (see Illustration 3-13) Of the 64 households tested, 34% (22 out of 64) were above the EPA's 10 ppb Minimum Criteria Level, although there was no observed spatial trend in arsenic concentration throughout the county (see Illustration 3-14) (Merola, 2009).

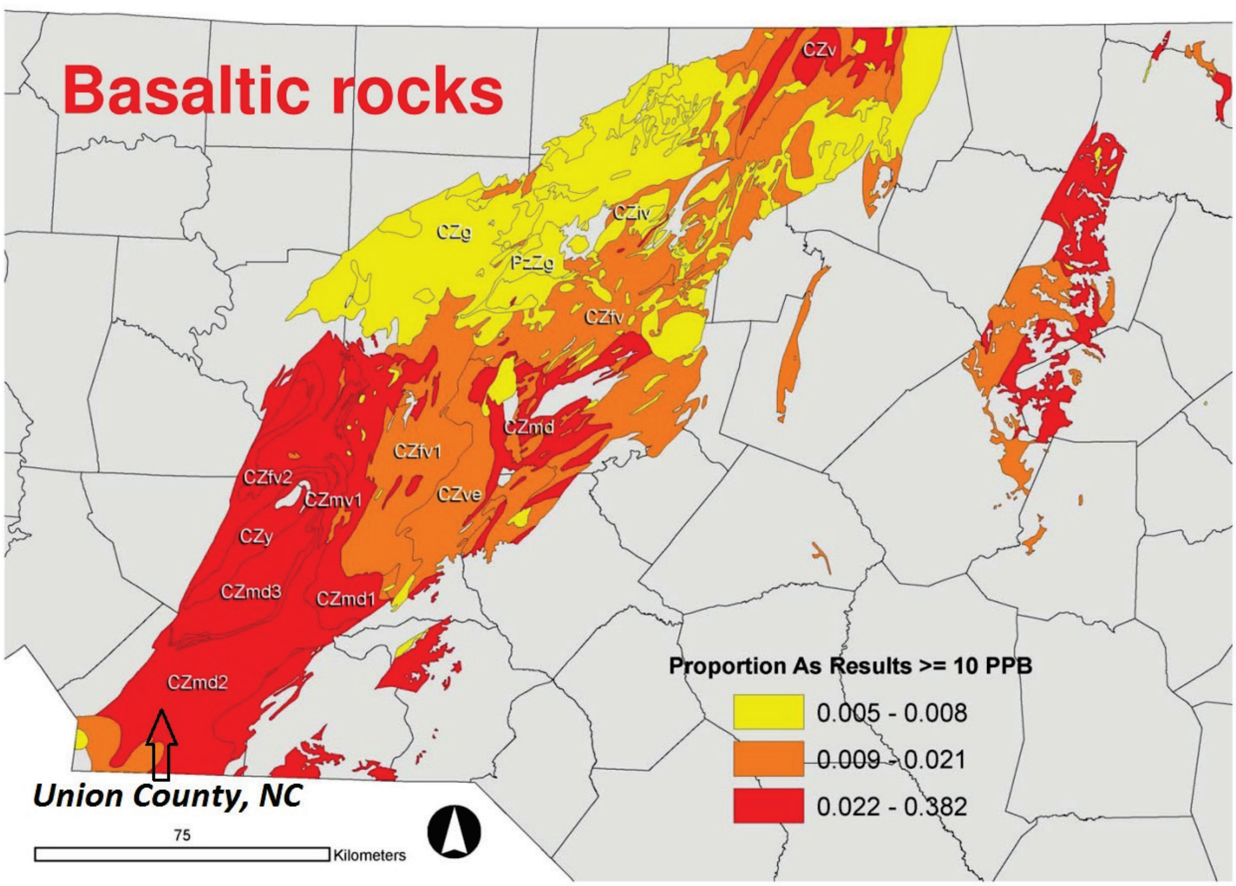


Illustration 3-13 Proportion of Households With Arsenic Concentrations in Drinking Water ≥ EPA's 10 ppb MCL and its Relation to Geology (Merola, 2009)

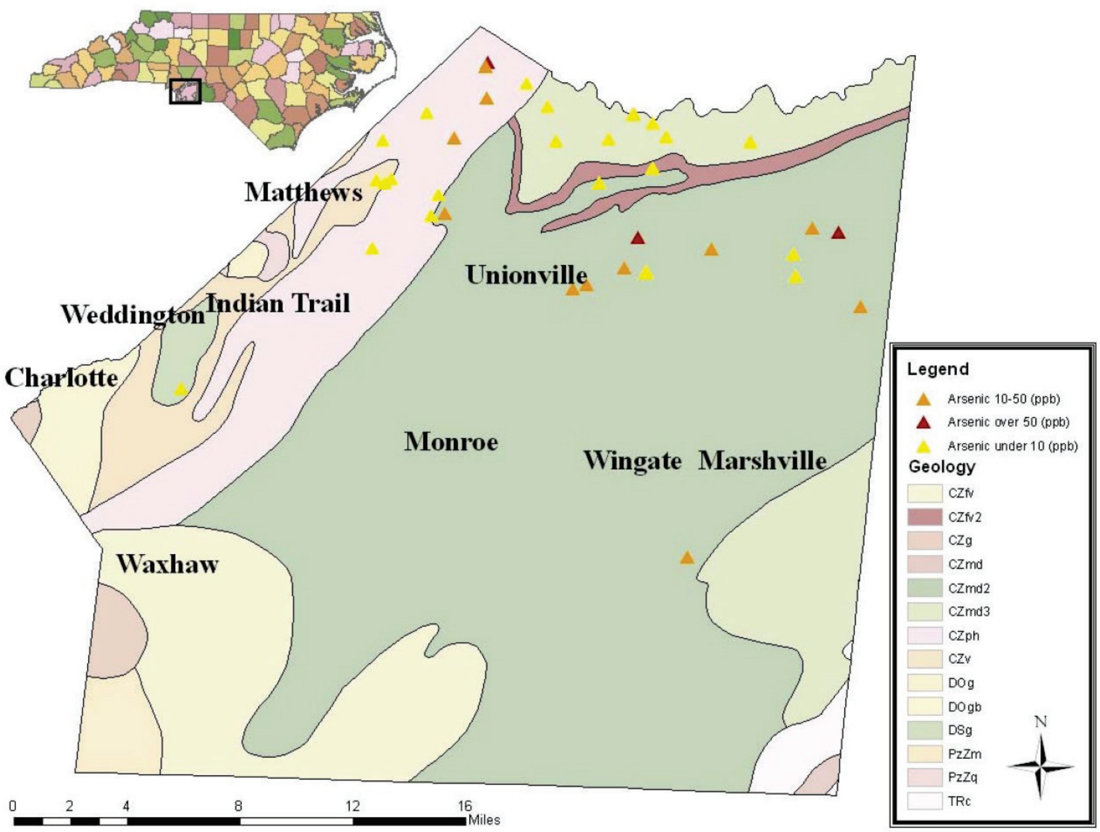


Illustration 3-14 Spatial Distribution of Arsenic Concentrations Found in Individual Wells Tested in Union County (Merola, 2009)

This study demonstrated that there are elevated levels of arsenic in the drinking water of privately owned wells in Union County, North Carolina. Thirty-four percent of households randomly tested are above the EPA's Minimum Criteria Level. The spatial distribution of arsenic found in these households shows no trends. This is to be expected with the fractured nature of the region, and further supports the evidence that the arsenic present is directly related to the geology of the region and not from anthropogenic sources (Merola, 2009).

Previous studies performing a spatial analysis of total arsenic in groundwater from wells located throughout the North Carolina Piedmont also found that wells in rock bodies of the Carolina Slate Belt in the area around Stanly and Union Counties had the greatest probability of containing elevated levels of arsenic above a concentration of 0.001 mg/L. Rocks of volcanic or volcaniclastic origin associated with the high probability areas have the greatest potential for hosting wells with elevated arsenic concentrations (Harden, Chapman, & Harned, 2009).

Other Groundwater Pollutants

Groundwater can become unusable if it becomes polluted and is no longer safe to drink. In areas where the material above the aquifer is permeable, pollutants can seep into groundwater. Groundwater can be polluted by many sources, including seepage through landfills, from septic tanks, from leaky underground fuel tanks, and sometimes from fertilizers or pesticides used on farms (U.S. Department of the Interior, 2001). Public concern about groundwater degradation from point-and nonpoint-source contaminants continues to increase. Groundwater pollutants can be either organic or inorganic. Organic materials are composed primarily of carbon and hydrogen; they may also contain smaller amounts of chlorine, nitrogen, sulfur, and phosphorus. Organic chemicals currently detected in the groundwater include solvents, degreasers, petroleum components, pesticides, certain industrial by-products, and viral and bacterial pathogens. Inorganic pollutants include materials such as nitrate, which can come from fertilizers or decayed organic materials; chlorides; and heavy metals, such as copper and lead (Zublena, 1993).

Other groundwater pollutants of important consideration in Union County are total dissolved solids and nitrate. While water contaminated with nitrate can be treated so that it meets drinking standards, treatments are expensive and include processes such as reverse osmosis, deionization, and distillation. Common sources of nitrate include septic systems, animal manure, decaying organic matter, and commercial nitrogen fertilizers, many of which are related to agricultural land uses, consistent with the eastern portions of Union County (Zublena, 1993). Total dissolved solids (TDS) within groundwater are also an important groundwater quality to consider when evaluating groundwater as a potential public water supply source. Although TDS is not generally considered a primary pollutant (e.g. it is not deemed to be associated with health effects) it is used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants. Primary sources for TDS in receiving waters are agricultural and residential runoff, leaching of soil contamination and point source water pollution discharge from industrial or sewage treatment plants.

Illustration 3-15 reflects the distribution of total dissolved solids and nitrite plus nitrate in groundwater throughout the Blue Ridge and Piedmont Provinces of North Carolina. This figure indicates the elevated levels of total dissolved solids in Union County groundwater as well a slightly elevated level of nitrite plus nitrate. Levels of nitrite plus nitrate are indicated by the figure to be very high in neighboring Anson County.

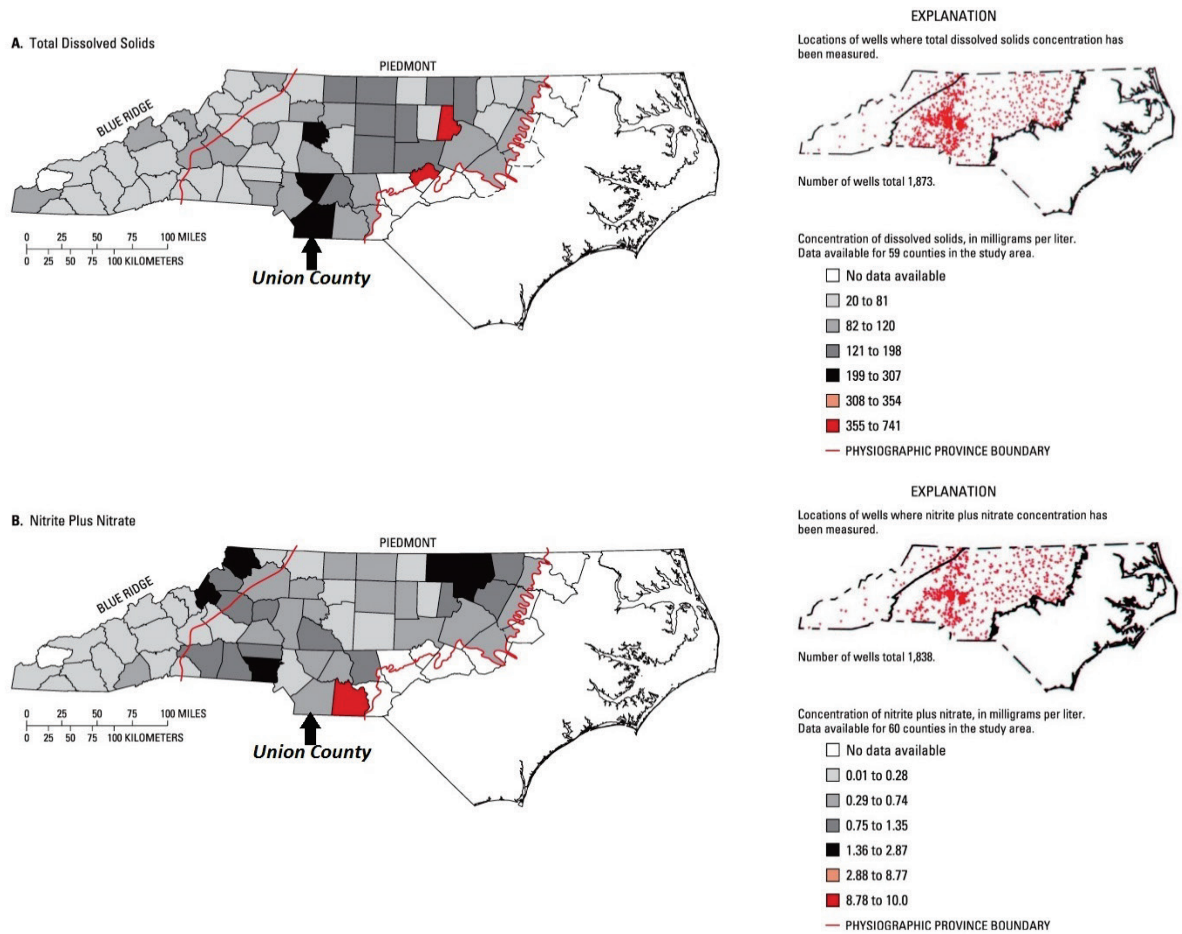


Illustration 3-15 Geographic Variation of Median Concentrations of Total Dissolved Solids and Nitrite Plus Nitrate in Groundwater, by County, in North Carolina (Zublena, 1993)

USGS Groundwater Quality Testing

A 2009 characterization of groundwater quality in the Piedmont and Blue Ridge Provinces of North Carolina found the most common exceedances of the drinking-water criteria (in accordance with Federal and State water-quality standards) occurred for radon, pH, manganese, iron, and zinc. Radon had the most exceedances, with groundwater from 61 of the 69 sampled wells having activities higher than the U.S. Environmental Protection Agency's proposed maximum contaminant level of 300 picocuries per liter. Overall, the Carolina slate geozone had six water-quality properties or constituents that exceeded applicable drinking-water criteria in at least one well. A limited number of geozone wells had exceedances of arsenic, lead, nitrate, and uranium. The USEPA Minimum Criteria Level of 0.010 mg/L (10ppb) for arsenic was exceeded in 4 of 17 wells (24%) sampled in the Carolina slate belt geozone (Harden, Chapman, & Harned, 2009).

Exceedances of dissolved arsenic for the Carolina slate geozone occurred in four wells, with concentrations ranging from 0.0106 to 0.0383 mg/L for wells located in the central and southern parts of the geozone, including two of three wells evaluated within Union County. This observed distribution of arsenic exceedances is in agreement with other studies that identified a zone trending northeast from Union to Person Counties where groundwater has a high probability of containing ambient concentrations of arsenic above the USEPA Minimum Criteria Level of 0.010 mg/L, especially in association with rocks of the Carolina Slate Belt (Harden, Chapman, & Harned, 2009).

The most common exceedances of the drinking-water criteria occurred for radon, pH, manganese, iron, and zinc. Radon activity levels exceeding the proposed Minimum Criteria Level of 300 pCi/L occurred in all geozones. Radon occurs naturally in groundwater of the Piedmont and Mountains Provinces with the highest levels often associated with metaigneous rocks of felsic composition. Manganese exceeded the Minimum Criteria Level of 0.05 mg/L for wells in six geozones, with the highest proportion of exceedances occurring in the Milton and Carolina slate geozones. Exceedances of iron and zinc occurred in over half the geozones, and most commonly for the Milton or Carolina slate geozones (Harden, Chapman, & Harned, 2009).

With the exception of nitrate and zinc, constituents with concentrations exceeding drinking-water criteria appeared to reflect ambient groundwater conditions in the geozones. Exceedances of nitrate and zinc are considered to reflect contamination from local land use and well-casing materials, respectively. Radon was the most commonly exceeded constituent, with 61 of the 69 sampled wells having activities higher than the proposed Minimum Criteria Level of 300 pCi/L. The presence of radon in groundwater used for public supply is of particular environmental concern because of the potential human exposure to radon in groundwater through ingestion (drinking) or inhalation (showering), which increases the risk of developing cancer. The trace elements iron, manganese, and zinc were the other most common constituents that exceeded drinking-water criteria, but the concern with these analyses in drinking water generally is associated with aesthetic effects (Harden, Chapman, & Harned, 2009).

3.3.1.6. REGULATION OF GROUNDWATER IN NORTH CAROLINA

Groundwater Classification

North Carolina Administrative Code Title 15A Subchapter 2L Section .0100, .0200, .0300 Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina (April 1, 2013) identifies the classifications and water quality for groundwater resources within the State.

The classifications which may be assigned to the groundwaters in North Carolina are as follows:

1) Class GA groundwaters; usage and occurrence:
    a. Best Usage. Existing or potential source of drinking water supply for humans.
    b. Conditions Related to Best Usage. This class is intended for those groundwaters in which chloride concentrations are equal to or less than 250 mg/L, and which are considered suitable for drinking in their natural state, but which may require treatment to improve quality related to natural conditions.
    c. Occurrence. In the saturated zone.
2) Class GSA groundwaters; usage and occurrence:

a. Best Usage. Existing or potential source of water supply for potable mineral water and conversion to fresh waters.
b. Conditions Related to Best Usage. This class is intended for those groundwaters in which the chloride concentrations due to natural conditions is in excess of 250 mg/l, but which otherwise may be considered suitable for use as potable water after treatment to reduce concentrations of naturally occurring substances.
c. Occurrence. In the saturated zone.

3) Class GC groundwaters: usage and occurrence:
    a. Best Usage. The best usage of GC groundwaters is as a source of water supply for purposes other than drinking, including other domestic uses by humans.
    b. Conditions Related to Best Usage. This class includes those groundwaters that do not meet the quality criteria for GA or GSA groundwaters and for which efforts to improve groundwater quality would not be technologically feasible, or not in the best interest of the public. Continued consumption of waters of this class by humans could result in adverse health affects.
    c. Occurrence. Groundwaters of this class may be defined by the EMC on a case by case basis.

The NCAC also specifies the required water quality standards for groundwaters in the State. Groundwater standards of important note for consideration in Union County are as follows:

- Groundwater standard for arsenic is 10 ppb
- Groundwater standard for nitrate is 10 mg/L
- Groundwater standard for nitrite is 1 mg/L

Well Construction and Protection

North Carolina Administrative Code Title 15A Subchapter 18C defines rules related to the protection of public water supplies in North Carolina. Section 15A NCAC 18C .0203 defines requirements for public well water supplies. Any site or sites for any water supply well to be used as a community or non-transient, non-community water system must be investigated by an authorized representative of the Division of Environmental Health. Approval by the Division is required in addition to any approval or permit issued by any other state agency. This section also defines a series of site requirements and limitations for public well water supplies.

Of important note related to the construction of wells within Union County, the state's construction requirements note that wells drilled in areas underlain by metavolcanic rocks identified on the 1958 State Geologic Map as bedded argillites of the Carolina Slate Belt shall be cased to a minimum depth of 35 feet (10 feet deeper than all other areas). Areas within Union County subject to this requirement include all but the very western point of Union County near Mecklenburg County and the South Carolina line (Huffman & Miner, 1996).

3.3.1.7. MUNICIPAL GROUNDWATER SYSTEM DEVELOPMENT AND SITING

Background

Little research exists to effectively quantify the productivity and success of municipal groundwater supply systems in the Piedmont of North Carolina, primarily due to the hydrogeology of the region, its low groundwater yields and subsequent infrequency of large-scale municipal groundwater supply systems. However, a study of the Town of Cary's municipal groundwater system during the 1980's was completed by the USGS to evaluate system siting considerations, productivity and cost effectiveness (Daniel III C. C., 1990).

The Cary ground-water development program began in early 1981. For the evaluation conducted by the USGS, between November 1981 and October 1982, 13 wells were drilled. Eleven of these had sufficient yield to warrant construction of treatment distribution facilities so the wells could be put into production as part of the town supply. In addition, two preexisting wells were scheduled for reactivation after extensive testing. When the combined estimate yield of all usable wells approached the town goal of 1 mgd, drilling was discontinued and further activity was directed toward bringing the wells into productions. By May 1983, the first of the 13 wells was in routine operation (Daniel III C. C., 1990).

Although the data analyses and related interpretations described in the study report focused on a small area of the eastern Piedmont of North Carolina, it was indicated the methods of well-site selection, well construction, and water-supply management could likely be applied to the evaluation of groundwater supply systems through the Piedmont and southeastern United States (Daniel III C. C., 1990).

Siting Considerations

Non-hydrologic restraints, nearly all manmade, often make the best well sites unacceptable for public supply wells. Manmade restraints have considerable impact on the selection of well sites. Most of these, such as the proximity to landfills, urban and industrial developments, highways, railroads, airports, reservoirs, water lines, and sewer lines, can be readily identified. These restraints, whether existing or planned in the future, need to be taken into consideration during well site selection. Conversely, once wells are established, the watershed around the wells need to be protected from loss of recharge area and pollution by these same manmade features (Daniel III C. C., 1990).

Public health agency regulations that address the siting and construction of wells in the Piedmont and Blue Ridge regions of North Carolina can also have considerable impact on the site selection process. Generally, the health regulations deal with the immediate site of the well. Although all the health regulations have some effect on site selections, those with the greatest impact on well yield control the siting of a well in a valley or draw. Well sites in draws or valleys are generally not approved because of a potential danger from contamination from both groundwater and overland flow toward a well site. As such, well sites are typically relegated to hilltops and interstream divides, where water yield is typically lower because of fewer fractures beneath hilltops and less available recharge (Daniel III C. C., 1990).

The Town of Cary groundwater supply was comprised of a multiwall system, where wells were manifolded together so that water treatment equipment was needed only at one site on the manifold system (as opposed to each well). While reducing treatment and equipment costs, in order to manifold wells in an effective manner, the wells cannot be spaced too far apart. Additionally, the wells cannot be so close together that there is excessive drawdown interference. The Town of Cary study indicated that a spacing of 800 to 1,000 feet was reasonable between high-yield wells throughout the Piedmont and Blue Ridge (Daniel III C. C., 1990).

System Yield

In an operating system supplied only by groundwater, wells can be pumped at a constant rate that is less than or equal to the average summer recharge rate, provided that there is a sufficient number of wells to meet summer demand. If the pumping rate is set too high during the winter or if the winter recharge is below normal, the drawdown trend established will continue through the summer months, indicating over-pumping of the system. A downward trend will also occur if summer recharge is well below average, as would occur during a drought. In groundwater supply systems, where the goal is to produce the maximum amount of water, the groundwater level trends should be relatively flat, and, rather than having a constant pumping rate, the system operator must adjust pumping rates seasonally to match the recharge rates (Daniel III C. C., 1990). This can become a significant logistical challenge from an operational standpoint and can be very difficult to effectively regulate for the very large well network that would be required to meet Union County's demands.

In the Cary study, long-term testing and monitoring after the wells were put into production showed an 18-hour-on, 6-hour-off pumping cycle was much more effective than a 5-day-on and 2-day-off cycle due to increased total production, reduced head loss and less drawdown. It was also observed that long-term yields by the production of the wells were about 75 percent of those predicted on the basis of the 24-hour pumping tests required by North Carolina and only about 60 percent of the well driller's reported yields (Daniel III C. C., 1990).

The Town of Cary study reflected a system average pumping rate of 47.7 gallons per minute per well at an average pumping period of 17.45 hours per day. This equates to a daily average well production of 49,640 gallons per day (approximately. 0.05 mgd) per well or 34.5 gallons per minute per day per well (Daniel III C. C., 1990).

Cost Analysis

Cost analysis showed that, by using criteria-selected well sites, a cost-effective well system can be developed that will provide water at an equivalent or lower cost than a surface-water supply. The analysis showed that the system would be cost effective if only one high-yield well were obtained out of every four drilled (Daniel III C. C., 1990). However, the Town of Cary's groundwater system was developed with a water supply demand of only 1 mgd. For smaller municipal systems, groundwater supply networks can be cost-effective solutions. However, for large systems with large water demands, the costs and land requirements for a vast network of wells to meet such demands becomes prohibitive in comparison to readily available surface water supplies. Even the use of a groundwater supply to supplement surface water supplies is often impractical for larger utilities. Of additional note, as the Town of Cary has grown over the last 30 years as a suburb of the City of Raleigh, Cary relies solely on surface water sources to meet its water demand, withdrawing an average of 15.3 mgd from B. Everett Jordan Lake in 2013.

The Cary study determined that in order to be cost-effective (i.e. comparable costs to surface water supply), a new well had to produce at least 44 gallons per minute individually and at least 33 gallons per minute on a manifolded system (Daniel III C. C., 1990). Based on the hydrogeological composition of the Carolina slate belt in which Union County is located and the estimated average well yield of 15 gallons per minute, as previously discussed, it is highly unlikely that a Union County groundwater supply system could achieve the system yields needed to make groundwater a cost effective alternative to surface water supply.

Based on the results of the Town of Cary evaluation, to develop a public groundwater supply system to meet Union County's projected demands in the Rocky River IBT Basin, an extensive land area would be needed to develop the number of wells needed for the system. Additionally, estimated costs would likely be significant. Average well yields for the Town of Cary were estimated at 34.5 gallons per minute. However, average well yields within the argillite formations of Union County have been estimated by the USGS to be 15 gallons per minute. Based on the Town of Cary study, well spacings for a manifolded system were suggested to be 1,000 feet apart, meaning each well in the system has a footprint of 1,000,000 square feet (approximately 23 acres). Table 3-6 summarizes the requirements for a groundwater supply system that would be needed for Union County based on a 15 gpm well production (average for Union County) and a 34.5 gpm production (average determined in Town of Cary study) per day. The results are presented for maximum month daily water demand at 5, 10, 15, 20 and 23 mgd. 23 mgd is the maximum month daily water demand proposed for the Yadkin River Water Supply Project. Estimated costs are prorated from the Town of Cary study cost estimates for capital and sunk costs per well for a manifolded well system (at ~$50,000 per well in 1982 dollars) and based on 2014 US dollars (now equal to ~$120,000 per well due to the 1983 to 2014 cumulative inflation rate of ~140%, as published in the US Bureau of Labor Statistics Consumer Price Index (CPI)).

Table 3-6 Requirements for Development of a Union County Groundwater Supply System for the Rocky River IBT Basin Service Area.

Water Demand	15 gpm/day well productivity[1]			
	# Wells Req'd	Area Required[3] (acres)	% Union County Land Area	Estimated Cost[4]
5 mgd	230	5,290	1.3%	$27.6 M
10 mgd	460	10,580	2.6%	$55.2 M
15 mgd	685	15,755	3.8%	$82.2 M
20 mgd	925	21,275	5.2%	$111.0 M
23 mgd[5]	**1,065**	**24,495**	**6.0%**	**$127.8 M**
28 mgd[6]	**1,295**	**29,785**	**7.2%**	**$155.4 M**

Water Demand	34.5 gpm/day well productivity[2]			
	# Wells Req'd	Area Required[3] (acres)	% Union County Land Area	Estimated Cost[4]
5 mgd	100	2,300	0.6%	$12.0 M
10 mgd	200	4,600	1.1%	$24.0 M
15 mgd	300	6,900	1.7%	$36.0 M
20 mgd	400	9,200	2.2%	$48.0 M
23 mgd[5]	**460**	**10,580**	**2.6%**	**$55.2 M**
28 mgd[6]	**560**	**12,880**	**3.1%**	**$67.2 M**

Notes:

1. 15 gpm/day well productivity based on average well productivity in Carolina Slate Belt argillite formations (Union County) (Daniel III & Dahlen, 2002).
2. 34.5gpm/day well productivity based on Town of Cary average day productivity from 1980s evaluation (Daniel III C. C., 1990).
3. Estimated land area required for Union County groundwater supply system as determined from assumed 1,000 foot well spacing as recommended by Town of Cary study (Daniel III C. C., 1990).
4. Estimated groundwater supply system development costs based on 2014 dollars, using cost estimates for manifolded systems presented in the Town of Cary study (Daniel III C. C., 1990). Does not include additional costs for necessary water treatment plant and groundwater transmission main infrastructure.
5. 23 mgd is the maximum month daily demand projected for Union County's Rocky River IBT Basin by year 2050 that would be needed from the Yadkin River Water Supply Project or alternatively from a public groundwater supply system.
6. 28 mgd is the maximum day demand projected for Union County's Rocky River IBT Basin by year 2050 that would be needed from the Yadkin River Water Supply Project or alternatively from a public groundwater supply system.

3.3.1.8. CONCLUSIONS

Problems related to ground-water development and protection within the Blue Ridge and Piedmont fall into two general categories: (1) groundwater availability; and (2) groundwater quality. Well yields are highly variable, even from wells tapping the same hydrogeologic units. Increasing population growth, industrial development, and recent droughts have increased the demand for additional water supplies in the study area. Increased groundwater withdrawal has caused declines in water levels in places, decreases in well yields, and interference between cones of depression associated with closely spaced pumping wells. Pumping of wells can induce infiltration from streams or reduce groundwater discharge to streams, thus reducing streamflow by an unacceptable amount (Daniel III & Dahlen, 2002).

The use of groundwater as a reliable water supply source for Union County to serve its existing and future customers in the Rocky River IBT Basin is not a viable alternative for a number of reasons. Concerns with groundwater yield, groundwater quality and development costs and logistics for a large scale well network within the County severely limit the potential effectiveness of this water supply alternative. The use of groundwater to meet Union County's water supply demands is not preferred to other alternatives for the following reasons:

- Groundwater Availability – Based on the hydrogeologic composition of the majority of the County, which consists primarily of argillite, due to its position within the Carolina Slate Belt, average well yields have been determined in previous USGS studies to be 15 gallons per minute. Limited numbers of high productivity wells within these formations mean that the County would require an extensive network of groundwater wells of average production. Due to the required spacing of individual wells, the amount of land (presumably existing agricultural land) and cost required to develop such an extensive network of wells is not preferred to other surface water alternatives as a result of the potential site development impacts of this alternative. Even the use of groundwater to supplement surface water supplies does not justify the cost and land impacts that would be necessary to develop groundwater as a reliable source of water supply for Union County.

- Land Impacts – Figures 3-1e and 3-2 depicts a generalized footprint for the required well field and pipe corridor needed for Alternative 8. To determine a potential well field development area for this alternative, a grouping of parcels providing 15-20% more undeveloped land than what is needed for the well field was identified as a circular area. As shown in Figure 3-2 this area represents approximately 28,300 acres, as compared to the 24,500-acre maximum month daily average demand requirement. In order to maintain an appropriate distance from streams, all land within 500 feet of a DWR-classified stream was eliminated from the required area calculation. From this potential 28,300 acre well field development area, a transmission corridor of approximately 7 miles, following the shortest distance along existing roads, to the proposed water treatment plant Site Area D is also identified in Figures 3-1e and 3-2. This figure highlights the magnitude of the required well field development area within Union County and inherent impracticality of this alternative.
- Groundwater Quality – Groundwater in various areas of Union County, particularly in the northern portions of the Rocky River IBT Basin has been determined to contain concentrations of arsenic, radon and nitrate above the US EPA and State of North Carolina limitations. Groundwater used for large scale public supply purposes in the County would likely require water treatment to a similar level as surface water sources to remove potential contaminants. Therefore, it is estimated that water treatment for groundwater would require similar facilities and costs as those proposed for surface water alternatives. Furthermore, it is a goal of Union County's Public Works Department to replace groundwater wells with known arsenic contamination by providing these residents with public water service.

3.3.2. Alternative 9 – Water Conservation and Demand Management

3.3.2.1. UNION COUNTY WATER USE ORDINANCE

As previously discussed in Section 2.5, on May 4, 2015 Union County officially adopted a new Water Use Ordinance (Ordinance) which outlines conservation measures required when water demand by customers connected to the Union County water system reaches a point where continued or increased demand will equal or exceed the treatment and/or transmission capacity of the system or portions thereof. The Ordinance serves as an update to the County's Water Conservation Ordinance, which was originally adopted in 1992 and subsequently amended several times.

The County's Ordinance is applicable during times of drought, where raw water supply is at risk, and when there are other capacity limitations within the County's water treatment and distribution system due to high demands or system emergencies. The Ordinance has five levels of water shortage conditions, including Stage 0, 1, 2, 3, and 4 Water Shortage Conditions, which are issued with increasing severity according to the applicable water shortage.

A complete copy of the County's previous Water Conservation Ordinance, new Water Use Ordinance and Water Shortage Response Plan are provided in Appendix E, CD-1.

Since 2009, Union County has remained in a Stage 2 Water Shortage Condition, as defined by the Water Conservation Ordinance. During such time, Union County has imposed mandatory water use restrictions limiting lawn irrigation to no more than two days per week per customer. Such restrictions have been voluntarily imposed by Union County, while not in a drought, primarily due to capacity concerns to meet the system's water demand on peak days. Such restrictions are considered to be stringent during non-drought periods and have proven successful over the last five years in reducing the County's peak day water demands.

3.3.2.2. LOW INFLOW PROTOCOL FOR THE CATAWBA-WATEREE HYDROELECTRIC PROJECT

In addition to the Water Use Ordinance, as joint owner of the Catawba River Water Treatment Plant in Lancaster County, South Carolina, Union County must abide by the restrictions set forth in the Low Inflow Protocol (LIP) for the Catawba-Wateree Hydroelectric Project during drought conditions. The purpose of this LIP is to establish procedures for reductions in water use during periods of low inflow to the Catawba-Wateree Hydroelectric Project. The LIP was developed on the basis that all parties with interests in water quantity will share the responsibility to establish priorities and to conserve the limited water supply. A copy of the LIP may be found in Appendix E, CD-1.

Table 3-7 summarizes the required water use reduction goals applicable to Union County, based on water use restrictions for customers, as defined by the LIP for the Catawba-Wateree Hydroelectric Project.

Table 3-7 Catawba-Wateree Low Inflow Protocol Water Use Reduction Goal by LIP Stage

LIP Stage	Water Use Reduction Type	Water Use Reduction Goal
Normal	None	N/A
Stage 0	None	N/A
Stage 1	Voluntary	3-5%
Stage 2	Mandatory	5-10%
Stage 3	Increased Mandatory	10-20%
Stage 4	Emergency Mandatory	20-30%

3.3.2.3. LOW INFLOW PROTOCOL FOR THE YADKIN & YADKIN-PEE DEE RIVER HYDROELECTRIC PROJECTS

Similar to the LIP for the Catawba-Wateree Hydroelectric Project, an LIP for the Yadkin and Yadkin-Pee Dee River Hydroelectric Projects, operated by APGI and Duke Energy Progress, respectively, exists for the Yadkin River Basin. This LIP is implemented during periods when there is not enough water flowing into the projects' reservoirs to meet the projects' required minimum instream flows while maintaining reservoir water elevations within normal operating ranges. This LIP also specifies water withdrawal reduction measures for other water users in portions of the Yadkin River Basin during times that inflow is not adequate to meet all of the normal water demands for water and maintain reservoir levels as normally targeted. A copy of the LIP may be found in Appendix E, CD-1.

If granted an IBT certificate to transfer water from one of the reservoirs of the Yadkin River Basin governed by the LIP, Union County would also be required to abide by such LIP requirements. Table 3-8 summarizes the required water use reduction goals which would be applicable to Union County, based on water use restrictions for customers, as defined by the LIP for the Yadkin and Yadkin-Pee Dee Hydroelectric Projects.

Table 3-8 Yadkin-Pee Dee Low Inflow Protocol Water Use Reduction Goals by LIP Stage

LIP Stage	Water Use Reduction Type	Water Use Reduction Goal
Normal	None	N/A
Stage 0	None	N/A
Stage 1	Voluntary	5%
Stage 2	Mandatory	10%
Stage 3	Emergency Mandatory	20%
Stage 4	Emergency Mandatory	>20% (as determined by Yadkin Drought Management Advisory Group)

3.3.2.4. DETAILS FOR ALTERNATIVE 9

Based on the three existing water conservation and demand management ordinances and protocols that are applicable to Union County, additional measures of such conservation and demand management are not warranted. The County has recently revised their Water Conservation Ordinance to a new Water Use Ordinance that permanently limits outdoor landscape watering and lawn irrigation to three (3) days per week during normal water conditions in an effort to maintain the lower peak day demands that the County has experienced following the 2006-2008 drought while remaining in a Stage 2 Water Shortage Condition since that time. Upon its adoption by the County Board of Commissioners, such baseline water use restrictions are now some of the most stringent in North Carolina. Based on an analysis of historical water usage, the Water Use Ordinance exceeds the reduction goals included in the Catawba-Wateree LIP.

The Union County water demand projections previously discussed in Section 2.3 have been based upon historical water use data and peaking factors since the 2006-2008 drought. As such, they are developed upon data generated while the County has maintained mandatory water use restrictions under the Stage 2 Water Shortage Condition. Inherently, the effect of water conservation and demand management is already built into the water demand projections established as part of this EIS. Further options for reducing water demand through conservation and demand management would be difficult to identify, quantify and ultimately implement as part of this Alternative.

If granted an IBT certificate for water transfers from the Yadkin River IBT Basin to the Rocky River IBT Basin of the Yadkin River Basin, Union County would be subject to two LIPs: the

Catawba-Wateree LIP and the Yadkin-Pee Dee LIP. While very similar in their water use reduction goals for corresponding stages of drought, there are several slight differences. Whereas the Catawba-Wateree LIP provides a target range for water use reductions from Stages 1 through 4, the Yadkin-Pee Dee LIP provides a set reduction goal for each Stage, which is generally the upper bound of the reduction goal ranges outlined in the Catawba-Wateree LIP.

Since the Union County water system serves customers within both the Catawba and Yadkin River Basins, it is committed to promoting a consistent message related to water use reduction measures during times of drought in order to comply with both the Catawba-Wateree and Yadkin-Pee Dee LIPs. Such coordination of messages throughout the water system will also be important to effectively link both LIPs with the County's Water Use Ordinance. As such, the water use reduction goals outlined in 3-9 are recommended for the entirety of the Union County water system, and represent the upper threshold of both LIPs by stage.

Table 3-9 Proposed Union County Low Inflow Protocol Water Use Reduction Goals by LIP Stage

LIP Stage	Union County Water Shortage Condition	Water Use Reduction Type	Water Use Reduction Goal
Normal	-	None	N/A
Stage 0	-	None	N/A
Stage 1	Stage 1	Voluntary	5%
Stage 2	Stage 2	Mandatory	10%
Stage 3	Stage 3	Emergency Mandatory	20%
Stage 4	Stage 4	Emergency Mandatory	>20%

While such reduction goals are not expected to reduce the overall projected water demand for Union County's Yadkin River Water Supply Project and subsequent IBT, these conservation measures are intended to help reduce maximum day and maximum month peaking factors that may be experienced during future droughts, and avoid the high peaking factors that were previously experienced by the County during the 2006-2008 drought. Adherence to the LIPs and County Ordinance will help ensure the average annual day to max day peaking factor used as the basis of projections for the Yadkin River Water Supply Project remain at or below 1.7. Additionally, these goals seek to promote a collaborative environment between Union County and other water users within both the Catawba and Yadkin River Basins during periods of low inflow to both basins.

In addition to the County's Water Use Ordinance and use of the LIP for water conservation and demand management during water shortage conditions, Union County is also in the process of implementing a schedule to conduct annual water system audits according to the AWWA M36 Water Audit Method as a means to identify and potentially reduce "Non-revenue" Water volumes, particularly water losses. Additional discussion on this audit procedure was previously discussed in section 2.3.4 of this document. The intent of these routine water audits will be to quantify the components of "Revenue Water" and "Non-Revenue Water" and identify ways to reduce apparent and real losses.

According to AWWA, "Non-Revenue Water" reflects the distributed volume of water that is not reflected in customer billings. Non-revenue Water however, is specifically defined as the sum of

Unbilled Authorized Consumption (water for firefighting, flushing, etc.) plus Apparent Losses (customer meter inaccuracies, unauthorized consumption and systematic data handling errors) plus Real Losses (system leakage and storage tank overflows). In this way, the term "Non-revenue Water" includes the sum of the varied and disparate types of losses and authorized unbilled consumption typically occurring in water utilities (AWWA, 2012). The goal of Union County's water audit program is to identify the most effective and economical water loss management practices, from "low-hanging fruit" options such as resolving potential customer billing and metering errors and reducing unauthorized water use, to potentially more complex and costly measures such as system leak identification and repair, where the audit indicates this to be a beneficial water loss management solution.

3.3.3. Alternative 10 – Direct Potable Water Reuse

3.3.3.1. GENERAL

Scarcity of freshwater resources for drinking water use in many areas of the world creates a need for creative alternative water sources. Establishing a method of supplying stable, sufficient, and safe drinking water to communities is essential. In areas of the world where water resources have become scare, a novel solution is direct potable reuse (DPR). This introduction of highly-treated wastewater into the drinking water treatment process solves the problem of unreliable raw water resource availability due to water scarcity/water stress, population and demographic pressures, polluted freshwater sources, and costly deliverance of water from distant locations. At one point in the not too distant past, DPR was not considered a practical option by many water resources and health organizations. However, advances in water treatment technology, water quality monitoring, constituent detection and health risk analysis systems have occurred. As a result, scientific and public health researchers, water industry specialists, policy makers and community stakeholders are looking to DPR's as a potential alternative water source. However, widespread acceptance of DPR will require identification and resolution of concerns regarding treatment train technology, health risks, regulatory issues, management and operational controls, public perception issues and cost (Cain, 2011).

The premise of DPR involves directly pumping highly treated wastewater into drinking water treatment systems for potable use. Potable water reuse takes two forms; indirect potable reuse (IPR) and direct potable reuse (DPR). Planned IPR is considered to be the planned incorporation of reclaimed water into a raw water supply, such as in potable water storage reservoirs or a groundwater aquifer, resulting in mixing and assimilation, thus providing an 'environmental buffer' which, after a specified time period, is withdrawn for drinking water treatment. Unplanned IPR has occurred for decades in the US where treated wastewater effluent is discharged into a river source upstream from a drinking water treatment plant intake. Unplanned IPR is also known as de facto IPR. DPR refers to the introduction of highly treated reclaimed water either directly into the potable water supply distribution system downstream of a water treatment plant, or into the raw water supply immediately upstream of a water treatment plant. DPR occurs without intervening storage and is considered a 'pipe-to-pipe' transfer. Of important distinction is the existence and use of this IPR 'environmental buffer' which serves as a spatial and temporal buffer between treated wastewater effluent and drinking water treatment (Cain, 2011). A schematic of the DPR process is reflected in Illustration 3-16.

DPR has been recommended as a better alternative to IPR due to its efficiency (recycling the water where needed in the amounts needed), cost (avoiding storage, pumping and retreatment costs), and purity (piping highly treated wastewater effluent directly into enhanced drinking water treatment trains avoids potential contamination of highly purified water in environmental barriers). Additionally, IPR through groundwater recharge requires a suitable aquifer and IPR through surface water augmentation requires reservoir site availability (Cain, 2011).

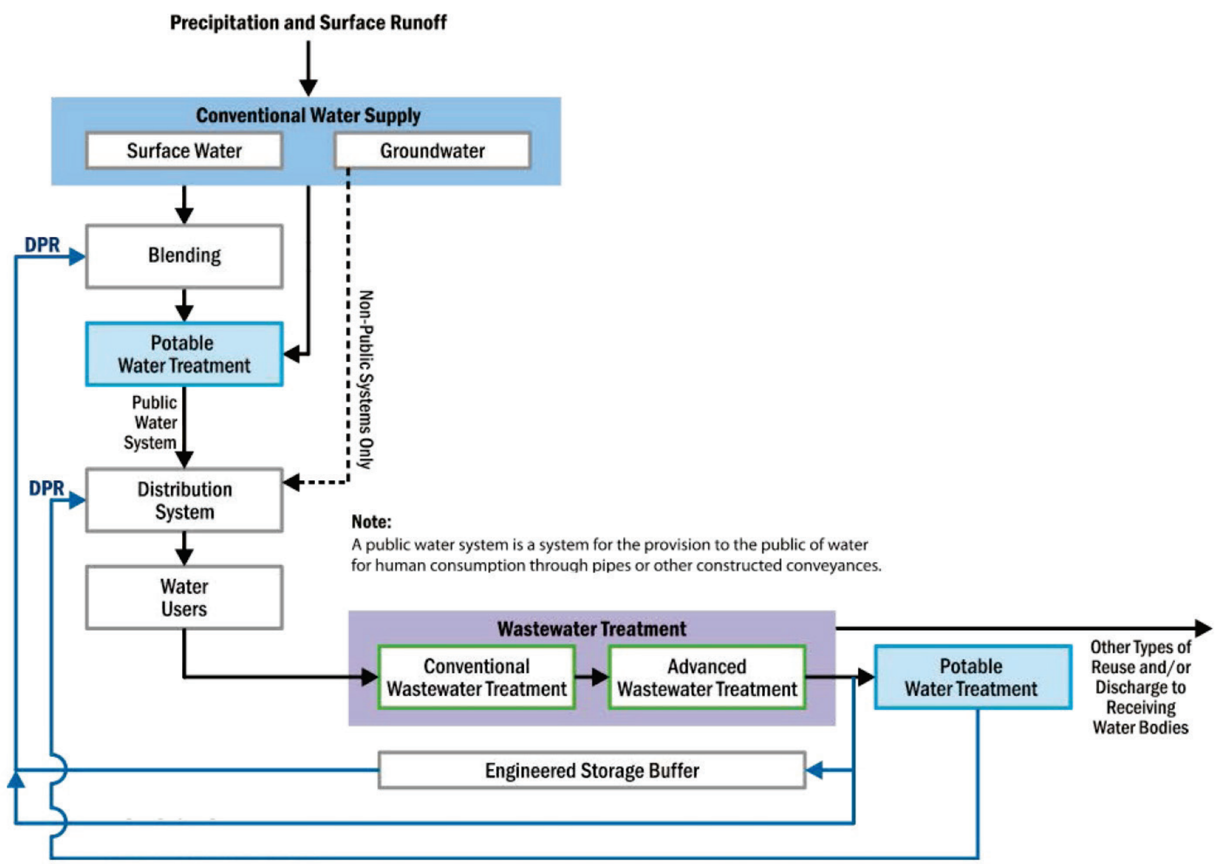


Illustration 3-16 Direct Potable Reuse Process Schematic (U.S. Environmental Protection Agency, 2012)

3.3.3.2. CONCERNS AND CONSIDERATIONS

The use of recycled water for DPR raises a number of issues and requires a careful examination of regulatory requirements, health concerns, project management and operation, and public perception. To date, regulations or criteria for direct potable reuse have only been established by several individual states within in the United States, and the practice generally has been deemed unacceptable in the past by regulatory agencies due to a lack of definitive information related to public health protection. However, certain states, such as California and Texas are considering DPR’s potential as a reasonable option to consider based upon significant advances in treatment technology and monitoring methodology in the last decade, health effects data from IPR projects and DPR demonstration facilities, and water quality and treatment performance data generated at operational IPR projects that have advanced wastewater treatment (Crook, 2010).

Although there is limited experience with DPR both globally and within the United States, several epidemiological and toxicological health effects studies have been conducted in the last 30 years on recycled water generated at IPR projects and at direct potable reuse demonstration facilities to evaluate the public health implications of potable reuse. While none of the studies indicated that drinking recycled water would present health risks greater than those attributable to existing water supplies, the data from the studies are sparse and the limited nature of the toxicological and epidemiological techniques used for many of the studies prevent extrapolation of the results to potable reuse projects in general. However, some health experts are of the opinion that – if multiple treatment barriers are in place such that all water quality criteria for constituents of concern are reliably met and the chemical composition of the water is well understood – the need for toxicological characterization of the water is low and may not be needed for DPR projects (Crook, 2010).

Assessment of the safety of using recycled water for DPR must consider several factors, such as microbial and chemical quality of the product water, emerging concerns over Endocrine Disruptive Compounds (EDCs), treatment performance and reliability, multiple barriers, monitoring capability, and system operation and management. For direct potable reuse to proceed in the United States, these factors (and others) present issues that would need to be resolved by regulatory agencies during the development of regulations, policies, and/or guidelines (Crook, 2010).

3.3.3.3. ADVANCED WATER TREATMENT FOR DIRECT POTABLE REUSE

To ensure that a water agency consistently produces safe potable water, sequential multiple barriers are installed to remove constituents of concern. Technological redundancy enhances reliability of safe water production. Current advances in real-time monitoring technology and robustness of existing and new technologies, such as enhanced membrane systems and advanced oxidation processes, offer nearly complete elimination of trace contaminants. Multiple barrier systems also include non-treatment and operational components, inserting safety barriers based on associated constituent risk to end users (Crook, 2010).

Current technologies allow for high quality water production which can surpass current drinking water standards via Advanced Drinking Water Treatment (ADWT). ADWT is focused on trace constituent removal from reclaimed water beginning with secondary effluent from a conventional wastewater treatment plant, applying tertiary treatment, and then dissolved constituent removal, conditioning and disinfection. Bacteria, viruses and protozoa are treated with filtration and disinfection. Inorganics are treated with membrane bioreactors (MBR) and reverse osmosis (RO). EDCs and Pharmaceuticals and Personal Care Products (PPCPs) are targeted by Microfiltration (MF), RO and Ultraviolet Irradiation (UV). Selection of treatment steps depends on multiple factors including source water composition, and with DPR, end potable use drives selection. Common ADWT treatment trains include MF, RO, Powder/Granular Activated Carbon (PAC/GAC), Advanced Oxidation Processes (AOPs) and chlorination or UV treatment. Not all systems use all of these technologies at once. A typical treatment train in IPR systems is conventional treatment followed by MF, RO and UV followed by conventional drinking water treatment (Cain, 2011). Key treatment technologies are as follows:

- Powdered, granular, biological activated carbon (PAC, GAC, BAC) - MBRs
- Reverse osmosis (RO) - MBR
- Ion exchange
- Advanced oxidation processes (AOPs)
- Nanofiltration (NF) - MBR
- Microfiltration (MF) and Ultrafiltration (UF) - MBRs
- Chlorine, ozone and ultraviolet radiation (UV) disinfection

3.3.3.4. OBSTACLES FOR ACCEPTANCE AND IMPLEMENTATION OF DIRECT POTABLE REUSE

Effectiveness and Reliability of Treatment Train Unit Processes

Obstacles are inherent in all ADWT treatment train processes. PAC and GAC obstacles include logistical difficulties with transporting large volumes of materials, high media replacement costs, contactor space requirements, and sensitivity to pH, temperature and flow rate. Obstacles arising from NF and RO use include imperative analysis of RO feed water and selection of an appropriate pretreatment system given that RO membranes are highly sensitive. Membrane fouling, cleaning, and lifespan as well as operating and maintenance costs are persistent issues. Efficient Ion exchange is highly dependent upon on levels of particulate and colloidal matter, solvent and organic polymer presence. These can cause 'blinding' of the ion exchange surfaces and thus require chemical pretreatment for clarification to optimize performance. Advanced oxidation processes produce brominated byproducts but can be managed by pH control or ammonia addition. Additional byproducts are carbon dioxide and mineral acids. Bicarbonate, carbonate, pH, and metal ions affect advanced oxidation performance and must be corrected for at the outset. MF/UF endure typical membrane obstacles including life, performance, operating efficiency, flux maintenance and increased operating costs (Cain, 2011).

Each disinfection procedure has associated obstacles. With chlorine disinfection, byproducts (trihalomethanes and haloacetic acids) are formed and total dissolved solids (TDS) increase. After disinfection, dechlorination is necessary to reduce chlorine levels to acceptable environmental levels. Use of ozone disinfection creates DBPs, although they are not chlorinated; the type created depends on bromide's presence or absence in the effluent. Effectiveness of UV disinfection depends on certain permeate parameters, particularly chemical/microorganism characteristics, particle presence, microorganism regrowth potential post treatment, and the UV system's physical state (Cain, 2011).

The ADWT separation process generates waste stream concentrates of technological, management and economic concern. Waste products created during purification of secondary effluent include concentrated rejected constituents from liquid waste (regeneration brines, backwash), concentrated trace constituents saturating media during adsorption phases (retentate), and chemicals added to the process and concentrated from precipitate compounds (Cain, 2011).

Health Risk Concerns
Few epidemiological and toxicological potable reuse health effects studies have been conducted over the past 30 years to investigate the public health impact of IPR and DPR. A large-scale DPR project in Windhoek, Namibia utilized epidemiological and toxicological studies to find no relationship observed between drinking water source and diarrheal disease cases. A Denver, Colorado potable water reuse demonstration project published another DPR study. A two year toxicological health effects study in humans for chronic and reproductive effects found no adverse health effects for exposure to reclaimed water supplies. Other health effects studies have evaluated IPR with toxicological studies in animals, the most recent being a 2007 IPR Singapore Water Reclamation Study which did not show any health effects in fish or mice. Although these studies revealed no obvious health effects, design shortcomings, age of studies and technology's rapid advancement over the past decade are factors worthy of important consideration in interpretation and extrapolation. While significant IPR findings are encouraging, the jump from IPR to DPR requires careful consideration of potential short and long term health effects (Cain, 2011).

Addressing Key Regulatory Issues
U.S. federal regulations do not currently exist for governance of water reuse practices. The U.S. EPA suggests certain IPR guidelines and considerations for DPR in their 2012 Guidelines for Water Reuse (U.S. Environmental Protection Agency, 2012). IPR guidelines address treatment techniques, reclaimed water quality guidelines and water monitoring and setback distances for the three types of IPR (groundwater recharge by spreading into potable aquifers, groundwater recharge by injection into potable aquifers and augmentation of surface supplies) (Cain, 2011). DPR considerations stated in the EPA guidelines address the general treatment process, planning considerations, and future research needs (U.S. Environmental Protection Agency, 2012).

Many individual states have passed legislation for their state water reuse practices. Conservation, non-potable uses, and in a few states, IPR, are defined by state regulations which vary considerably in their parameters and type of reuse application. These regulations are conservative in nature with public health protection being the most important consideration. State regulations vary in treatment and monitoring parameters but all operate under the assumption that minimal to no additional treatment will be required following discharge to the environmental buffer prior to drinking water treatment abstraction. Florida, California and Texas have the most specific regulations for treatment and quality criteria for potable reuse. Currently, there are no known state regulations or guidelines for DPR within North Carolina (Cain, 2011).

Public Perception
Public perception issues are the largest hurdles to overcome in DPR acceptance. Drinking water that once contained human waste is perceived as 'contaminated.' Without a separation and dilution step, between sewage effluent and influent to the drinking water treatment plant, public DPR acceptance will be difficult to impossible. The perception that water is everywhere,

and therefore DPR is unnecessary, is another major public perception obstacle. Experience from the Windhoek, Namibia's DPR project found that public perception was the main obstacle and DPR can typically only succeed if no other options exist for the community or region (Cain, 2011).

Management and Operational Controls
Consideration of system design must included analysis and preparation for system failure, immediate response planning including discharge diversion and storage use, organization of emergency water supply and security issues, and analysis of compensation for loss of retention/reaction time (i.e., IPR requires 6 months). It is necessary to evaluate the need for enhanced source control programs to reduce or remove the entrance of certain chemicals into the wastewater collection system. This would include aspects of monitoring, permitting, and physical/program design steps. Evaluation of data reporting tasks includes internal protocol planning and external reporting of monitoring results to regulatory agencies and the public. Operational guideline development is required to assure DPR plant system reliability and includes identifying changes to operator certification requirements and monitoring changes in the distribution system. Proper concentrate and residual management will be guided by NPDES permitting development and state level amendments. Finally, monitoring for environmental impacts of DPR requires delineation (Cain, 2011).

3.3.3.5. REGULATION OF DPR

Regulation of DPR in the United States
As previously indicated, to date, no known regulations or criteria have been developed for DPR in North Carolina, and only small scale DPR projects have just recently been implemented within the United States. The only large-scale global example of an operational DPR project is in water-scarce Windhoek, Namibia, where highly treated recycled water is put into a drinking water system that serves 250,000 people. The DPR system in Windhoek has been in operation since 1968 (Crook, 2010). However, DBR has recently become a reality in the United States and is being evaluated with heightened interest as a practical means to address water supply needs.

In order to implement DPR as a common practice within the United States, a myriad of key regulatory issues need to be resolved and include the following (Crook, 2010):

- Clarify what constitutes direct potable reuse.
- Compensate for the loss of an environmental buffer (a natural water body such as a lake or reservoir that physically separates product water from a recycling water facility and the intake to a drinking water plant).
- Determine the number, type, and reliability of treatment processes necessary to serve as multiple barriers (which are incorporated into the design and operation of water recycling facilities to preclude the passage of microbial pathogens and harmful chemicals constituents into the water system).
- Determine if dilution (or, the blending of recycled water with non-recycled waters, such as surface water or imported water) will be required as an added safety factor.

- Determine what monitoring requirements will be needed to assess the efficiency of the treatment process in removing microbial pathogens and chemical constituents.
- Clarify the type and level of public health risk assessment needed (which may include evaluating the risk of treatment system failure and potential health risks due to such a failure).
- Determine if scientific peer review of direct potable reuse projects by expert advisory panels will be a requirement.
- Evaluate how existing drinking water statues, regulations, policies, and permitting processes may apply to direct potable reuse projects.
- Clarify the roles of regulatory agencies in providing oversight of direct potable reuse projects.
- Develop a communication system for the timely sharing of information between water utilities and regulatory agencies to avoid the distribution of unsafe water.

Regulation of Water Reuse in North Carolina
North Carolina's water reuse policy and rule making statute, § 143 355.5, requires the Environmental Management Commission to "encourage and promote safe and beneficial reuse of treated wastewater as an alternative to surface water discharge". The resulting rules are Title 15A of the North Carolina Administration Code Subchapter 2T.0900.

Under existing North Carolina rules, reclaimed water can be used for non-potable purposes. Water reuse for potable purposes, including direct potable reuse, is not currently permitted under North Carolina statute.

3.3.3.6. DIRECT POTABLE REUSE IN UNION COUNTY

As DPR is not currently permitted in North Carolina, and as there is limited experience with such systems within the United States, the use of DPR does not lend itself as a viable alternative water source for Union County to serve its existing and future customers in the Rocky River IBT Basin at this time. However, should the future regulatory framework within the United States and North Carolina change to allow DPR and additional experience, research and public acceptance of DPR prove its success and value as an alternative water source, the following considerations should be made for Union County's water service in the Rocky-River IBT basin.

Currently, Union County wastewater from its service area in the Rocky River IBT Basin is treated in privately owned septic systems, or at either the Crooked Creek WRF, pumped to the 12 Mile Creek WRF, or treated at the City of Monroe's WWTP. The County also operates several small residential neighborhood treatment facilities within the Rocky River IBT Basin. The most viable wastewater flow that could be a candidate for DPR would be the portion of Union County flow that is allocated to the City of Monroe's WWTP. Flow from the County's Lake Lee, Lake Twitty, Richardson Creek and Eastside wastewater service basins is treated at this facility, along with wastewater flow from Marshville and Monroe.

If this wastewater flow were to be used for DPR purposes, the water would first need to be treated at the City of Monroe WWTP or future expanded County facility. Following initial treatment, new infrastructure for advanced drinking water treatment (ADWT) of the wastewater would be required. This infrastructure could be placed at the site of the existing City of Monroe WWTP, or alternatively, a new Union County Water Reclamation Facility could be constructed to include primary wastewater treatment and ADWT unit processes. In either case, following ADWT, the water would then need to be blended in the distribution system with finished water from the proposed new North Union County Water Treatment Plant (as previously described for other alternatives), to meet the projected water demand for the County's service area within the Rocky River IBT Basin. Implementation of DPR would inevitably require the construction of two new treatment facilities (ADWT for supplemental water provided by DPR and potable water treatment for raw water supplied for surface water sources). Figure 3-3 provides a conceptual schematic of existing wastewater treatment facilities and flow diversions from wastewater service basins within Union County, as well as the proposed treated water distribution under the DPR alternative.

Table 3-10 reflects the projected average annual day wastewater flow for Union County Public Works that is sent to the City of Monroe's WWTP for treatment. Flows are projected to grow from 1.5 mgd in 2015 to 6.6 mgd by 2050. However, the 2050 wastewater flow projection of 6.6 mgd is only 40% of the 16.5 mgd average daily water need for the Yadkin River Water Supply Project. As such, the use of DPR in Union County does not lend itself at a full demand solution for water supply, but rather only as a potential supplemental supply source.

Table 3-10 Projected Union County Average Annual Daily Wastewater Flow to City of Monroe WWTP (in MGD)

Wastewater Service Basin	Projection Year				
	2015	2020	2030	2040	2050
Lake Twitty Basin	0.2	0.4	1.0	1.4	1.9
Eastside Basin	1.3	1.6	2.1	2.9	3.9
Lake Lee Basin	0.0	0.0	0.3	0.3	0.5
Richardson Creek Basin	0.0	0.0	0.1	0.1	0.2
Total Flow	**1.5**	**2.1**	**3.4**	**4.7**	**6.6**

3.3.3.7. CONCLUSION

DPR may be a viable option for future water resource management as cities and regions struggle to ensure a dependable supply of safe drinking water amidst growing population, environmental and cost pressures. However, there are only a handful of existing small-scale DPR facilities and several ongoing test pilot studies within the United States, and limited large-scale operating DPR facilities in the world (Windhoek, Namibia). Within the United States there is currently no federal framework in place by which to regulate DPR facilities, beyond those regulations implemented by certain individual states. In North Carolina, DPR is not currently permitted for potable water supply. The need for stronger epidemiological research, including observational epidemiology such as case/control and retrospective and prospective cohort studies, and potentially clinical trials, to mitigate health effects concerns has been identified as an utmost priority (Cain, 2011). Furthermore, DPR's acceptance depends upon stakeholders, policymakers, scientific researchers and public health professionals investigating opportunities and solving problems present in DPR's treatment train processes, health risk concerns, key regulatory issues, management and operational controls and public perception issues (Cain, 2011).

Based on access to other, more reasonable, surface water supply alternatives, coupled with the current regulatory framework at both the federal and state level, DPR is not a reasonable and practical solution to Union County's existing and projected future water needs in the Rocky River IBT Basin. Beyond regulatory challenges, health concerns and public perception issues related to DPR and inherent costs of advanced drinking water treatment for wastewater over and above traditional water treatment of surface water supplies are all factors that make this alternative a challenging and impractical alternative to implement at this time.

Furthermore, projected wastewater flow in Union County which is the most viable candidate for DPR to supply the County's service area within Rocky River IBT Basin is limited to the flow currently treated at the City of Monroe's Eastside Wastewater Treatment Plant. Future projected Union County wastewater flow at this facility (not including the City of Monroe) from the Lake Lee, Lake Twitty, Richardson Creek and Eastside wastewater service basins are estimated to account for only 40% of the County's average day future water demands that would be needed from this project. Therefore, the use of DPR could only serve to supplement the County's water demand from surface water sources. The inability of DPR to meet the County's full water demand in this service area further makes the logistics and cost of this strategy impractical and unable to meet Union County's purpose and need.

3.3.4. Alternative 11 - Wastewater Returns to the Yadkin River Basin, Pee Dee River (Lake Tillery)

3.3.4.1. GENERAL

Water reclamation for nonpotable applications is well established, as discussed in previous sections, with system designs and treatment technologies that are generally well accepted by communities, practitioners, and regulatory authorities. The use of reclaimed water to augment potable water supplies has significant potential for helping to meet future needs, but planned potable water reuse only accounts for a small fraction of the volume of water currently being reused. However, if de facto (or unplanned) water reuse is considered, potable reuse is certainly significant to the nation's current water supply portfolio. The unplanned reuse of wastewater effluent as a water supply is common, with some drinking water treatment plants using waters from which a large fraction originated as wastewater effluent from upstream communities, especially under low-flow conditions. Thus, the term "de facto reuse" is often used to describe unplanned IPR. Examples of de facto potable reuse abound, including such large cities as Philadelphia, Nashville, Cincinnati, and New Orleans, which draw their drinking water from the Delaware, Cumberland, Ohio, and Mississippi Rivers, respectively. These communities, and most others using unplanned IPR sources, do provide their customers with potable water from these rivers that meet current drinking water regulations by virtue of the drinking water treatment technologies used (U.S. Environmental Protection Agency, 2012).

The key distinction between indirect and direct potable reuse, as discussed earlier under Alternative 10, is that direct potable reuse does not include temporal or spatial separation, such as natural (environmental) buffers between the introduction of recycled water and its distribution as drinking water. IPR is usually defined as the augmentation of a drinking water source (surface water or groundwater) with recycled water, followed by an environmental buffer that precedes normal drinking water treatment, whereas direct potable reuse is generally defined as the introduction of recycled water directly into a potable water distribution system downstream of a water treatment plant (Crook, 2010).

This practice of discharging treated wastewater effluent to a natural environmental buffer, such as a stream or aquifer, has historically been deemed as an appropriate practice for IPR. However, research during the past decade on the performance of several full-scale advanced water treatment operations indicates that some engineered systems can perform equally well or better than some existing environmental buffers in attenuating contaminants, and the proper use of indicators and surrogates in the design of reuse systems offers the potential to address many concerns regarding quality assurance. A number of these planned IPR projects have been in use for many years, demonstrating successful operation and treatment (U.S. Environmental Protection Agency, 2012).

Planned IPR involves a proactive decision by a utility to discharge or encourage discharge of reclaimed water into surface water or groundwater supplies for the specific purpose of augmenting the yield of the supply. For the purposes of the discussion related to planned IPR, it is useful to examine Illustration 3-17, which provides a graphical representation of IPR with specific scenarios (U.S. Environmental Protection Agency, 2012).

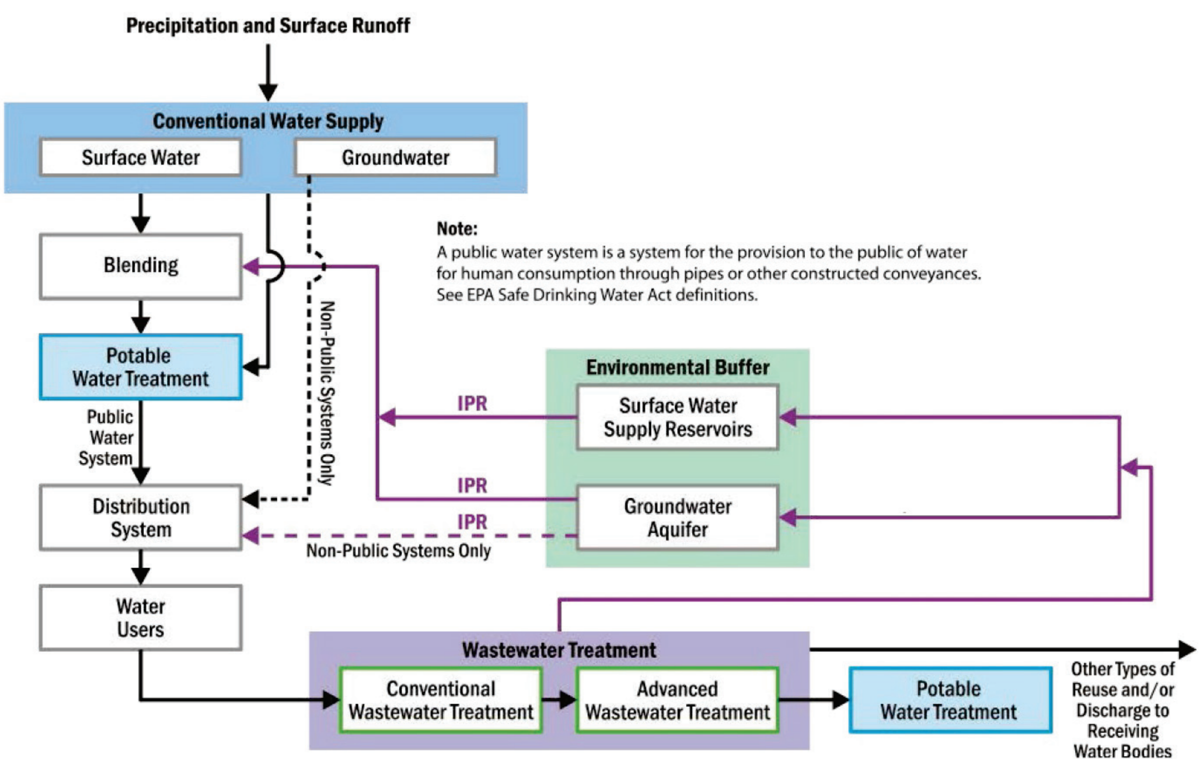


Illustration 3-17 Planned Indirect Potable Reuse Process Scenarios Schematic (U.S. Environmental Protection Agency, 2012)

In either case, the decision to pursue planned IPR typically involves the following factors:

- Limited availability and yield of alternate sources
- High cost of developing alternate water sources
- Conscious or unconscious public acceptance
- Confidence in, and some level of control over, both advanced reclaimed water treatment processes and water treatment processes

In some cases, the level of reclaimed water treatment required to meet water quality standards is considerable. The incentive to provide additional treatment may be driven by regulations intent on protecting water supplies but in most cases is also linked to benefits to the discharger or community in increasing the yield of water supplies that they depend on either directly or indirectly. While satisfying these four factors may be necessary to pursue IPR, they are not sufficient. Two specific components of these factors typically control the viability of implementation. First, even though existing water supplies may be of limited availability and yield, the means via water rights, permits, and storage contracts must exist to reap the benefits of withdrawing the additional yield of the augmented water supply. Second, public acceptance of IPR is of paramount importance but sometimes takes counterintuitive turns based on the specifics of the project and the local community. The following examples illustrate how these key components can play out in project planning and implementation (U.S. Environmental Protection Agency, 2012).

An often-cited example of IPR is the Upper Occoquan Service Authority (UOSA) discharge into Occoquan Reservoir in Northern Virginia. In this particular case, serious water quality issues were caused by multiple small effluent discharges into the reservoir. The Fairfax County Water Authority withdraws water from the reservoir to meet the water supply needs of a large portion of Northern Virginia. In 1971, the UOSA was formed to address the water quality problem by the same local government entities that relied on the reservoir for their water supply. Therefore, these local governments, and by proxy their residents, received the benefits of the investments of additional wastewater treatment, satisfying the first key component that their water supply was now both protected and augmented. Regarding the second key component, the improvements made a dramatic improvement in the water quality of the reservoir that was readily visible to the general public. Algae blooms, foul odors, low DO for fish, etc., were addressed by the regionalization and advanced treatment and provided the public with a tangible example showing improved water quality over past practices (U.S. Environmental Protection Agency, 2012).

Another example is the Gwinnett County, Ga., where treated effluent is discharged to Lake Lanier. Operated by the USACE, Lake Lanier is formed by Buford Dam on the Chattahoochee River north of Atlanta. Gwinnett County, along with several other communities around the lake, withdraws all of its water for potable supply from Lake Lanier. Given the linkage between the water withdrawal from the lake and the desire to return reclaimed water to the lake, the first key component was satisfied by the issuance of a revised state withdrawal permit and amended USACE storage contract that provided credit for the water returned. In this case, the key issue focused on permitting the discharge and on the multiple administrative and legal challenges identified by stakeholders with interest in the lake. Because the focus of the stakeholders was primarily lake quality, discharge limits were significantly reduced from already-low proposed levels. For example, the proposed 0.13 mg/L total phosphorus limit based on detailed lake modeling was eventually reduced through the legal and permitting process to 0.08 mg/L using anti-degradation regulations as the rationale. Interestingly, plaintiffs also successfully pushed for the outfall to be closer to the county's raw water intake to ensure that the reclaimed water discharge would be as reliable as possible (U.S. Environmental Protection Agency, 2012).

In other example IPR projects, including San Diego and Tampa, the issue of supply and demand was not a significant concern, as the ability of the dischargers to utilize the reclaimed water to augment their yields was confirmed early in the planning process. However, unlike Gwinnett County, the primary opposition to IPR was related to the perceived health risks to the public from drinking the treated drinking water from the blended source. Public opposition of this type has significantly delayed or tabled many IPR plans. In many cases the opposition appears to be rooted, in part, to the public's perception of the quality of the existing water source and that it will be degraded by the addition of reclaimed water. San Diego was able to provide new educational communication materials to the public and interest groups and is operating an IPR demonstration facility to provide specific data for permitting to augment the San Vicente Reservoir with recycled water (U.S. Environmental Protection Agency, 2012).

3.3.4.2. NPDES DISCHARGES IN NORTH CAROLINA

North Carolina's water reuse policy and rule making statute, § 143 355.5, requires the Environmental Management Commission to "encourage and promote safe and beneficial reuse of treated wastewater as an alternative to surface water discharge." The resulting rules are Title 15A of the North Carolina Administration Code Subchapter 2T.0900.

As a general rule, DWR recommends that utilities allow 2 ½ years to complete the process of permitting a new NPDES wastewater discharge or facility expansion/modification. North Carolina's general process for permitting is reflected in Illustration 3-18.

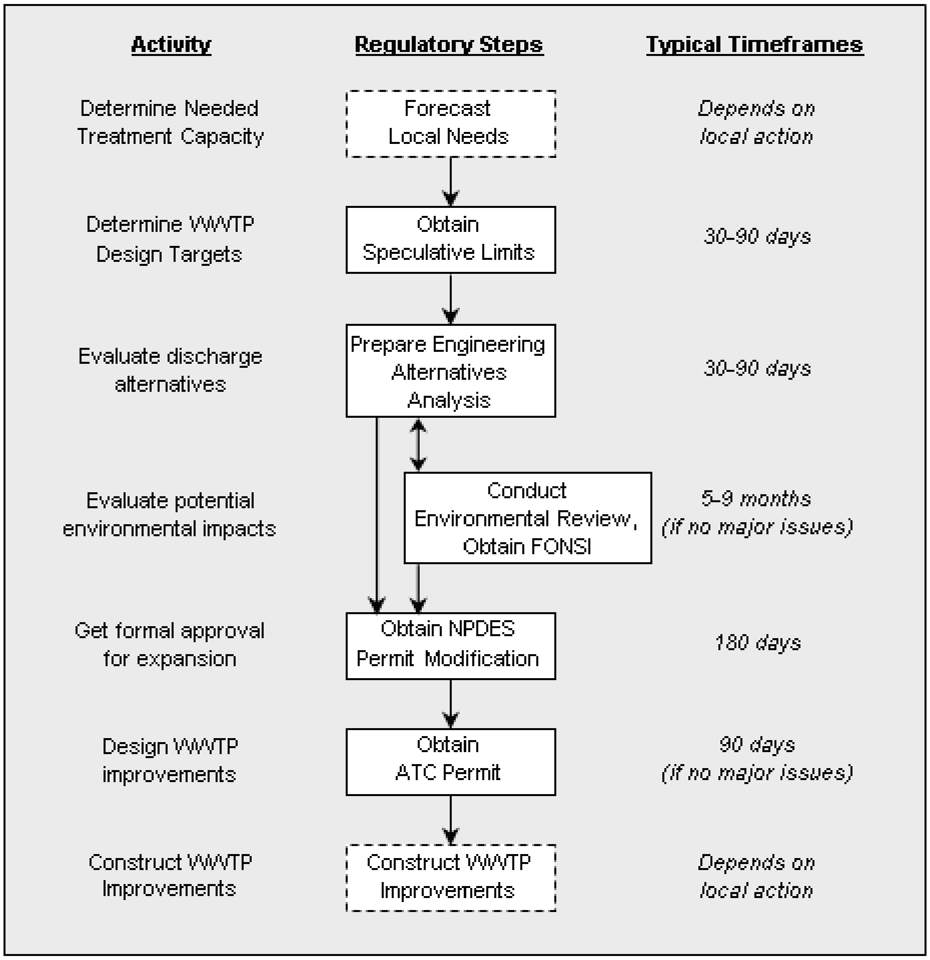


Illustration 3-18 North Carolina Wastewater Discharge Permitting Process

Speculative limits must be developed as part of the permitting process and are provided by DWR to publicly owned facilities to establish performance criteria for the design of the wastewater treatment plant improvements. Limits are developed based on the established uses of the receiving water body, the capacity of the water body to accept the additional wastewater loads or current management strategies at the time the speculative limits are developed. Many issues can influence these permit limits conditions: impairment of the stream, over allocation of loads, or stream classification restrictions.

If the project is subject to the State Environmental Policy Act (SEPA) review, the requirements of the Engineering Alternatives Analysis (EAA) must be folded into the Environmental Assessment (EA) or Environmental Impact Statement (EIS). SEPA applicability and requirements are discussed in the following section. According to North Carolina rules, the expansion of an existing discharge facility of 500,000 or more gallons per day additional flow or permitting of a new NPDES discharge will require preparation of a SEPA document.

In North Carolina, there are several potential restrictions to a wastewater discharge to surface waters, including:

- Zero flow stream restrictions (15A NCAC 2B.0206(d)(2)) apply to oxygen-consuming waste in zero-flow streams. No new or expanding (additional) discharge of oxygen-consuming waste will be allowed to surface waters of North Carolina if both the summer 7Q10 and 30Q2 streamflows are estimated to be zero, in accordance with 15A NCAC 2B.0206(d).
    - New and Expanding Discharge to Zero Flow Streams (both 7Q10 and 30Q2 = 0). Regulation 2B .0206 disallows new discharges of oxygen¬ consuming wastewater to streams which have no flow under both 7Q10 and 30Q2 conditions.
    - New and Expanding Discharge to Zero Flow Streams (7Q10= 0; 30Q2 >0). Regulation 2B .0206 sets effluent limitations at BOD5 = 5 mg/l, NH3-N= 2 mg/l, and DO = 6 mg/l to streams with no 7Q10 flow, but positive 30Q2 flow, unless it is determined that these limits will not protect water quality standards.
- Receiving stream classification restrictions (e.g., ORW, WS, SA, NSW, and HQW class waters have various discharge restrictions or require stricter treatment standards).
    - Surface Water Classifications are designations applied to surface water bodies, such as streams, rivers and lakes, which define the best uses to be protected within these waters (for example swimming, fishing, drinking water supply) and carry with them an associated set of water quality standards to protect those uses. Surface water classifications are one tool that state and federal agencies use to manage and protect all streams, rivers, lakes, and other surface waters in North Carolina.
    - Many of the classifications, especially those designed to protect drinking water supplies and certain high quality waters, have protection rules which regulate activities, such as wastewater discharges that may impact surface water quality. No permitted expansions of domestic wastes are allowed on waters classified as WS I & II, or ORW to preserve the uses of these waters. Other classifications may require the discharger to meet stringent limits.
- Basinwide Water Quality Plans. These basin-specific plans list NPDES permitting strategies that may limit wastewater discharges to particular streams within the basin due to lack of stream assimilative capacity, etc.
    - Basinwide water quality plans are prepared by DWR for each of the 17 major river basins in the state. Preparation of a basinwide water quality plan is a ten-year process. Basinwide planning is a tool to identify water quality problems and restore full use to impaired waters, identify and protect high value resource waters, and protect unimpaired waters, yet allow for reasonable economic growth.
    - A basin plan presents water quality initiatives and recommendations for each subbasin in a river basin. The recommendations presented in the basin plan will be implemented when developing a permit or evaluating a permit expansion request.
- Assimilative Capacity. Water bodies are limited to the total combined wastewater flow they can carry.

  - DWR utilizes analytical models to determine the maximum amount of wastewater that can be discharged into a body of water and still meet the water quality standards. If such study shows that the receiving stream can't assimilate additional oxygen consuming wastes, expansion of an existing discharge is not allowed.
- Impaired waters and TMDLs. Certain water bodies listed as impaired on the 303(d) list and/or subject to impending TMDLs may have wastewater discharge restrictions.
  - Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. Listed waters must be prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed for all listed waters.
  - The DWR evaluates waters for multiple uses in each basinwide management plan. These uses include aquatic life support, primary and secondary recreation, fish consumption, water supply, and for coastal waters, shellfish harvesting. If data indicate that any one of these is impaired, the water body is included in the Section 303(d) list. Waters on the 303(d) list are scheduled for additional study and/or development of a TMDL.
  - A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. An implementation plan outlines the steps necessary to reduce pollutant loads in a certain body of water to restore and maintain designated uses. The development of TMDLs and implementation plans are often the best method to improve water quality. Federal regulations prohibit the addition of certain new sources and new discharges of pollutants to waters listed on the North Carolina 303(d) List until a TMDL is established. The terms and conditions of the TMDL will be followed at the time a request for speculative limits is made.
- Presence of Endangered Species. If endangered species are present in the proposed discharge location, there may be wastewater discharge restrictions.

Since a goal of the Clean Water Act is to minimize or eliminate point source discharges to surface waters, any proposal for a new or expanding wastewater discharge within North Carolina must include evaluation of wastewater disposal alternatives in addition to direct discharge. Particularly for dischargers of domestic wastewater, the following wastewater disposal alternatives should be considered:

- Connection to an existing wastewater treatment plant (public or private)
- Land application alternatives, such as individual/community onsite subsurface systems, drip irrigation, spray irrigation
- Wastewater reuse
- Surface water discharge through the NPDES program
- Combinations of the above

3.3.4.3. UNION COUNTY WASTEWATER RETURNS TO LAKE TILLERY

Currently, Union County wastewater in the service areas within the Rocky River IBT Basin is treated via privately owned septic systems, or at either the Crooked Creek WRF, pumped to the 12 Mile Creek WRF, or treated at the City of Monroe's WWTP. The County also operates several small residential neighborhood treatment facilities within the Rocky River IBT Basin. The most viable wastewater flow that could be a candidate for IPR would be the portion of Union County flow that is allocated to the City of Monroe's WWTP. Flow from the County's Lake Lee, Lake Twitty, Richardson Creek and Eastside wastewater service basins is treated at this facility, along with wastewater flow from Marshville and Monroe.

If this wastewater flow were to be used for IPR purposes, the water would first need to be treated at the WWTP. Following wastewater treatment, new infrastructure would be required to pump the Union County wastewater allocation at the treatment plant northeastward to the upstream reach of Lake Tillery. This infrastructure is assumed to be placed at the site of the existing City of Monroe WWTP. Figure 3-4 provides a conceptual schematic of existing wastewater treatment facilities and flow diversions from wastewater service basins within Union County, as well as the proposed Union County wastewater flow diversion from the Monroe WWTP to Lake Tillery under Alternative 11.

As Monroe's WWTP currently discharges to Richardson Creek and subsequently flows to the Rocky River and into the Pee Dee River, downstream of Lake Tillery, a Union County IBT from Lake Tillery (Alternative 1) would not classify for a Cork Rule Exception. However, if Union County's wastewater generated in the Lake Twitty, Lake Lee, Richardson Creek and Eastside service areas were diverted from the Monroe WWTP back to Lake Tillery, the Cork Rule Exception would apply. Under this exception, the IBT from Lake Tillery could be reduced by the amount of treated wastewater being returned to the lake. In effect, Alternative 11 is an IBT minimization strategy for Alternative 1.

Table 3-11 reflects the projected average annual daily wastewater flow for Union County Public Works that is sent to the City of Monroe's WWTP for treatment. Flows are projected to grow from 1.5 mgd in 2015 to 6.6 mgd by 2050. However, the 2050 wastewater flow projection of 6.6 mgd is only 40% of the 16.5 mgd average daily water need for the Yadkin River Water Supply Project. As indicated in Table 3-11, the use of IPR in Union County would serve only to reduce (not eliminate) the total amount of the IBT from the Yadkin River IBT Basin to the Rocky River IBT Basin.

Table 3-11 Projected Union County Average Annual Daily Wastewater Flow to City of Monroe WWTP (in mgd)

Wastewater Service Basin	Projected Flow (mgd) Projection Year				
	2015	2020	2030	2040	2050
Lake Twitty Basin	0.2	0.4	1.0	1.4	1.9
Eastside Basin	1.3	1.6	2.1	2.9	3.9
Lake Lee Basin	0.0	0.0	0.3	0.3	0.5
Richardson Creek Basin	0.0	0.0	0.1	0.1	0.2
Total Flow	**1.5**	**2.1**	**3.4**	**4.7**	**6.6**

Table 3-12 reflects the projected IBT under Alternative 11, with reductions in the Alternative 1 IBT quantity afforded from the proposed wastewater return back to Lake Tillery, assuming the wastewater diversions begin when a new water supply from Lake Tillery begins (post 2020). Note that the IBT quantity is calculated as maximum month daily average water demand minus the average annual daily wastewater returns to more closely approximate the actual IBT during the drier and hotter summer months.

Table 3-12 IBT from Lake Tillery under Alternative 11 (in mgd)

	Projected Flow (mgd) by Projection Year				
	2015	2020	2030	2040	2050
Maximum Month Daily Average Water Supply from Lake Tillery	0	0	9.8	16.4	23
Annual Average Daily Wastewater Returns to Lake Tillery	0	0	3.4	4.7	6.6
Total IBT	**0**	**0**	**6.4**	**11.7**	**16.4**

Note: IBT quantity is calculated as maximum month daily average water demand minus the average annual daily wastewater returns to more closely approximate the actual IBT during the drier and hotter summer months.

3.3.4.4. NPDES DISCHARGE PERMITTING CONSIDERATIONS AND CONCERNS

Background

A preliminary evaluation of potential new Union County NPDES discharge sites within the Lake Tillery watershed as part of Alternative 11 focused on Mountain Creek, Jacob's Creek and the main stem of the Pee Dee River on Lake Tillery, along the western side of the watershed. Mountain Creek and Jacob's Creek are the largest watersheds draining to Lake Tillery along the western slope. Potential discharge locations were identified based on proximity to roadway crossings to the water bodies. Three sites were identified on Jacob's Creek, including the US-52 crossing, Dennis Road crossing, and Indian Mound Road Crossing near the Jacob's Creek Cove of Lake Tillery. One site was identified on Mountain Creek, located at the Valley Drive crossing over the creek, just upstream of the Little Mountain Creek confluence with Mountain Creek. Two potential sites were identified on the main stem of the Pee Dee River in Lake Tillery, including at the end of Morrow Mountain Road within Morrow Mountain State Park at the confluence of the Uwharrie River with Lake Tillery (approximately 11 river miles upstream of the proposed Union County raw water intake for Alternative 1) and at the Troy Road (NC 24/27/73) river crossing (approximately 5.5 river miles upstream of the proposed Union County raw water intake for Alternative 1).

Similar to direct potable reuse, but perhaps not to the same extent, the use of recycled water for IPR raises a number of issues and requires a careful examination of regulatory requirements, health concerns, project management and operation, and public perception. Several epidemiological and toxicological health effects studies have been conducted in the last 30 years on recycled water generated at IPR projects to evaluate the public health implications of potable reuse. While none of the studies indicated that drinking recycled water would present health risks greater than those attributable to existing water supplies, the data from the studies are sparse and the limited nature of the toxicological and epidemiological techniques used for many of the studies prevent extrapolation of the results to potable reuse projects in general (Crook, 2010). Additional concerns and considerations for permitting a new NPDES discharge involve receiving water quality and impacts to the aquatic ecosystem.

DENR has developed the Yadkin-Pee Dee River Basin Plan which outlines water quality plans for the basin, including Lake Tillery and the Pee Dee River, downstream of the lake. Major considerations for permitting NPDES discharges within this area are noted to include zero-flow stream restrictions, biological habitat considerations, and assimilative capacity considerations, particularly related to dissolved oxygen standards (NCDENR, 2008).

Zero Flow Stream Restrictions

Streams throughout this area have low base flows and tend to stop flowing in summer months. Additionally, several streams, including Mountain Creek lacked sufficient flows to enable water quality sampling as part of DENR's work for the Yadkin-Pee Dee River Basin Plan in 2006 (NCDENR, 2008).

Potential NPDES discharge locations in the Mountain Creek and Jacob's Creek watershed scan effectively be eliminated from consideration as candidate sites for a new treated wastewater discharge under state permitting statutes, due to low flow stream limitations. 7Q10 and 30Q2 flow estimates were derived for these watershed's using for the Carolina Slate Belt (argillite zone), as published in the USGS Water-Supply Paper 2403, "Low-Flow Characteristics of Streams in North Carolina," which outlines typical low flow value which may be attributed to various hydrologic areas of the state on a per square mile of drainage area to a particular point in an unregulated stream (Giese & Mason, 1993).Values published in this document for the Carolina Slate Belt argillite zone indicate 7Q10 values of 0.009, 0.007, 0.001, 0.000, and 0.000 cfs per drainage area square mile for the maximum, 75th percentile, 50th percentile, 25th percentile, and minimum, respectively. Additionally, drainage areas less than 12 square miles in this region typically have a 7Q10 value of zero. Values published in the document for the Carolina Slate Belt argillite zone indicate 30Q2 values of 0.060, 0.029, 0.014, 0.010, and 0.002 cfs per drainage area square mile for the maximum, 75th percentile, 50th percentile, 25th percentile, and minimum, respectively.

As indicated in Table 3-13, each of the locations has a 7Q10 value significantly less than 1 cfs and approximately 0 cfs at the 50% percentile. As indicated in Table 3-14, each of the locations has a 30Q2 less than 1 cfs and approximately 0 cfs at the minimum range.

Table 3-13 7Q10 Estimates for Jacob's Creek and Mountain Creek

Stream	Site	Drainage Area (sq miles)	7Q10 Flow Estimate (in cfs) Max	75%	50%	25%	Min
Jacobs Creek	Indian Mound Road	11.5	0.104	0.081	0.012	0.000	0.000
Jacobs Creek	US-52	2.9	0.026	0.020	0.003	0.000	0.000
Jacobs Creek	Dennis Road	3.4	0.031	0.024	0.003	0.000	0.000
Mountain Creek	Valley Drive	13.8	0.124	0.097	0.014	0.000	0.000

Table 3-14 30Q2 Estimates for Jacob's Creek and Mountain Creek

Stream	Site	Drainage Area (sq miles)	30Q2 Flow Estimate (in cfs) Max	75%	50%	25%	Min
Jacobs Creek	Indian Mound Road	11.5	0.693	0.335	0.162	0.115	0.023
Jacobs Creek	US-52	2.9	0.026	0.020	0.003	0.029	0.006
Jacobs Creek	Dennis Road	3.4	0.031	0.024	0.003	0.034	0.007
Mountain Creek	Valley Drive	13.8	0.124	0.097	0.014	0.138	0.028

An additional evaluation was conducted to look at potential USGS streamflow gages within the Yadkin River Basin to use as surrogate gages to estimate 7Q10 for the candidate discharge sites. Using historical streamflow data from four representative USGS gages, and the US EPA's dFlow analysis utility, both 7Q10 and 30Q2 flows could be determined within the region on a per square mile basis to correlate to the flows estimated in Tables 3-13 and 3-14. The results of this evaluation are indicated in Table 3-15. This table indicates that 7Q10 are approximately zero and 30Q2 values are minimal within the area hydrologic region around Lake Tillery.

Table 3-15 7Q10 and 30Q2 Flow Estimates for USGS Gages in Lake Tillery Watershed

Stream	USGS Gage	Drainage Area (sq miles)	EPA dFLOW 7Q10 (in cfs) Total Flow	EPA dFLOW 7Q10 (in cfs) Flow per sq. mile	EPA dFLOW 30Q2 (in cfs) Total Flow	EPA dFLOW 30Q2 (in cfs) Flow per sq. mile
Uwharrie River	2123500 (El Dorado)	342	3.85	0.011	28.8	0.084
Dutchman's Creek	2123567 (Uwharrie)	3.44	0.04	0.012	0.4	0.116
Brown Creek	2127000 (Polkton)	110	0.00	0.000	0.16	0.001
Little River	2128000 (Star)	106	0.26	0.002	9.77	0.092

While an NPDES discharge could technically be permitted at several of these locations where the 7Q10 flow is estimated to be 0 cfs, since the 30Q2 is above 0 cfs, the wastewater discharge limitations would be significantly more stringent according to State requirements, and may be beyond the current treatment capabilities of the City of Monroe's wastewater treatment plant. As such, this evaluation supports the Yadkin-Pee Dee River Basin Plan's assertion that new NPDES discharges within the Lake Tillery-Pee Dee watershed should not be permitted on low flow streams, but rather directed to the Yadkin-Pee Dee River main stem. Either the Morrow Mountain State Park or Troy Road (NC 24/27/73) crossing locations on Lake Tillery that were also identified as part of this evaluation could be viable candidate sites for a new discharge.

Biological Habitat

As part of the Mountain Creek, Little Mountain Creek and Jacobs Creek Ecosystem Enhancement Program Study, three sites were sampled for benthic macroinvertebrates in January 2004 as part of the Memorandum of Agreement between the Division of Water Quality and the North Carolina Ecosystem Enhancement Program in the creation of a Local Watershed Plan for the Mountain Creek planning area. Bioclassifications ranged from Poor to Good-Fair. The benthic communities at all three sites indicate the low flow conditions naturally present in the Slate Belt ecoregion (NCDENR, 2008).

As part of a previous Fish Community Ecosystem Enhancement Program Study, the instream and riparian habitats, physical and chemical characteristics, and fish communities of Mountain, Little Mountain, and Jacobs Creeks in Stanly County were evaluated by DENR in 2004. These streams are downstream from the Towns of Badin and Albemarle and near Morrow Mountain State Park. Nonpoint nutrient runoff from pastures and livestock which have access to the streams contributed to slightly elevated conductivities, abundant periphyton, and an abundance of nutrient indicator species and tolerant fish (NCDENR, 2008).

Additional wastewater discharges to low-flow feeder streams within the Lake Tillery watershed under Alternative 11 could negatively affect existing biological habitat due to decreased dissolved oxygen content within the streams. Hence, a new NPDES discharge should be avoided on such streams, but rather be directed to the main stem of the river under Alternative 11.

Assimilative Capacity

The Pee Dee River currently has 10 minor NPDES WWTP dischargers and no major dischargers. Many of these are located within watersheds where biological samples were collected for the State's Yadkin-Pee Dee River Basin Plan. These include Greater Badin WWTP (NC 0074756), discharging up to 0.55 mgd to Little Mountain Creek; Mount Gilead Town WWTP (NC 0021105), 0.85 mgd to Clarks Creek; and Montgomery County WTP (0080322), 0.47 mgd to UT Clarks Creek. Three facilities are located within the Little River Watershed. These are Biscoe Town WWTP (NC 0021504) discharging up to 0.6 mgd to Hickory Branch; Carolina Trace Utilities Inc. (NC 0038831), 0.325 mgd to the Upper Little River; and Troy Town WWTP (NC 0028916), 0.84 mgd to Densons Creek. One discharger, Ansonville Town WWTP (NC 008125), discharges up to 0.12 mgd directly to the Pee Dee River. Another facility, Stony Gap Fish House (NC 0040801) has ceased discharging up to 0.004 mgd to UT Jacobs Creek prior to January 2007 (NCDENR, 2008).

Low dissolved oxygen is a problem throughout this subbasin. In many cases, naturally low flow in the summer depresses oxygen levels. In the case of Little Mountain Creek, which feeds to Mountain Creek, the low flows are not able to dilute the Badin WWTP discharge, further degrading the stream. The Yadkin-Pee Dee River Basin Plan indicates that new discharges with significant biological oxygen demands should not be permitted in low flow streams. It further suggests that these and existing discharges should be directed to the Pee Dee main stem or streams with consistent flows, suitable for waste assimilation. Water reuse options are also listed as a suggested alternative to surface water discharges (NCDENR, 2008).

3.3.4.5. INFRASTRUCTURE REQUIREMENTS

Pumping Station

Immediately upstream of the discharge point into Richardson Creek, Union County's portion of Monroe WWTP treated effluent will be diverted into a new pump station. The diversion structure will include a flow control valve and flow meter so that only Union County's equivalent quantity of the Monroe WWTP effluent can be isolated and diverted. The new pump station will direct the diverted flow across the existing treatment plant site and along a 45-mile transmission alignment, until the flow is discharged into the headwaters of Lake Tillery.

Union County's contribution to the Monroe WWTP flow is projected to reach 6.6 million gallons per day (mgd) by the year 2050. This value was multiplied by a peak hour factor of 2.5 to arrive at the design flow of 16.5 mgd for conceptual sizing of the wetwell, pumps, and pipeline described below. A "4 + 1" pumping configuration was selected, with four submersible pumps operating in parallel and one on standby. These five pumps would be housed in a wetwell sized for a cycle time of 7.5 minutes (i.e., 8 cycles per hour), and all associated electrical equipment and controls would be housed directly above the wetwell. Five 16-inch pump discharge pipes are proposed to feed into one 36-inch transmission line. The wetwell and pump station structure would need to be approximately 30-feet deep. A diesel generator and odor control system will be provided immediately adjacent to the pump station, and a dedicated access road will encircle the building.

Proposed Transmission Alignment

The proposed transmission alignment for this alternative is reflected as Alternative 11 on Figure 2-3. The detailed study corridor for this proposed route is also reflected in Figure 3-1f. For this alternative, the treated wastewater conveyance from the City of Monroe WWTP to Lake Tillery would require a booster pump station to be installed at the existing site of the Monroe WWTP. From this pump station, the transmission alignment would follow Monroe-Ansonville Road (SR1751) east to Ansonville Road (SR1002). The alignment would follow Ansonville Road to the northeast to NC 205 at which point it would travel northward along NC 205 towards New Salem. Where the alignment reaches the proposed Alternative 1 alignment from the proposed Yadkin River Water Treatment Plant, the wastewater conveyance alignment would follow an identical alignment as the raw water transmission alignment for Alternative 1 northeastward to Norwood.

Once reaching US 52 in Norwood, the wastewater conveyance alignment would diverge from the raw water conveyance alignment and travel northward toward the headwaters of Lake Tillery. The proposed alignment for Alternative 11 would cross over US 52 in Norwood and follow Pee Dee Avenue northward. Pee Dee Avenue eventually becomes Indian Mound Road, and the proposed alignment would continue northward along Indian Mound Road to the intersection with Troy Road (NC 24/27/73), southeast of Albemarle. At this location, the alignment would travel eastward along Troy Road approximately 1 mile to the upstream reach of Lake Tillery, where it would discharge into the river. This location is approximately 5.5 river miles north of the proposed raw water intake location for Alternative 1.

The transmission line was conceptually sized to maintain a water velocity between two and five feet per second in order to allow for scouring and to reduce friction losses. This desired velocity can be achieved at the Year 2050 design flow using a 36-inch line. Additionally, based on total dynamic head (TDH) calculations at various flow rates and at intermediate points along the proposed transmission line route, it was determined there is not a need for any intermediate pump station(s). This is due largely to the overall downhill nature of the proposed route.

3.3.4.6. CONCLUSION

In consideration of the recommendations set forth in the Yadkin-Pee Dee River Basin Plan for the Lake Tillery-Pee Dee River reach and the low-flow characteristics of streams feeding into Lake Tillery, Alternative 11 is developed based on an assumed new NPDES discharge into the main steam of the river at Lake Tillery. Evaluation of potential discharges to major feeder streams to Lake Tillery (Mountain Creek and Jacob's Creek) indicate that estimated 7Q10 flows are zero or near zero, which would limit the ability to permit a new discharge into these waters, as previously discussed. Additionally, assimilative capacity concerns are an issue for large wastewater discharges into such tributary streams.

If Alternative 11 were to be used as a means to reduce the net IBT of water transfers from Lake Tillery as proposed in Alternative 1, it is estimated that the IBT could be reduced by approximately 29% to 35% depending on projection year and actual future wastewater flows generated. However, such benefits afforded to water quantity in Lake Tillery may be outweighed by water quality and environmental impacts of a new wastewater discharge and associated sanitary sewer transmission infrastructure required as part of this alternative.

3.4. Opinions of Costs for Project Alternatives

3.4.1. Background and Assumptions

Conceptual opinions of project costs were completed for each alternative to determine financial feasibility, help differentiate among the various water supply solutions, and provide useful information for the selection of the Preferred Alternative. While the project alternatives vary considerably in their approach, scope, and magnitude, the goal for development of the opinions of cost is to provide an overall project value for each alternative that allows for a fair comparison and differentiation between alternatives (i.e. an ‘apples to apples’ comparison). Further, some of the project alternatives can be characterized as having sub-alternatives (e.g. alternative raw water transmission routes, alternative locations for WTP sites, differing types of intake facilities). In these cases, the basis for cost comparison has been selected as the lowest cost sub-alternative or the sub-alternative that represents an average cost value.

The following key notes and assumptions are provided as background for the development of the opinions of costs:

- Costs are developed only to a conceptual level, with most simulating Class 4 construction cost opinions as defined by the Association for the Advancement of Cost Engineering.
- Costs are given in 2014 dollars with no escalation of costs into the future. These escalation costs for the various alternatives are likely to be similar and are, therefore, not a major differentiator in the alternatives analysis.
- Only capital and project development costs are included. Operation and maintenance costs for the various alternatives are likely to be similar, based on actual water demand by Union County customers and therefore, are not a major differentiator in the alternatives analysis.
- All infrastructure required to produce the required water demand of 28 mgd (max. day) described in Section 3 of this document is assumed to be constructed in the initial phase and in 2014 dollars. While it is highly likely that elements of the project alternatives will be built in phases, this phasing approach is likely to be similar for the various alternatives and therefore, is not a major differentiator in the alternatives analysis.
- Costs for finished water transmission and distribution have not been included since these are likely to be similar for the various alternatives and therefore, are not a major differentiator in the alternatives analysis.
- Cost elements for subjective areas such as contractor’s mobilization, general conditions, overhead and profit (e.g. 20%) as well as design and construction phase engineering (e.g. 15%) were held constant between alternatives.

This approach to development of costs provides an appropriate evaluation of financial feasibility, a basis of comparison for the financial aspects of the various alternatives, and key input into identification of the Preferred Alternative.

3.4.2. Opinions of Costs Summary for Project Alternatives

Table 3-16, on the following page, provides a structured comparison of the various alternatives presented in this document. The information in Table 3-16 has been formatted to allow a breakout of key project elements that may be different among the alternatives. For instance, while some alternatives require a terminal storage reservoir at the WTP site, others do not. Alternatives 9 and 10 are shown as "Not Applicable" since it was determined that these alternatives do not present a viable solution to the water supply demands of Union County. Alternative 11 is shown as an additive cost to Alternative 1 since this alternative includes all of the elements of Alternative 1 plus the added costs of returning treated wastewater to Lake Tillery.

Detailed development of these cost opinions is included in Appendix C.

3.4.3. Opinions of Costs Summary for Sub-Alternatives

As mentioned previously, some of the project alternatives include sub-alternatives. To determine which sub-alternative to include in the analysis presented in the previous section, opinions of costs were completed for each sub-alternative.

These sub-alternatives include:

- Raw water transmission main routing options within Stanly County.
- Raw water transmission main routing options to each of water treatment plant sites A, B, C, and D, as applicable.
- Ranney collector well raw water intake costs for Alternatives 4 and 5.

For reference, these various sub-alternative costs are presented in Appendix C. Relevant notes and assumptions for these sub-alternative costs are similar to those outlined above.

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Table 3-16 Union County YRWSP – Conceptual Cost Opinion (in Millions of $) for YRWSP Alternatives

Project Cost Item	ALTERNATIVE[1]												
	1A	2A	2B	3A	3B	4	5	6	7	8	9	10	11[2]
Raw Water Intake & Pump Station	$7.9	$7.9	$7.9	$7.9	$7.9	$8.2	$19.9	$10.2	$9.1	$155.4	NA	NA	See Alt 1
Raw Water Transmission	$152.7	$206.5	$206.4	$194.9	$162.4	$203.0	$49.3	-	$16.9	$61.6	NA	NA	See Alt 1
Raw Water Transmission - Land	$1.8	$2.4	$2.4	$2.1	$1.7	$2.2	$0.6	-	-	$0.7	NA	NA	See Alt 1
Terminal Reservoir	-	-	-	-	-	$30.7	$42.2	-	-		NA	NA	-
Terminal Reservoir – Land	-	-	-	-	-	$0.8	$1.3	-	-	-	NA	NA	-
Water Treatment Plant	$76.6	$76.6	$76.6	$76.6	$76.6	$76.6	$76.6	$60.4	$65.0	$76.6	NA	NA	See Alt 1
Water Treatment Plant – Land	$0.7	$0.7	$0.7	$0.7	$0.3	$0.7	$0.7	-	-	$0.3	NA	NA	See Alt 1
Finished Water Transmission to WTP Site C/D (excluding land) [3]	-	-	-	-	-	-	-	$181.4	$170.1		NA	NA	-
Wastewater Returns to Tillery	-	-	-	-	-	-	-	-	-	-	NA	NA	$137.5
TOTAL	**$239.7**	**$294.1**	**$294.0**	**$282.2**	**$248.9**	**$322.2**	**$190.6**	**$252.0**	**$261.1**	**$294.6**	**NA**	**NA**	**$377.2**
Ranking by Cost (Lowest to Highest)	2	8	7	6	3	9	1	4	5	6	NA	NA	10

Notes:

[1]Alternative Cost Descriptions:

- Alternative 1A - Water supply from Lake Tillery with transmission to WTP Site Area C (note - Alternative 1B project cost is similar, but raw water transmission costs and land are higher due to increased length of alignment)
- Alternative 2A - Water supply from Narrows Reservoir with transmission to WTP Site Area C
- Alternative 2B - Water supply from Tuckertown Reservoir with transmission to WTP Site Area C
- Alternative 3A - Water supply from Blewett Falls Lake with transmission to WTP Site Area C
- Alternative 3B - Water supply from Blewett Falls Lake with transmission to WTP Site Area D
- Alternative 4 - Water supply from Pee Dee River with transmission to WTP Site Area C
- Alternative 5 - Water supply from Rocky River with transmission to WTP Site Area C
- Alternative 6 - Water supply from Catawba River Water Supply Project (Catawba River)
- Alternative 7 - Water supply from Charlotte Water (Mountain Island Lake) and Catawba River Water Supply Project (Catawba River)
- Alternative 8 - Water supply from groundwater with transmission to WTP Site Area D
- Alternative 9 - Water demand management / conservation
- Alternative 10 - Direct potable reuse
- Alternative 11 - Wastewater returns to Lake Tillery (total cost shown includes Alternative 1 water supply plus Alternative 11 costs

[2] Wastewater returns to Lake Tillery is an additive cost to any of the water supply alternatives. For comparison, it has been added to Alternative 1.

[3] Costs determined for Alternatives 6 & 7 to provide a basis of comparison against the other alternatives.

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4.0 AFFECTED ENVIRONMENT

4.1 Introduction

Information relative to existing environmental conditions in the project areas is provided in this section. The project area for each alternative includes the pipe corridor, raw water intake, pump station(s), and proposed water treatment plant (WTP), if applicable. The potential exists for minor modifications to the project footprint during later phases of design. Additionally, the selection of a final WTP site will not be completed until formal design of the project, and will be based upon actual availability and suitability of land at the time of project design. As such, specific identification or selection of a preferred site cannot be made at this time, and each of the potential sites have been evaluated as part of this EIS.

For all alternatives, the affected environment was assessed for a pipe corridor width that would accommodate slight adjustments in the alignment during the design phase. Where feasible, quantitative evaluations of existing conditions were performed based on electronic and hardcopy data obtained from private, municipal, state, and federal entities. Elements that are common for all alternatives are discussed as a whole. Elements that differ between alternatives are discussed separately.

In Sections 4 and 5, the descriptive nomenclature of the project alternatives has been modified to reduce the table column width and to facilitate discussion of multiple alternatives. The descriptive nomenclature and project alternative numbering scheme used in Sections 4 and 5 are identified in Table 4-1.

Although Table 4-1 includes Alternatives 9 and 10, these two alternatives are not discussed in detail in Sections 4 and 5. Alternative 9 does not include new infrastructure or require the use of any land outside of the existing treatment and transmission facilities. Alternative 10 is not permissible under current laws in the state of North Carolina.

Table 4-1 Project Alternatives Nomenclature Used in Sections 4 and 5

Alternative Name	Alternative Nomenclature Used in Sections 4 and 5
Lake Tillery Intake (Partnership with Town of Norwood) – Alignment A	1A
Lake Tillery Intake (Partnership with Town of Norwood) – Alignment B	1B
Tuckertown Reservoir Intake (Partnership with City of Albemarle)	2A
Narrows Reservoir (Badin Lake) Intake (Partnership with City of Albemarle)	2B
Blewett Falls Lake Intake (Partnership with Anson County) – Alignment A	3A
Blewett Falls Lake Intake (Partnership with Anson County) – Alignment B	3B
Pee Dee River Intake (Between Lake Tillery and Blewett Falls Lake)	4
Rocky River Intake	5
Catawba River Water Treatment Plant Expansion	6
Water Purchase from Charlotte Water	7
Groundwater	8
Water Demand Management	9 [1]
Direct Potable Reuse	10 [2]
Wastewater Returns to Lake Tillery (Indirect Potable Reuse)	11
No Action	12 / No Action
WTP Area A	WTP A
Transmission line corridor from WTP Area A to WTP Area B, including WTP	WTP B

[1] Alternative 9 is not assessed in detail in Sections 4 and 5 as the alternative does not require new infrastructure or the use of land outside of the existing treatment facilities.
[2] Alternative 10 is not assessed in detail in Sections 4 and 5 due to elimination from consideration on legal grounds.

Anticipated areas of construction associated with pump stations, access roads, intake structures and low-head dam, areas associated with WTP sites, and easement widths associated with the pipe corridors were used to quantify existing conditions and the affected environment. For all alternatives with the exception of Alternative 3B, the assessed width of the corridor is 100 feet on each side of the proposed alignment. The assessed corridor for Alternative 3B extends 100 feet outward from the edge of pavement of U.S. 74 where the corridor follows U.S. 74 and 100 feet on each side of the proposed alignment for portions thereof not located along U.S. 74. Alternative WTP A consists of the half-mile radius circle associated with WTP A. Alternative WTP B consists of the pipe corridor between WTP Area A and WTP Area B and the half-mile radius circle associated with the WTP B facility. Alternative WTP C consists of the pipe corridor between WTP Area A and WTP Area C and the half-mile radius circle associated with the WTP C facility.

Table 4-2 provides the metrics used for the analysis (i.e., corridor length and acreage) specific to each alternative. The well field associated with Alternative 8 consists of 28,300 acres. Implementation of Alternative 8 will not require development of the entire 28,300 acre area; however, the location and size of the infrastructure associated with each individual well is not known at this time. Unless otherwise noted, quantifications provided for Alternative 8 include the resources located within the entire well field site. The components of each alternative are illustrated on Figure 3-1.

Table 4-2 Project Length and Area per Alternative Used in Quantitative Analysis of Affected Environment

Alternative	Pipe Corridor Length, miles	Access Road Length, feet [1]	Pipeline Corridor Area, acres	Pump Station Area, acres	Access Road Area, acres [1]	WTP Area, acres	Other Infrastructure, acres [2]	Total Project Area, acres
1A	23.7	----	551.3	0.4	----	----	<0.1	551.8
1B	25.9	----	623.2	0.4	----	----	<0.1	623.7
2A	34.5	----	757.9	0.3	----	----	<0.1	758.3
2B	34.9	250	782.3	0.4	0.1	----	<0.1	782.9
3A	29.7	----	709.0	0.4	----	----	<0.1	709.5
3B	30.3	----	672.1	0.4	----	502.6	<0.1	1,175.2
4	20.6	----	480.7	0.4	----	----	<0.1	481.2
5	2.9	450	65.3	0.4	0.1	----	0.3	66.1
6	25.7	----	576.1	---- [4]	---- [4]	----	----	576.1 [4]
7	5.7	----	137.8	---- [4]	---- [4]	----	----	137.8 [4]
8	6.9 [3]	---- [4]	167.3 [3]	---- [4]	---- [4]	502.6	---- [4]	669.9 [4]
11	44.8	----	1,064.7	---- [4]	---- [4]	----	<0.1	1,064.8 [4]
WTP A	----	----	----	----	----	502.6	----	502.6
WTP B	7.3	----	167.4	----	----	502.6	----	670.0
WTP C	6.1	----	149.3	----	----	502.6	----	651.9

[1] Metrics are not included if the access road is located in a transmission line corridor.
[2] Other infrastructure includes intake structures, discharge structures, and low-head dam project areas.
[3] Length and area shown for pipe corridor represents only the segment of pipe required to connect the nearest edge of the well field to the proposed WTP. Additional pipe corridor is required within the well field to collect groundwater from the wells and convey it to northeastern edge of the well field.
[4] Additional assessment and design are required to quantify the access road, pump station, and additional infrastructure associated with this alternative.

4.2 Topography and Geology

The project areas are situated in the Piedmont physiographic province. The geography of the Piedmont physiographic province consists of gently rolling hills and low ridges underlain by Proterozoic and Paleozoic metamorphic and intrusive igneous rocks. The project areas are underlain by metamorphic, intrusive, and sedimentary rocks associated with Carolina Slate Belt, Charlotte and Milton Belts, Coastal Plain, and Triassic Basin (NCDENR, 2007; SCDNR, 2005) .

Union County is primarily underlain by metasedimentary rocks, specifically argillite. The rock is a compact rock that has been consolidated under pressure to a greater degree than its parent rock, which may be mudstone or shale. Argillite lacks the cleavage of slate and is less likely to be split or fractured than shale. Locally, beds of mudstone, shale, thinly laminated siltstone, conglomerate, and felsic volcanic rock may occur within the argillite formation.

The project areas are located on the New London, Frog Pond, Albemarle, Morrow Mountain, Midland, Stanfield, Oakboro, Aquadale, Mount Gilead West, Bakers, Watson, Polkton, Ansonville, Mangum, Waxhaw, Monroe, Wingate, Marshville, Russellville, Wadesboro, Lilesville, Tradesville, and Pageland, North Carolina and Catawba NE and Van Wyck, South Carolina United States Geological Survey (USGS) 7.5-minute Topographic Quadrangle Maps as illustrated in Figure 4-1. Elevations in the project areas range from approximately 175 feet above mean sea level (msl) to 770 feet msl. The minimum and maximum elevations within the project areas of each alternative are summarized in Table 4-3.

Table 4-3 Elevations per Alternative

Alternative	Minimum and Maximum Elevations, feet msl
1A	255 to 550
1B	275 to 645
2A	315 to 770
2B	315 to 750
3A	175 to 550
3B	175 to 525
4	190 to 550
5	315 to 528
6	525 to 770
7	495 to 745
8	460 to 725
11	260 to 592
WTP A	465 to 560
WTP B	502 to 585
WTP C	457 to 575

4.3 Soils

The published soil survey for each county and the Natural Resources Conservation Service (NRCS) Web Soil Survey contain general and detailed information relative to the soils underlying Anson, Lancaster, Mecklenburg, Stanly, and Union counties (USDA, 2005; USDA, 1973; USDA, 1973; USDA, 1980; USDA, 1989; USDA, 1996,respectively). Across the five counties, the general soil types are separated into forty-four (44) soil associations based on landscape position and underlying geology or parent material (USDA, 1973; USDA, 1980; USDA, 1989; USDA, 1996; USDA, 2005). The soil associations that underlie the study areas of the proposed alternatives are described in Table 4-4.

Soil associations are divided into soil mapping units, which allow for detailed descriptions of the soils and the properties thereof at a specific location. The detailed soil types, or soil-mapping units, are delineated, mapped, and described by NRCS and available through the Web Soil Survey (USDA, 2014). One hundred thirteen (113) soil types are present within the project areas. Due to the alternatives being in geologically similar locations within the landscape, the soil types are common for most of the alternatives. The soils present within the project areas are depicted on Figure 4-2 and provided in Table 4-5 (USDA, 2014).

Table 4-4 Soil Associations per Alternative

Soil Association	Alternative(s)	Slope	Depth	Drainage	Subsoil/Parent Material (PM)	County
Ailey-Emporia-Candor	3a, 3b	nearly level to strong	very deep	well drained	sandy or loamy subsoil/ loamy, clayey, and sandy marine sediment PM	Anson
Badin-Cid-Goldston-Tatum	1a, 1b, 2a, 2b, 3a, 3b, 4, 5, 6, 7, 8, 11, WTP A, WTP B, WTP C	nearly level to steep	shallow to deep	excessively to somewhat poorly drained	loamy or clayey subsoil/ Carolina slate PM	Union
Badin-Goldston	1a, 1b, 2a, 2b, 11	undulating to steep	shallow to moderately deep	well drained	loamy to clayey subsoil/ Carolina slate residuum PM	Stanly
Badin-Tarrus-Nanford	4	gentle to strong	moderately deep to deep	well drained	clayey subsoil/ Carolina Slate Belt argilite, schist, and other fine-grained rock PM	Anson
Cecil	7	gentle to strong	very deep	well drained	clayey subsoil/ acid igneous and metamorphic rock PM	Mecklenburg
Cecil-Appling	6	gentle to strong	very deep	well drained	clayey subsoil/ felsic crystalline rock PM	Union
Cecil-Davidson	6	gentle to strong	deep	well drained	clay subsoil	Lancaster
Chewacla-Shellbluff-Riverview	3a, 3b, 4	nearly level	very deep	well to somewhat poorly drained	loamy subsoil/ recent alluvial sediment PM	Anson
Cid-Badin-Goldston	3b, 6, 7, 8, 11	nearly level to steep	shallow to moderately deep	excessively to somewhat poorly drained	loamy or clayey subsoil/ Carolina slate PM	Union
Enon	1a, 1b, 11	undulating to hilly	very deep	well drained	plastic clayey subsoil/ mixed acid and basic rock PM	Stanly
Georgeville-Goldston-Lignum	7	gentle to strong	shallow to very deep	well to moderately well drained	clayey or loamy subsoil/ fine-grained schist or slate PM	Mecklenburg
Goldston-Badin	3a, 3b, 4, WTP C	gentle to steep	shallow to moderately deep	well drained	loamy or clayey subsoil/ Carolina Slate Belt argilite and other fine-grained rock PM	Anson

Soil Association	Alternative(s)	Slope	Depth	Drainage	Subsoil/Parent Material (PM)	County
Goldston-Badin-Cid	1a, 1b, 2a, 2b, 3a, 3b, 4, 5, 8, 11, WTP A	nearly level to steep	shallow to moderately deep	excessively to somewhat poorly drained	loamy or clayey subsoil/ Carolina slate PM	Union
Mayodan-Polkton-White Store	3a, 3b	gentle to moderate	moderately to very deep	well to moderately well drained	clayey subsoil/ Triassic siltstone, sandstone, shale, and mudstone PM	Anson
Misenheimer-Kirksey-Badin	1a, 1b, 2a, 2b, 11	nearly level to gentle	shallow to deep	somewhat poorly to well drained	loamy to clayey subsoil/ fine-grained metavolcanic and metasedimentary rock and Carolina slate PM	Stanly
Pacolet	3a, 3b	gentle to steep	very deep	well drained	loamy or clayey subsoil/ porphyritic granite PM	Anson
Pinoka-Mayodan	3a, 3b	gentle to moderate	moderately to very deep	well drained	loamy or clayey subsoil/ sandstone, mudstone, siltstone, conglomerate, or shale PM	Anson
Tatum	6, 8, WTP B	gentle to steep	deep	well drained	clayey subsoil/ Carolina slate PM	Union
Tatum-Badin-Georgeville	1b, 2a, 2b	gentle to rolling	moderately to very deep	well drained	clayey subsoil/ Carolina slate residuum PM	Stanly
Tatum (eroded)-Badin-Georgeville (eroded)	1a, 1b, 11	gentle to steep	moderately to very deep	well drained	clayey subsoil/ Carolina slate residuum PM	Stanly
Tetotum-Hornsboro-McQueen	4	nearly level to strong	very deep	well to somewhat poorly drained	loamy or clayey subsoil/ alluvium PM	Anson
Uwharrie-Hiwassee-Tatum	2a, 2b	gentle to very steep	deep to very deep	well drained	clayey subsoil/ fine-grained metamorphic or igneous pyroclastic rock or felsic and mafic rock PM	Stanly

Table 4-5 Soil Series per Alternative, Acres

Soil Series	Alternative														
	1A	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**[1]	**11**	**WTP A**	**WTP B**	**WTP C**
Ailey-Appling complex, 2 to 8 percent slopes	----	----	----	----	----	----	----	----	63	----	----	----	----	----	----
Ailey-Appling complex, 8 to 15 percent slopes, bouldery	----	----	----	----	----	----	----	----	2	----	----	----	----	----	----
Ailey loamy sand, 2 to 8 percent slopes	----	----	----	----	----	9	----	----	----	----	----	----	----	----	----
Appling fine sandy loam, 2 to 6 percent slopes, eroded	----	----	----	----	----	----	----	----	51	----	----	----	----	----	----
Appling fine sandy loam, 6 to 10 percent slopes, eroded	----	----	----	----	----	----	----	----	4	----	----	----	----	----	----
Appling fine sandy loam, 10 to 15 percent slopes, eroded	----	----	----	----	----	----	----	----	0.8	----	----	----	----	----	----
Appling sandy loam, 2 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	230	----	----	----	----
Appling sandy loam, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	17	----	----	----	----
Badin channery silt loam, 2 to 8 percent slopes	144	89	114	116	75	15	148	33	17	16	9,913	247	46	56	38
Badin channery silt loam, 8 to 15 percent slopes	38	36	55	70	27	10	58	----	----	1	1,416	80	219	----	11

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Badin channery silt loam, 15 to 45 percent slopes	4	3	9	7	----	----	----	----	----	----	----	5	----	----	----
Badin channery silty clay loam, 2 to 8 percent slopes, moderately eroded	1	1	1	1	19	0.4	19	1	26	12	3,001	94	53	8	21
Badin channery silty clay loam, 8 to 15 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	3	----	477	4	7	----	----
Badin-Goldston complex, 2 to 8 percent slopes	----	----	----	----	8	----	0.3	----	----	----	----	----	----	----	----
Badin-Goldston complex, 8 to 15 percent slopes	----	----	----	----	2	----	6	----	----	----	----	----	----	----	----
Badin-Goldston complex, 15 to 25 percent slopes	----	----	----	----	1	11	15	----	----	----	----	----	----	----	----
Badin-Urban land complex, 2 to 8 percent slopes	----	14	73	73	----	----	----	----	5	3	97	19	3	----	----
Badin-Urban land complex, 8 to 25 percent slopes	----	16	14	10	----	----	----	----	----	----	----	1	----	5	8
Candor sand, 1 to 8 percent slopes	----	----	----	----	----	7	----	----	----	----	----	----	----	----	----
Cecil clay loam, 2 to 6 percent slopes, severely eroded	----	----	----	----	----	----	----	----	5	----	----	----	----	----	----
Cecil clay loam, 6 to 10 percent slopes, severely eroded	----	----	----	----	----	----	----	----	16	----	----	----	----	----	----

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Cecil clay loam, 10 to 25 percent slopes, severely eroded	----	----	----	----	----	----	----	----	17	----	----	----	----	----	----
Cecil fine sandy loam, 2 to 6 percent slopes, eroded	----	----	----	----	----	----	----	----	21	----	----	----	----	----	----
Cecil fine sandy loam, 6 to 10 percent slopes, eroded	----	----	----	----	----	----	----	----	5	----	----	----	----	----	----
Cecil fine sandy loam, 15 to 25 percent slopes, eroded	----	----	----	----	----	----	----	----	3	----	----	----	----	----	----
Cecil gravelly sandy clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	85	----	----	----	----	----	----
Cecil sandy clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	18	----	----	----	----	----
Cecil sandy clay loam, 8 to 15 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	0.1	----	----	----	----	----
Chenneby silt loam, 0 to 2 percent slopes, frequently flooded	----	3	2	2	----	----	----	----	----	----	----	----	----	----	----
Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	0.4	1	1	1	73	14	15	1	2	4	1,957	8	----	----	2

Soil Series	Alternative														
	1A	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**[1]	**11**	**WTP A**	**WTP B**	**WTP C**
Chewacla and Chastain soils, 0 to 2 percent slopes, frequently flooded	----	----	----	----	----	23	----	----	2	----	----	----	----	----	----
Cid channery silt loam, 1 to 5 percent slopes	----	----	----	----	----	----	4	9	70	35	14,87 3	68	----	----	----
Cid channery silt loam, 1 to 5 percent slopes	9	9	9	9	4	18	----	----	----	----	----	----	----	66	13
Claycreek fine sandy loam, 0 to 2 percent slopes	----	----	----	----	----	15	----	----	----	----	----	----	----	----	----
Congaree fine sandy loam, 0 to 2 percent slopes, frequently flooded	1	1	1	----	----	----	----	0.1	----	----	----	1	----	----	----
Creedmoor fine sandy loam, 2 to 8 percent slopes	----	----	----	----	24	31	----	----	----	----	----	----	----	----	----
Emporia loamy sand, 2 to 6 percent slopes	----	----	----	----	----	34	----	----	----	----	----	----	----	----	----
Enon cobbly loam, 2 to 8 percent slopes	17	6	19	14	----	----	----	----	----	----	----	----	----	----	----
Enon very cobbly loam, 4 to 15 percent slopes, very stony	----	----	----	----	----	----	----	----	----	----	----	2	----	----	----
Enon cobbly loam, 8 to 15 percent slopes	0.2	4	2	1	----	----	----	----	----	----	----	----	----	----	----
Enon very cobbly loam, 4 to 15 percent slopes, very stony	6	6	----	15	----	----	----	----	----	----	----	----	----	----	----

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Enon very cobbly loam, 15 to 25 percent slopes, very stony	2	6	----	----	----	----	----	----	----	----	----	8	----	----	----
Fuquay loamy sand, 0 to 3 percent slopes	----	----	----	----	----	14	----	----	----	----	----	----	----	----	----
Georgeville silt loam, 4 to 15 percent slopes, extremely bouldery	0.1	4	2	1	----	----	----	----	----	----	----	0.1	----	----	----
Georgeville silt loam, 15 to 45 percent slopes, extremely bouldery	----	5	----	----	----	----	----	----	----	----	----	----	----	----	----
Georgeville silty clay loam, 2 to 8 percent slopes, moderately eroded	----	----	5	----	----	----	----	----	16	4	----	----	----	----	----
Georgeville silty clay loam, 8 to 15 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	0.3	----	----	----	----	----
Goldston channery silt loam, 2 to 8 percent slopes	----	----	----	----	34	31	38	----	----	----	----	----	----	----	----
Goldston channery silt loam, 8 to 15 percent slopes	----	----	----	----	43	7	14	----	----	----	----	----	----	----	----
Goldston channery silt loam, 15 to 25 percent slopes	----	----	----	----	18	----	10	----	----	----	----	----	----	----	----
Goldston channery silt loam, 25 to 45 percent slopes	----	----	----	----	23	1	----	----	----	----	----	----	----	----	----

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Goldston very channery silt loam, 2 to 8 percent slopes	----	----	----	----	----	----	----	----	----	0.1	----	----	----	----	----
Goldston very channery silt loam, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	1	----	----	----	----	----
Goldston very channery silt loam, 4 to 15 percent slopes	87	129	148	169	6	40	6	----	----	----	743	100	31	----	5
Goldston very channery silt loam, 15 to 45 percent slopes	40	44	16	16	----	7	----	1	----	----	69	49	----	----	----
Goldston-Badin complex, 2 to 8 percent slopes	4	4	4	4	50	10	50	4	26	16	6,585	57	134	10	22
Goldston-Badin complex, 8 to 15 percent slopes	7	7	7	7	4	----	4	7	3	2	1,103	25	----	----	2
Goldston-Badin complex, 15 to 45 percent slopes	8	8	8	8	----	----	----	8	----	----	163	10	----	----	2
Hiwassee gravelly loam, 2 to 8 percent slopes	2	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Hiwassee gravelly loam, 8 to 15 percent slopes	----	----	3	----	----	----	----	----	----	----	----	----	----	----	----
Hiwassee clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	7	----	----	----	----	----	----	----	----

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Hiwassee clay loam, 8 to 15 percent slopes, moderately eroded	----	----	----	----	----	----	1	----	----	----	----	----	----	----	----
Hiwassee gravelly loam, 2 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	2	----	----	----
Hornsboro silt loam, 0 to 2 percent slopes, rarely flooded	----	----	----	----	8	0.3	----	----	----	----	----	----	----	----	----
Iredell fine sandy loam, 1 to 6 percent slopes	----	----	----	----	3	----	----	----	----	----	----	----	----	----	----
Kirksey silt loam, 0 to 6 percent slopes	49	40	19	32	----	----	----	----	----	----	----	54	----	----	----
Lignum gravelly silt loam, 2 to 8 percent slopes	----	----	----	----	----	----	----	----	----	6	----	----	----	----	----
Lillington gravelly sandy loam, 2 to 8 percent slopes	----	----	----	----	6	9	----	----	----	----	----	----	----	----	----
Lillington gravelly sandy loam, 8 to 15 percent slopes	----	----	----	----	6	7	----	----	----	----	----	----	----	----	----
Lloyd gravelly loam, 2 to 8 percent slopes	----	----	16	----	----	----	----	----	----	----	----	----	----	----	----
Lloyd gravelly loam, 8 to 15 percent slopes	----	----	19	----	----	----	----	----	----	----	----	----	----	----	----
Masada and Altavista soils, 2 to 6 percent slopes	----	----	----	----	----	----	----	----	2	----	----	----	----	----	----
Mayodan fine sandy loam, 2 to 8 percent slopes	----	----	----	----	23	33	----	----	----	----	----	----	----	----	----

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Mayodan fine sandy loam, 8 to 15 percent slopes	----	----	----	----	----	0.2	----	----	----	----	----	----	----	----	----
Mayodan gravelly sandy loam, 2 to 8 percent slopes	----	----	----	----	2	42	20	----	----	----	----	----	----	----	----
Mayodan gravelly sandy loam, 8 to 15 percent slopes	----	----	----	----	4	39	----	----	----	----	----	----	----	----	----
Mayodan-Urban land complex, 4 to 10 percent slopes	----	----	----	----	----	67	----	----	----	----	----	----	----	----	----
McQueen loam, 1 to 6 percent slopes	----	----	----	----	1	2	----	----	----	----	----	----	----	----	----
Mecklenburg fine sandy loam, 10 to 15 percent slopes, eroded	----	----	----	----	----	----	----	----	1	----	----	----	----	----	----
Mecklenburg sandy clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	7	----	----	----	----
Misenheimer channery silt loam, 0 to 4 percent slopes	39	86	40	48	----	----	----	----	----	----	----	39	10	----	----
Misenheimer-Callison complex, 0 to 3 percent slopes	----	----	----	----	----	0.1	12	----	----	----	----	----	----	0.1	5
Misenheimer-Cid complex, 0 to 3 percent slopes	----	----	----	----	4	1	4	----	----	2	1,010	12	----	----	----
Monacan loam, 0 to 2 percent slopes, frequently flooded	----	----	----	----	----	----	----	----	----	1	----	----	----	----	----

Soil Series	Alternative														
	1A	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**[1]	**11**	**WTP A**	**WTP B**	**WTP C**
Oakboro silt loam, 0 to 2 percent slopes, frequently flooded	16	41	21	16	----	----	----	----	----	----	----	23	----	----	----
Pacolet gravelly sandy loam, 2 to 8 percent slopes	----	----	----	----	2	31	----	----	----	----	----	----	----	----	----
Pacolet gravelly sandy loam, 8 to 15 percent slopes	----	----	----	----	19	26	----	----	----	----	----	----	----	----	----
Pacolet gravelly sandy loam, 15 to 25 percent slopes	----	----	----	----	18	12	----	----	----	----	----	----	----	----	----
Pacolet gravelly sandy loam, 25 to 45 percent slopes	----	----	----	----	39	11	----	----	----	----	----	----	----	----	----
Pelion loamy sand, 1 to 4 percent slopes	----	----	----	----	----	4	----	----	----	----	----	----	----	----	----
Pinoka-Carbonton complex, 2 to 8 percent slopes	----	----	----	----	35	----	----	----	----	----	----	----	----	----	----
Pinoka fine sandy loam, 8 to 15 percent slopes	----	----	----	----	51	----	----	----	----	----	----	----	----	----	----
Pinoka fine sandy loam, 15 to 30 percent slopes	----	----	----	----	5	----	----	----	----	----	----	----	----	----	----
Polkton-White Store complex, 2 to 8 percent slopes, severely eroded	----	----	----	----	----	33	----	----	----	----	----	----	----	----	----
Roanoke loam, 0 to 2 percent slopes, rarely flooded	----	----	----	----	4	----	----	----	----	----	----	----	----	----	----

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Secrest-Cid complex, 0 to 3 percent slopes	----	----	----	----	----	----	----	----	4	2	1,068	----	----	----	----
Shellbluff loam, 0 to 2 percent slopes, occasionally flooded	----	----	----	----	0.1	----	9	----	----	----	----	----	----	----	----
State fine sandy loam, 0 to 2 percent slopes, rarely flooded	----	----	----	----	4	2	----	----	----	----	----	----	----	----	----
Tarrus channery silt loam, 2 to 8 percent slopes	21	13	79	74	----	----	----	----	----	----	----	41	----	----	----
Tarrus channery silt loam, 8 to 15 percent slopes	0.3	3.3	14	----	----	----	----	----	----	----	----	0.3	----	----	----
Tarrus channery silty clay loam, 2 to 8 percent slopes, moderately eroded	5	10	14	1	----	----	----	----	----	----	----	47	----	----	----
Tarrus channery silty clay loam, 8 to 15 percent slopes, moderately eroded	----	----	4	----	----	----	----	----	----	----	----	----	----	----	----
Tarrus gravelly silt loam, 2 to 8 percent slopes	----	----	----	----	5	----	69	----	----	2	4,346	16	----	15	12
Tarrus gravelly silt loam, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	515	----	----	----	----
Tarrus gravelly silty clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	102	13	4,832	3	----	17	16

Soil Series	Alternative														
	1A	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8[1]**	**11**	**WTP A**	**WTP B**	**WTP C**
Tarrus gravelly silty clay loam, 8 to 15 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	2	----	164	----	----	----	0.1
Tarrus-Georgeville complex, 8 to 15 percent slopes	----	----	----	----	----	----	6	----	----	----	----	----	----	----	----
Tarrus-Urban land complex, 2 to 8 percent slopes	----	----	----	----	----	----	----	----	5	----	40	24	----	----	----
Tarrus-Urban land complex, 2 to 8 percent slopes	21	27	23	76	----	----	----	----	----	----	----	----	----	----	----
Tillery silt loam, 0 to 3 percent slopes	----	----	----	----	11	1	4	----	----	----	----	----	----	----	----
Udorthents, loamy	----	4	1	----	----	----	----	----	4	----	----	----	----	----	----
Udorthents, loamy, 0 to 15 percent slopes	----	----	----	----	17	40	----	----	----	----	----	----	----	----	----
Urban land	3	3	8	8	----	----	----	----	----	----	----	3	----	----	----
Wagram sand, 2 to 6 percent slopes	----	----	----	----	----	----	----	----	4	----	----	----	----	----	1
Wedowee sandy loam, 10 to 25 percent slopes, eroded	----	----	----	----	----	----	----	----	1	----	----	----	----	----	----
Wehadkee and Chewacla soils	----	----	----	----	----	----	----	----	3	----	----	----	----	----	----
White Store fine sandy loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	28	20	----	----	----	----	----	----	----	----	----
Wickham sandy loam, 2 to 6 percent slopes, eroded	----	----	----	----	----	----	----	----	1	----	----	----	----	----	----

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Wilkes sandy loam, 2 to 6 percent slopes, eroded	----	----	----	----	----	----	----	----	4	----	----	----	----	----	----
Wynott gravelly loam, 2 to 8 percent slopes	----	----	----	----	----	----	----	----	2	----	632	----	----	----	----
Wynott gravelly loam, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	15	----	----	----	----
Wynott loam, 2 to 8 percent slopes	----	----	----	----	3	----	1	----	----	----	----	----	----	----	----

[1] *Alternative 8 includes all soils mapped in pipe corridor and well field area. Soils indicated for Alternative 8 are not specific to the soils that will be impacted if the alternative is selected and implemented.*

4.4 Land Use

Land use defines a community's physical form and function and provides a framework for all infrastructure-related decisions, including transportation, economic development, public utilities, community facilities, parks, and environmental protection. Land Use Plans or other planning documents have been prepared to guide growth and development in the municipalities and counties within the project areas. Examples of these land use planning programs include Land Use Plans, Comprehensive Plans, and Zoning Ordinances which are described below and explained in further detail in Section 6.

4.4.1 Zoning

The zoning information presented herein is compiled from zoning classifications by the Towns of New London, Norwood, Ansonville, Wadesboro, Peachland, Fairview, Monroe, Mineral Springs, Mint Hill, and Waxhaw as well as Union, Stanly, and Anson counties, North Carolina and Lancaster County, South Carolina (Stanly County, 2013); North Carolina Department of Commerce, Division of Community Assistance 2008 (NC Department of Commerce , 2008); Anson County GIS Department 2014 (Anson County, 2014); Centralina Council of Governments 2006 (Town of Fairview, 2006); Town of Monroe 2008 (Town of Monroe, 2008); Town of Mineral Springs 2008 (Town of Mineral Springs, 2008); Mint Hill Planning Department 2011 (Town of Mint Hill, 2011); Town of Waxhaw Planning Department 2008 (Town of Waxhaw, 2008); Union County GIS Department 2010 (Union County, 2010); Stanly County Planning Department 2002 ; Anson County Planning and Zoning Department 2014 (Anson County, 2014) ; Lancaster County Planning Department 2013 (Lancaster County, 2013). Mapping of zoning districts is presented in Appendix E, CD-1. A discussion of the zoning classifications within the study area is provided herein. Quantification of zoning districts for each alternative is not provided as some areas traversed by the proposed alternatives are not zoned and zoning data is not available electronically for all jurisdictions.

The proposed raw water transmission corridor alternatives cross fourteen municipal and four county zoning jurisdictions. The primary zoning classifications associated with the corridor alternatives include residential, commercial, industrial, and agricultural. Additional zoning classifications representing smaller portions of the corridor alternatives include office and apartments, manufacturing, institutional, special use and conditional, public and semi-public lands, wooded and undeveloped areas, and parks, recreation, and open space districts. The proposed WTP Site Alternatives are situated in areas that are zoned as low-density residential.

4.4.2 Land Use Plans

Land Use Plans or other similar planning documents have been developed and approved by several municipalities and counties in which a portion of the project is located. Some of the planning documents provide a general goal or set of goals for each land use type or zoning district in the jurisdiction, while others provide greater detail, including policies and strategies for achieving the land use goals as well as maps depicting the areas of the jurisdiction's purview to be targeted for each development or preservation type. Common elements of the land use planning frameworks include the encouragement of well-planned growth while providing economic development, public facilities and services, intergovernmental coordination and cooperation, housing and neighborhoods, and transportation and protecting agriculture, open space, and environmental resources. Anson, Lancaster, Stanly, and Union County along with the municipalities of Waxhaw, Mineral Springs, Wesley Chapel, Marvin, Weddington, Indian Trail, Stallings, Hemby Bridge, Lake Park, Fairview, Unionville, Wingate, Norwood, Ansonville, New London, Wadesboro, and Peachland all have adopted a land use planning framework. The specifics of the land use planning programs in the communities within the project area are described in Section 6.

4.4.3 Existing Land Use

The evaluation of existing land use is typically based on the information and mapping provided in the local government's Land Use Plan. However, for the proposed project area, limited data on the existing land uses within the proposed project footprints is available from the local municipalities and counties through published or publicly available mapping, or other documentation. While several jurisdictions provide an existing land use map, they are at a scale that is difficult to accurately assess existing land uses in specific project corridors. Therefore, the existing land use for the project areas is described in general terms and is based on a combination of the published land use mapping, where available, and aerial photography.

Where available and usable relative to the proposed project, published land use data was evaluated as the primary source of information, supplemented by aerial photography. Analysis of land use was performed using GIS to correlate the project areas with the aerial photography. Areas used for agricultural purposes were identified as were areas developed for residential, industrial, and commercial uses. Undeveloped, wooded areas may include areas that are used for timberland, open space, and riparian buffers and those that are simply undeveloped.

4.4.3.1 COMMON ELEMENTS OF ALTERNATIVES 1A AND 1B

Alternatives 1A and 1B will require the acquisition of utility easement on property that is not owned by Stanly County, Union County, or the Towns of Norwood and Oakboro. The amount of easement needed varies per alternative. The pipe corridors associated with these two alternatives will follow North Carolina Department of Transportation (NCDOT) roadways and may be located within the right-of-way thereof. Existing land uses associated with the proposed pipe corridors for the two alternatives are predominantly woodlands and agricultural with small areas of residential and public/semi-public lands. Alternative 1A also traverses a large industrial parcel.

4.4.3.2 COMMON ELEMENTS OF ALTERNATIVES 2A AND 2B

Alternatives 2A and 2B will require the acquisition of utility easement on property that is not owned by Stanly County, Union County, or the Towns of Albemarle and New London. The amount of easement needed varies per alternative. The pipe corridors associated with these two alternatives will follow NCDOT roadways for the majority of their length and may be located in the right-of-way thereof. In addition to the roadway, the areas within and abutting the pipe corridor associated with Alternatives 2A and 2B are predominantly woodlands and agricultural lands with some small areas of residential development and public/semi-public lands.

4.4.3.3 ALTERNATIVE 3A

Alternative 3A primarily follows an existing overhead utility easement. Additional utility easement width along the existing easement may be necessary, and new utility easement along the remainder of the pipe corridor will be needed. The amount of easement necessary is unknown at this time. Areas associated with Alternative 3A that are located outside the utility easement include woodlands, agriculture, and roadways. Small pockets of residential and institutional development are also present within the pipe corridor for this alternative.

4.4.3.4 ALTERNATIVE 3B

The pipe corridor of Alternative 3B primarily follows the U.S. 74 corridor. Within the pipe corridor, land uses include woodlands; agricultural areas; and institutional, residential, and commercial development. Institutional developments in the pipe corridor are schools and a WTP. Acquisition of utility easement will be required under Alternative 3B. As there are existing buried utility lines along some of the same length of U.S. 74 as the proposed corridor, the area of new utility easement that would be needed is unknown at this time. The central and northern portions of the proposed WTP facility area are dominated by woods. Agriculture dominates the southern and eastern portions of the proposed WTP facility area and is present in the northern portion thereof.

4.4.3.5 ALTERNATIVE 4

The pipe corridor of Alternative 4 follows existing roadways along the majority of its length and is dominated by agricultural areas and woodlands. Residential development is also present within the pipe corridor. Utility easement acquisition will be required for Alternative 4.

4.4.3.6 ALTERNATIVE 5

The pipe corridor of Alternative 5 follows an existing roadway that is abutted by agriculture and residences with a few pockets of woods. Acquisition of utility easement is expected to be necessary for the pipe corridor and associated infrastructure. Existing easements may be present in the footprint of Alternative 5; therefore, easement acquisition areas are not known at this time.

4.4.3.7 ALTERNATIVE 6

Alternative 6 begins within the existing Catawba WTP in Lancaster County, South Carolina and follows roadway corridors to its terminus in Monroe, North Carolina. The pipe corridor will follow an existing utility easement. Acquisition of additional easement may be required to accommodate the proposed pipe. The lands adjacent to the roadway and within the proposed pipe corridor include woodlands and areas that are in use for agricultural and residential purposes with pockets of commercial and industrial development.

4.4.3.8 ALTERNATIVE 7

Alternative 7 includes only a pipe corridor, which originates in Mint Hill, North Carolina and extends into Fairview, North Carolina, connecting two existing water distribution mains. The alternative follows a roadway corridor that is abutted by woodlands, residential development, and agricultural lands as well as a small area of recreational use. Acquisition of utility easement is expected to be required for the proposed alternative.

4.4.3.9 ALTERNATIVE 8

Alternative 8 includes the proposed groundwater well field, pipe corridor connecting the well field to the proposed WTP D facility, and the WTP D facility area. The well field vicinity includes properties with inhabited structures, including residences, commercial buildings, and industrial or institutional facilities. However, the properties that contain taxable structures are not included in the footprint of the proposed well field and are therefore not included in the discussion of land use for the alternative. Land use in the well field is agricultural and forested/undeveloped. The pipe corridor includes agricultural, residential, and undeveloped areas, and the WTP site is primarily wooded and agricultural with a few residences.

4.4.3.10 ALTERNATIVE 11

Alternative 11 follows existing roads from the City of Monroe WWTP to Lake Tillery at the NC 27/NC 24 bridge. The proposed pipe corridor is partially located within existing NCDOT rights-of-way. Other land uses within the proposed pipe corridor are predominantly agricultural and residential. Wooded areas are common within the corridor, and institutional and commercial uses are present in small pockets. One large industrial parcel is traversed by Alternative 11. Acquisition of utility easement is expected to be required for the alternative. The pump station required for the alternative will be located within the existing City of Monroe WWTP site.

4.4.3.11 ALTERNATIVE WTP A

The proposed WTP A facility area is predominantly agricultural with several wooded areas and a few residences. WTP A is located in unincorporated Union County. Acquisition of property for the proposed WTP will be necessary if WTP Site A is implemented.

4.4.3.12 ALTERNATIVE WTP B

Alternative WTP B corridor follows existing roadways, and the corridor is abutted by woodlands, residential development, and agricultural lands. Acquisition of utility easement is expected to be required for the proposed alternative. The southern-most portion of the pipe corridor and the WTP B area is located in Unionville. The WTP B facility area consists of several residences, agricultural areas, and forested areas.

4.4.3.13 ALTERNATIVE WTP C

The Alternative WTP C pipe corridor follows existing roadways and is dominated by agricultural areas and woodlands. Residential development is also present within the pipe corridor. Utility easement acquisition will be required for the WTP C corridor. The proposed WTP C facility area contains numerous residences, several agricultural areas, and some wooded areas.

4.4.4 Land Cover

Land cover describes the type of vegetation and the intensity of the development of an area. Primary classes of land cover include forested areas, agricultural lands, and developed cover. The primary classes are further divided into specific types, which may be defined by the vegetative composition of a forested or herbaceous area, the specific agricultural use, or the intensity of the development or improvement. For the purposes of this project, land cover was analyzed at the primary classification level. Land cover in the project areas, excluding the well field area, is summarized in Table 4-6 and illustrated in Figure 4-3.

Table 4-6 Land Cover in Project Area

Project Component	Alternative(s)	Undeveloped, Wooded, %	Agricultural Use, %	Developed, %
Pipe Corridor	1A	27	28	45
	1B	31	28	41
	2A	22	21	58
	2B	20	19	61
	3A	36	25	38
	3B	37	7	57
	4	35	35	30
	5	21	33	46
	6	35	11	54
	7	23	24	54
	8 [1]	18	58	24
	11	22	29	49
	WTP B	27	32	41
	WTP C	31	33	36
Pump Station	1A and 1B	----	----	100
	2A	25	----	75
	2B	100	----	----
	3A and 3B	100	----	----
	4	----	100	----
	5	----	----	100
	11	----	----	100
Access Road [2]	2B	85	----	15
	3A and 3B	100	----	----
	5	----	----	100
Water Treatment Plant	WTP A	30	69	1
	3B and 8 (WTP D)	96	4	----
	6 (Catawba WTP)	40	----	60
	WTP B	65	33	1
	WTP C	26	73	1

See table notes next page

[1] Land cover for pipe corridor represents only the segment of pipe required to connect the nearest edge of the well field to the proposed WTP. Additional pipe corridor is required within the well field to collect groundwater from the wells and convey it to northeastern edge of the well field.
[2] Land cover associated with access roads located within the pipe corridor are included in the pipe corridor calculations.

4.5 Public Lands and Scenic, Recreational, and State Natural Areas

Federal, state, county, and municipal-owned lands, parks, and scenic and recreational areas located throughout the project area are described herein. Areas designated by the DENR Office of Conservation, Planning and Community Affairs, Natural Heritage Program (NHP) as significant natural heritage areas (SNHAs) are also discussed in this section. SNHAs may be on public or private land and their designation as a natural area by NHP does not confer protection. The South Carolina Department of Natural Resources (SCDNR) manages public lands through a Wildlife Management Area (WMA) program and a Heritage Trust Program. Additional recreational opportunities are provided by the rivers and reservoirs present in the project areas.

A summary of the public lands and scenic, recreational, and state natural areas within or in proximity to the project area is provided in Table 4-7 and illustrated in Figure 4-4. Quantification of public lands in the project area is provided in Table 4-8. The information depicted on Figure 4-4 and provided in the tables was obtained from data downloaded from the NC OneMap (www.nconemap.com), SCDNR websites, and other readily available sources.

Table 4-7 Summary of Public Lands and Scenic, Recreational, and State Areas Natural by Alternative

Name	Description
Alternative 1A:	
Bike Routes	○ 5.3 miles of corridor is located within designated bike route areas ○ Transmission corridor crosses one bike route
SNHAs	○ Long Creek Slate Slopes is traversed by corridor ○ New Salem Branch is traversed by the corridor and access road ○ Baucom Bluff is approximately 385 feet west of corridor
Other Recreational Areas	○ The raw water intake is located in Lake Tillery ○ The pipe corridor crosses Rocky River
Alternative 1B:	
Bike Routes	○ 0.3 mile of corridor is located within designated bike route areas ○ Transmission corridor crosses bike routes five times
SNHAs	○ Transmission corridor crosses Big Bear Creek Aquatic Habitat twice ○ New Salem Branch is traversed by corridor and access road ○ Baucom Bluff is approximately 385 feet west of corridor
Conservation Lands	○ Corridor traverses Oakboro Community Park II
Other Recreational Areas	○ The raw water intake is located in Lake Tillery ○ The pipe corridor crosses Rocky River
Alternative 2A:	
Bike Routes	○ 14 miles of corridor is located within designated bike route areas
SNHAs	○ Big Bear Creek Aquatic Habitat is crossed by the corridor twice ○ New Salem Branch is traversed by the corridor ○ Baucom Bluff is approximately 385 feet west of corridor
State Owned Lands	○ State owned land is located approximately 90 feet west of corridor

Name	Description
Other Recreational Areas	○ The raw water intake is located in Narrows Reservoir (Badin Lake) ○ The pipe corridor crosses Rocky River
Alternative 2B:	
Bike Routes	○ 14 miles of corridor is located within designated bike route areas
SNHAs	○ New London Ridges is traversed by corridor ○ Corridor crosses Big Bear Creek Aquatic Habitat twice ○ New Salem Branch is traversed by the corridor ○ Baucom Bluff is approximately 385 feet west of corridor
State Owned Lands	○ State owned land is located approximately 90 feet west of corridor
Other Recreational Areas	○ The raw water intake is located in Tuckertown Reservoir ○ The pipe corridor crosses Rocky River
Alternative 3A:	
SNHAs	○ Upper Brown Creek Swamp is traversed by the corridor ○ Fish Road Basic Forest is located approximately 600 feet north of corridor ○ Deep Bottom Branch Bluffs is located approximately 500 feet north of corridor
State Game Lands	○ The pump station is located within the Pee Dee River State Game Land, which is privately owned ○ Pee Dee River State Game Land is traversed by the corridor and access road
Other Recreational Areas	○ The raw water intake is located in Blewett Falls Lake
Alternative 3B:	
SNHAs	○ Upper Brown Creek Swamp is traversed by the corridor
State Owned Lands	○ Anson Correctional Center and Highway Patrol Station is traversed by the corridor
State Game Lands	○ The pump station is located within the Pee Dee River State Game Land, which is privately owned ○ Pee Dee River State Game Land is traversed by the corridor and access road
Other Recreational Areas	○ The raw water intake is located in Blewett Falls Lake
Alternative 4:	
SNHAs	○ The raw water intake is located in the Middle Pee Dee River Aquatic Habitat ○ Fish Road Basic Forest is located approximately 600 feet north of the corridor
Other Recreational Areas	○ The raw water intake is located in the Pee Dee River
Alternative 5:	
SNHAs	○ New Salem Branch is traversed by the corridor ○ Most of the access road and a portion of the pump station are located in New Salem Branch
Other Recreational Areas	○ The low-head dam and raw water intake are located in Rocky River
Alternative 6:	
SNHAs	○ Andrew Jackson Ridges is located approximately 575 feet south of corridor

Name	Description
Conservation Lands	○ Catawba Land Conservancy parcel abuts corridor
Other Recreational Areas	○ The raw water intake is located in Catawba River
Alternative 7:	
Bike Routes	○ The entire corridor is located within a designated bike route area ○ The corridor crosses two bike routes
SNHAs	○ Goose Creek Aquatic Habitat is traversed by corridor
Conservation Easements	○ A portion of a Union County Conservation Easement is located within the corridor
Alternative 8:	
SNHAs	○ A portion of Lanes Creek Aquatic Habitat is located in the southeastern portion of the well field area
Conservation Easements	○ Catawba Land Conservancy parcel abuts access road ○ Three North Carolina Ecosystem Enhancement Program easements are located within the well field area
Alternative 11:	
Bike Routes	○ 10.6 miles of corridor is located within designated bike route areas
SNHAs	○ Long Creek Slate Slopes is traversed by the project corridor ○ Polk Mountain is traversed by the project corridor ○ New Salem Branch is traversed by the project corridor ○ River Haven Ridge is located approximately 35 feet south of the corridor ○ Dennis Road Ridge is located approximately 190 feet west of the corridor ○ Baucom Bluff is located approximately 385 feet west of the corridor
Conservation Lands	○ Lake Tillery Access is located approximately 400 feet east of the corridor
Other Recreational Areas	○ The treated effluent discharge is located in Lake Tillery ○ The pipe corridor crosses Rocky River
WTP A:	
	○ None Present
WTP B:	
	○ None Present
WTP C:	
	○ None Present

Table 4-8 Quantification Summary of Public Lands by Alternative, Acres

	Parks	Open Space	Significant Natural Heritage Areas[1]	Other Public Lands
Alternative 1A	----	----	7.2	----
Alternative 1B	0.9	----	5.6	----
Alternative 2A	----	----	5.6	----
Alternative 2B	----	----	9.4	----
Alternative 3A	----	----	41.0	6.0
Alternative 3B	----	----	5.7	10.6
Alternative 4	----	----	0.5	----
Alternative 5	----	----	5.5	----
Alternative 6	----	----	----	----
Alternative 7	----	0.4	0.2	----
Alternative 8	----	33.7	7.7	----
Alternative 11	----	----	8.4	----
WTP A	----	----	----	----
WTP B	----	----	----	----
WTP C	----	----	----	----

[1] SNHAs designation does not confer protection.

4.6 Prime or Unique Agricultural Lands

The Federal Farmland Protection Policy Act requires state agencies to minimize the loss of prime agricultural land. Areas denoted as prime agricultural land by the United States Department of Agriculture (USDA) NRCS are present in the project areas. Per the NRCS Web Soil Survey, a detailed quantification of the acreage of prime agricultural lands within the alternative footprints is presented in Table 4-9 and depicted on Figure 4-5 (USDA, 2014).

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Table 4-9 Prime Agricultural Land Soils, Acres

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Appling fine sandy loam, 2 to 6 percent slopes, eroded	----	----	----	----	----	----	----	----	51	----	----	----	----	----	----
Appling sandy loam, 2 to 8 percent slopes	----	----	----	----	----	----	----	----		----	230	----	----	----	----
Cecil fine sandy loam, 2 to 6 percent slopes, eroded	----	----	----	----	----	----	----	----	21	----	----	----	----	----	----
Cecil gravelly sandy clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	85	----	----	----	----	----	----
Cecil sandy clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	18	----	----	----	----	----
Cecil sandy clay loam, 8 to 15 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	0.1	----	----	----	----	----
Chenneby silt loam, 0 to 2 percent slopes, frequently flooded	----	3	2	2	----	----	----	----	----	----	----	----	----	----	----
Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	0.4	1	1	1	73	14	15	1	2	4	1,957	8	----	----	2
Chewacla soils	----	----	----	----	----	----	----	----	2	----	----	----	----	----	----
Claycreek fine sandy loam, 0 to 2 percent slopes	----	----	----	----	----	15	----	----	----	----	----	----	----	----	----
Congaree fine sandy loam, 0 to 2 percent slopes, frequently flooded	1	1	1	----	----	----	----	0.1	----	----	----	1	----	----	----
Creedmoor fine sandy loam, 2 to 8 percent slopes	----	----	----	----	24	31	----	----	----	----	----	----	----	----	----

Soil Series	Alternative														
	1A	1B	2A	2B	3A	3B	4	5	6	7	8[1]	11	WTP A	WTP B	WTP C
Emporia loamy sand, 2 to 6 percent slopes	----	----	----	----	----	34	----	----	----	----	----	----	----	----	----
Georgeville silty clay loam, 2 to 8 percent slopes, moderately eroded	----	----	5	----	----	----	----	----	16	4	----	----	----	----	----
Hiwassee clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	7	----	----	----	----	----	----	----	----
Hiwassee gravelly loam, 2 to 8 percent slopes	2	----	----	----	----	----	----	----	----	----	----	2	----	----	----
Kirksey silt loam, 0 to 6 percent slopes	49	40	19	21	----	----	----	----	----	----	----	54	----	----	----
Lloyd gravelly loam, 2 to 8 percent slopes	----	----	16	----	----	----	----	----	----	----	----	----	----	----	----
Masada and Altavista soils, 2 to 6 percent slopes	----	----	----	----	----	----	----	----	2	----	----	----	----	----	----
Mayodan fine sandy loam, 2 to 8 percent slopes	----	----	----	----	23	33	----	----	----	----	----	----	----	----	----
Mayodan gravelly sandy loam, 2 to 8 percent slopes	----	----	----	----	2	42	20	----	----	----	----	----	----	----	----
McQueen loam, 1 to 6 percent slopes	----	----	----	----	1	2	----	----	----	----	----	----	----	----	----
Mecklenburg sandy clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	7	----	----	----	----
Monacan loam, 0 to 2 percent slopes, frequently flooded	----	----	----	----	----	----	----	----	----	1	----	----	----	----	----
Oakboro silt loam, 0 to 2 percent slopes, frequently flooded	16	41	21	16	----	----	----	----	----	----	----	23	----	----	----
Pacolet gravelly sandy loam, 2 to 8 percent slopes	----	----	----	----	2	31	----	----	----	----	----	----	----	----	----

Soil Series	Alternative														
	1A	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8[1]**	**11**	**WTP A**	**WTP B**	**WTP C**
Pelion loamy sand, 1 to 4 percent slopes	----	----	----	----	----	4		----	----	----	----	----	----	----	----
Shellbluff loam, 0 to 2 percent slopes, occasionally flooded	----	----	----	----	0.1	----	9	----	----	----	----	----	----	----	----
State fine sandy loam, 0 to 2 percent slopes, rarely flooded	----	----	----	----	4	2	----	----	----	----	----	----	----	----	----
Tarrus channery silt loam, 2 to 8 percent slopes	21	13	79	74	----	----	----	----	----	----	----	41	----	----	----
Tarrus channery silty clay loam, 2 to 8 percent slopes, moderately eroded	5	10	14	1	----	----	----	----	----	----	----	18	----	----	----
Tarrus gravelly silt loam, 2 to 8 percent slopes	----	----	----	----	5	----	29	----	----	2	4,346	16	----	----	8
Tarrus gravelly silty clay loam, 2 to 8 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	102	13	4,832	3	----	10	3
Tillery silt loam, 0 to 3 percent slopes	----	----	----	----	11	1	4	----	----	----	----	----	----	----	----
Wickham sandy loam, 2 to 6 percent slopes, eroded	----	----	----	----	----	----	----	----	1	----	----	----	----	----	----

[1] Alternative 8 includes all prime agricultural land mapped in pipe corridor and well field area. Prime agricultural land indicated for Alternative 8 are not specific to the areas that will be impacted if the alternative is selected and implemented.

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4.7 Areas of Archaeological or Historic Value

Authorized under the National Historic Preservation Act of 1966, the National Register of Historic Places (NRHP) houses the formal repository of information pertaining to historic structures and districts worth preservation. A database search of the National Register did not indicate any currently listed structures or historic districts present within the alternative alignments (NPS, 2014)). Table 4-10 includes a list of National Register listed, determined eligible, and potentially eligible historic resources/properties identified near the proposed project alignments according to the information available from the North Carolina State Historic Preservation Office GIS Service (HPOWEB) (SHPO, 2014). Properties designated as "Surveyed Only" (SO) and those noted as "Gone" or "Replaced" (a bridge designation) in the database are not included in Table 4-10. SHPO's scoping letter response along with subsequent coordination correspondence is provided in Appendix D.

Table 4-10 Historic Resources

Alternatives	Name of Resource	County	National Register Listing Status	Site ID
1A, 1B, 11	Norwood Commercial Historic District	Stanly	Study List	ST0531
1A, 1B, 11	Norwood Railroad Complex	Stanly	Blockface	ST0538
1A, 1B, 11	Efrid-Skidmore House	Stanly	Study List	ST0512
1A, 11	Cottonville Crossroads	Stanly	Surveyed Area	ST0323
2A	Carter House (The Farmhouse)	Stanly	Study List	ST0199
2B	C.V. Ritchie House	Stanly	Study List	ST0254
2B	Culp Bungalow	Stanly	Study List	ST0209
3B	Wadesboro Downtown Historic District	Anson	Listed	AN0554
3B	Polkton Historic District	Anson	Determined Eligible	AN0575
4	Bridge	Anson	Determined Eligible	AN----
6	Broom Cotton Gin	Union	Study List	UN0066
7	Long House	Union	Determined Eligible	UN0217
7	Uriah Tilden Belk House	Union	Study List	UN0038
1A, 1B, 2A, 2B, 3A, 4, 5, WTP B	Marshall Baucom House and Stores	Union	Study List	UN0025
8	Faulks Baptist Church and Cemetery	Union	Study List	UN0117
8	James Bivens House	Union	Study List	UN0052
8	James Austin House	Union	Study List	UN0012
11	James B. Garrison Bridge	Stanly	Determined Eligible	ST0688

In correspondence received on February 12, 2015, the NC State Historic Preservation Office stated they will await review of a preferred alternative before issuing comments detailing the need for an archaeological investigation (Appendix D). Future coordination with the Office of State Archaeology will occur with the review of a preferred alternative.

4.8 Air Quality

The U.S. Environmental Protection Agency (EPA) uses the Air Quality Index (AQI) to report ambient air quality conditions with ratings of good, moderate, unhealthy for sensitive groups, and unhealthy. AQI incorporates five criteria pollutants – ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide – into one index. The EPA has strengthened many of its National Ambient Air Quality Standards (NAAQS) in the past few years, and the latest changes were made in December 2012 to the standards for fine particle pollution and the AQI index value breakpoints (EPA, 2014c).

The North Carolina Division of Air Quality (DAQ) monitors compliance with the NAAQS. There are six air quality monitoring sites located in Mecklenburg County and one monitoring site located in Monroe, Union County. The other counties within the study area (Stanly and Anson Counties, NC and Lancaster County, SC) do not have air quality monitoring sites. According to the AQI during 2009 thru 2013, Union County recorded an AQI of "moderate" or better 99 percent of the recorded days (EPA, 2014b). The AQI data from 2009 to 2013 indicated air quality reached unhealthy levels for sensitive groups five days out of the past five years, and one day was recorded at an unhealthy level for the same time period (Table 4-11). Mecklenburg County over the same period recorded AQI as "moderate" or better 98 percent of the recorded days with 44 days reaching unhealthy levels for sensitive groups and one day recorded as unhealthy (Table 4-12).

Table 4-11 Union County Air Quality Index

Year [1]	Number of Recorded Days (Percent of Recorded Days)			
	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy
2009	191 (89)	23 (11)	1 (0)	0 (0)
2010	177 (80)	45 (20)	0 (0)	0 (0)
2011	170 (80)	41 (19)	2 (1)	0 (0)
2012	188 (88)	23 (11)	2 (1)	1 (0)
2013	200 (97)	7 (3)	0 (0)	0 (0)

[1] The 2014 data was not included, as it will be finalized in 2015.

Table 4-12 Mecklenburg County Air Quality Index

Year [1]	Number of Recorded Days (Percent of Recorded Days)			
	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy
2009	204 (56)	157 (43)	4 (1)	0 (0)
2010	167 (46)	183 (50)	14 (4)	1 (0)
2011	186 (51)	162 (44)	17 (5)	0 (0)
2012	239 (65)	118 (32)	9 (2)	0 (0)
2013	282 (77)	83 (23)	0 (0)	0 (0)

[1] The 2014 data was not included, as it will be finalized in 2015.

According to the annual AQI plots by air pollutants, the main air pollutant responsible for "unhealthy for sensitive groups" and "unhealthy" days in Union County is ozone (O_3). O_3 is created by chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOC) in the presence of sunlight. Emissions from industrial facilities, electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are major sources of NO_x and VOC. O_3 and fine particulate matter ($PM_{2.5}$) are also a main pollutant noted in Mecklenburg County. Sources of $PM_{2.5}$ include all types of combustion activities (motor vehicles, power plants, wood burning, etc.) and certain industrial processes.

EPA implements the NAAQS, as required by the Clean Air Act, by designating areas of the country as "attainment" or "nonattainment" areas for each of the criteria pollutants. Currently, Mecklenburg County and portions of Union County are included in the Charlotte-Rock Hill, NC-SC ozone nonattainment area, as shown on Figure 4-6 (EPA, 2014a). The area was designated marginal nonattainment for the 2008 8-hour ozone NAAQS by the EPA on July 20, 2012; however, this area is considered to be in attainment/maintenance for the 1997 Ozone Standards (NCDENR, 2014d). Portions of the project area associated with Alternatives 3B, 6, 7, 8, 11, WTP B, WTP C and WTP D are located within the nonattainment area. The remaining areas within the study area are considered as attainment or unclassified areas (NCDENR, 2014d).

4.9 Noise Levels

Noise is subject to the federal Noise Control Act of 1972 (PL-92-574) and Quiet Communities Act of 1978 (PL-95-6009), which require standards of compliance and recommend approaches to abate stationary noise sources such as airports, highways, and industrial facilities. Elevated noise levels have been documented as negatively affecting human health and welfare as well as wildlife behavior. Thus, federal, state and local governments have established noise standards and guidelines to protect citizens from potential hearing damage and various other adverse physiological and social effects associated with noise.

Noise levels are measured in terms of the A-weighted decibel [dB(A)] and are measured through a sound level meter having characteristics defined by the American National Standards Institute (ANSI). The majority of the study area is located in a low-density residential area and complies with noise standards. Current noise levels within the study area are considered part of the ambient noise levels for the area. The existing sources of noise pollution of the study area include traffic along the roadways and other ambient day-to-day noise representative of the residential, forested, recreational, and agricultural land uses within the rural areas of the project area. Within the more developed areas of the project area, increased noise occurs due to additional facilities, industries, and roadways.

4.10 Floodways and 100-Year Floodplains

The Federal Emergency Management Agency (FEMA) designates areas as 100-year floodplains and floodways. The designated areas are classified collectively as Special Flood Hazard Areas (SFHAs). As construction, disturbance, and development restrictions vary between the 100-year floodplain and the floodway, each designation is discussed separately herein. Table 4-13 and Figure 4-7 present information relative to the designations for each alternative corridor.

Six alternative corridors encroach on the designated floodways in the project area. Alternatives 2A and 2B cross the floodways associated with Long Creek and Town Creek. Alternative 2A also crosses the floodway of Little Long Creek. Alternative 3B traverses the floodways of Lanes Creek, Brown Creek, an unnamed tributary (UT) to Brown Creek, and Little Brown Creek. Alternative 6 crosses the floodway associated with Bearskin Creek, and Alternative 7 crosses the Goose Creek floodway. Alternative 11 traverses the floodway along Meadow Branch.

Alternatives 1A, 1B, 3A, 3B, and 4 include a proposed raw water intake located on the Pee Dee River or a reservoir thereon. A new raw water intake is proposed on a reservoir of the Yadkin River as part of Alternatives 2A and 2B and on the Rocky River as part of Alternative 5. The raw water intake structures associated with these alternatives have not been sited precisely; however, the intake structures are expected to be located within the 100-year floodplain associated with the Pee Dee, Yadkin, or Rocky River, respectively. Alternatives 6 and 7 do not include a new raw water intake but do traverse streams along which 100-year floodplains have been mapped by FEMA.

The proposed pump stations for Alternatives 1A, 1B, and 2B are not proposed to be located in a mapped 100-year floodplain. The Alternative 2A, 3A, 3B, 4, and 5 pump stations are sited in a 100-year floodplain area. No raw water pump station is proposed to be located within a floodway. The locations for the pump stations that may be required for Alternatives 6, 7, 8, and 11 have not been determined.

The areas associated with the proposed WTPs under Alternatives WTP A, WTP B, and WTP C do not contain any mapped floodway or 100-year floodplain areas. The proposed WTP D facility area includes a small portion of the 100-year floodplain associated with Lick Branch. Portions of each of the corridor alternatives, except the WTP B corridor, are located in floodways or 100-year floodplains designated by FEMA.

FEMA has assigned Base Flood Elevations (BFEs) for the 100-year floodplains traversed by the project areas. The BFEs along the Yadkin and Pee Dee Rivers range from 189 feet msl on Blewett Falls Lake to 565 feet msl on Tuckertown Reservoir. The highest BFEs along the proposed corridors are located adjacent to Alternative 6 and are 634 feet msl along Dry Fork, a tributary to Bearskin Creek, which feeds Richardson Creek near Monroe.

Table 4-13 Floodways and 100-Year Floodplains per Alternative, Acres

	Alternative	Pipe Corridor	Pump Station	Access Road [1]	Other Infrastructure [2]	Water Treatment Plant [3]	Total per Alternative
Floodway	1A	----	----	----	----	----	----
	1B	----	----	----	----	----	----
	2A	1.6	----	----	----	----	1.6
	2B	1.0	----	----	----	----	1.0
	3A	----	----	----	----	----	----
	3B	6.7	----	----	----	----	6.7
	4	----	----	----	----	----	----
	5	----	----	----	----	----	----
	6	0.6	----	----	----	----	0.6
	7	0.2	----	----	----	----	0.2
	8 [4]	----	----	----	----	----	----
	11	0.6	----	----	----	----	0.6
	WTP B	----	----	----	----	----	----
	WTP C	----	----	----	----	----	----
100-Year Floodplain	1A	13.5	0.1	----	<0.1	----	13.6
	1B	32.2	0.1	----	<0.1	----	32.3
	2A	21.2	0.3	----	<0.1	----	21.5
	2B	19.9	----	----	<0.1	----	19.9
	3A	86.9	1.6	0.4	<0.1	----	88.9
	3B	49.3	1.6	0.4	<0.1	----	51.3
	4	33.4	0.2	----	<0.1	----	33.6
	5	1.7	0.4	0.1	0.2	----	2.4
	6	7.6	----	----	<0.1	----	7.6
	7	4.7	----	----	----	----	4.7
	8 [5]	0.2	----	----	----	----	0.2
	11	28.1	----	----	<0.1	----	28.1
	WTP B	----	----	----	----	----	----
	WTP C	0.8	----	----	----	----	0.8

[1] Floodways and floodplains associated with access roads located within the pipe corridor are included in the pipe corridor calculations.
[2] Other infrastructure includes intake structures, discharge structures, and low-head dam project areas.
[3] Impacts are not included for WTP sites since the location and footprint of the infrastructure is not known.
[4] No floodways are located within the Alternative 8 project area.
[5] Special flood hazard areas are present within the Alternative 8 project area; however, the location of infrastructure within the project area has not been determined.

4.11 Wetlands

Wetlands, as defined by federal regulations [40 Code of Federal Regulations (CFR) 230.3(t)] and the N.C. Environmental Management Commission (EMC) rules (North Carolina Erosion and Sedimentation Control Administrative Code, 15A NCAC04B, 1989), are "…areas that are inundated or saturated by an accumulation of surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." The U.S. Army Corps of Engineers (USACE) requires the presence of three parameters (hydrophytic vegetation, hydric soils, and evidence of hydrology) in support of a jurisdictional wetland determination (USACE, 1987). The boundary between wetlands and deepwater habitat is defined as the maximum depth where rooted emergent vegetation may be found. Rooted emergent vegetation is generally present at depths less than six feet below mean low water during the growing season.

The United States Fish and Wildlife Service (USFWS) has mapped wetlands across the United States to create the National Wetland Inventory (NWI). NWI mapping depicts the type of wetland that is expected to occur in an area and has not been verified by onsite investigations. Delineation of wetlands within the proposed project areas have not been performed. Wetlands in the project areas were evaluated based on NWI mapping (Figure 4-8). Within the pipe corridors, wetland acreage varies from 0.01 acre in WTP B Alternative to 57.1 acres in Alternative 3A.

Table 4-14 provides a summary of NWI wetlands by alternative. The wetland acreage provided for Alternative 8 includes all NWI wetlands in the pipe corridor, WTP facility area, and well field and is expected to be much higher than the acreage that would be impacted if the alternative is selected and implemented.

In general, the dominant wetland type present within the transmission corridors is palustrine forested, broad-leaved deciduous, temporarily flooded (PFO1A) wetlands. Other wetland types represented in the project areas include palustrine, forested, broad-leaved deciduous and needle-leaved evergreen, temporarily flooded (PFO1/4A); palustrine, scrub-shrub, broad-leaved deciduous (PSS1); and palustrine, emergent, persistent (PEM1) wetlands. NWI mapping also includes rivers (R2UB), ponds (PAB, PUB, and PUS), and lakes (L1UB), which are discussed in greater detail in Section 4.12.

The palustrine, forested and palustrine, scrub-shrub wetlands in the project corridors are typically associated with small to medium streams and are characterized by the presence and prevalence of woody vegetation. Palustrine, emergent wetlands are dominated by herbaceous plant species and may contain scattered shrubs or trees. The palustrine, emergent wetlands in the project corridors are primarily located adjacent to or in the floodplain area of small to medium streams.

Table 4-14 NWI Wetlands in Proposed Project Areas

	NWI Wetland Classification, acres								
Alternative	**L1UB[1]**	**PAB3/4 [2]**	**PEM1 [3]**	**PFO1/4 [4]**	**PSS1 [5]**	**PUB [6]**	**PUS [7]**	**R2UB [8]**	**Total**
1A	0.2	----	----	----	----	0.5	----	1.6	2.2
1B	----	----	----	8.2	----	2.7	----	1.1	12.0
2A	----	----	----	0.6	----	0.8	----	1.1	2.4
2B	1.2	----	----	0.6	----	0.8	----	1.1	3.6
3A	0.2	----	2.7	48.0	4.8	1.3	----	----	57.1
3B [9]	0.2	----	<0.0	2.8	0.5	0.9	----	----	4.4
4	----	----	----	----	----	0.9	----	0.6	1.4
5	----	----	----	----	----	0.1	----	0.9	1.0
6	----	----	0.1	0.5	----	1.7	----	----	2.3
7	----	----	----	<0.0	----	0.2	----	----	0.2
8 [10]	153.5	2.6	21.1	234.2	12.8	515.4	6.6	----	946.3
11	3.1	----	----	1.1	----	1.2	----	1.6	6.9
WTP A [9]	----	----	----	----	----	----	----	----	----
WTP B [9]	----	----	----	----	----	0.01	----	----	0.01
WTP C [9]	----	----	----	----	----	0.2	----	----	0.2

[1] L1UB – Lacustrine, limnetic, unconsolidated bottom
[2] PAB3/4 – Palustrine, aquatic bed, rooted or floating vascular
[3] PEM1 – Palustrine, emergent, persistent
[4] PFO1/4 – Palustrine, forested, broad-leaved deciduous or needle-leaved evergreen
[5] PSS1 – Palustrine, scrub-shrub, broad-leaved deciduous
[6] PUB – Palustrine, unconsolidated bottom
[7] PUS – Palustrine, unconsolidated shore
[8] R2UB – Riverine, lower perennial, unconsolidated bottom
[9] Impacts are not included for WTP sites since the location and footprint of the infrastructure is not known.
[10] Alternative 8 includes all NWI wetlands mapped in pipe corridor and well field area. NWI wetlands indicated for Alternative 8 are not specific to the wetlands that will be impacted if the alternative is selected and implemented.

4.12 Water Resources (Surface Water and Groundwater)

4.12.1 Drainage Basins and Surface Water Supplies

The project area is located in the Yadkin-Pee Dee and Catawba River basins. The USGS has mapped watersheds throughout the United States, assigning each watershed a Hydrologic Unit Code (HUC) and name. The project components are located within five USGS 8-digit HUC areas, including 03040103 (Lower Yadkin River), 03040104 (Upper Pee Dee River), 03040105 (Rocky River), 03040201 (Lower Pee Dee River), and 03050103 (Lower Catawba). Some states, including North Carolina, also map river basins and subbasins to support the state's water quality management efforts. The portions of the project located in North Carolina occur in Division of Water Resources (DWR) subbasins 03-07-08, 03-07-10, 03-07-12, 03-07-13, 03-07-14, 03-07-16, 03-07-17, and 03-08-38. The subbasins are illustrated in Figure 4-9.

The Catawba River basin originates in the Blue Ridge Mountains of North Carolina, flows through the western Piedmont of North Carolina, crosses the North Carolina-South Carolina border near Charlotte, and traverses South Carolina to feed the Santee River basin and empty into the Atlantic Ocean. The Catawba River basin is one of two sources of headwaters for the

Santee-Cooper River system. The project area is located in one USGS subbasin in the Catawba River basin.

The Yadkin-Pee Dee River basin extends from the eastern slopes of the Blue Ridge Mountains near the North Carolina-Virginia border to the Atlantic Ocean off the South Carolina coast. The Yadkin River collects drainage off the mountains of North Carolina and flows southeast to join the Uwharrie River, forming the Pee Dee River. The Pee Dee River continues southeast into and across South Carolina, emptying into the Atlantic Ocean at Winyah Bay. The project area includes a portion of four USGS subbasins in the Yadkin-Pee Dee River basin.

4.12.2 Surface Water Use Classifications

DWR classifies surface waters of the state based on their existing or proposed uses. The primary classification system distinguishes the following three basic usage categories: waters used as a source of water supply for drinking, culinary, or food-processing purposes (Classes WS-I through WS-V), waters used for primary recreation (Class B), and Class C. Class C waters are protected for aquatic life propagation, survival, and maintenance of biological integrity (including fishing and fish), wildlife, secondary contact recreation, and agriculture. All freshwaters in the state of North Carolina have a minimum classification of Class C.

Water supply surface water classifications are further classified into five categories based on the level of protection required for the water supply and the level of development in the watershed. Class WS-I waters offer the most protection to water supplies and are located in natural and undeveloped watersheds in public ownership. Class WS-II waters are located in predominantly underdeveloped watersheds where WS-I classification is not feasible. WS-III classification applies to water supply waters where WS-I and WS-II classification is not feasible and the watershed has low to moderate development. Class WS-IV waters are located in moderately to highly developed watersheds where WS-I through WS-III classification is not feasible. Class WS-V waters are generally upstream and draining to Class WS-IV waters, used by industry to supply their employees with drinking water, or waters formerly used as water supply.

DWR assigns supplemental classifications to provide additional protection, management, or recognition of certain waters in the state. High Quality Waters (HQWs) and Outstanding Resource Waters (ORWs) are protected waters with excellent water quality. Waters needing additional nutrient management due to excessive growth of vegetation are classified as Nutrient Sensitive Waters (NSWs). Swamp waters (Sw) and trout waters (Tr) are also classified to recognize or protect the water's specific characteristics.

South Carolina Department of Health and Environmental Control (SCDHEC) classifies surface waters of the state using the following categories: Outstanding National Resource Waters (ONRW), ORW, trout waters (TN, TPGT, and TPT), freshwater (FW), shellfish harvesting waters (SFH), and tidal salt waters for recreation as well as crabbing and fishing (SA and SB).

The majority of the surface waters in the North Carolina portion of the project area are classified as C. The reach of the Yadkin River including the lower portion of High Rock Lake and extending to Narrows Reservoir (Badin Lake) and two reaches of the Pee Dee River, from the mouth of the Uwharrie River to Norwood Dam and from 0.8 mile downstream of the mouth of

Savannah Creek to the Blewett Falls Dam, are designated water supply waters, WS-IV CA, as well as Class B waters. The downstream most reach of Jacobs Creek is designated as WS-IV, CA. Cedar Creek, Savannah Creek, Smith Creek, and a reach of Richardson Creek are designated water supply waters, WS-IV. The Pee Dee River from the Norwood Dam to the mouth of Turkey Top Creek is designated as water supply waters, WS-V, and Class B. The classified streams in the project area are listed in Table 4-15. In addition to the named streams, numerous UTs to the classified streams are located in the project area. A stream that is not specifically classified by DWR or DHEC is assumed to have the same classification as the stream into which it empties, unless that unnamed waterbody is in North Carolina and specifically described in a river basin classification schedule.

Table 4-15 Surface Water Use Classifications in the Project Area

Name	Description	Class
Alternative 1A:		
Pee Dee River (including Lake Tillery below normal operating levels)	From mouth of Uwharrie River to Norwood Dam	WS-IV, B; CA
Rocky River	From source to Pee Dee River	C
Coldwater Branch	From source to Rocky River	C
Gilberts Creek	From source to Rocky River	C
Long Creek	From source to Rocky River	C
Horse Branch	From source to Long Creek	C
Long Branch	From source to Long Creek	C
Murray Branch	From source to Rocky River	C
Alligator Branch	From source to Murray Branch	C
Haw Branch	From source to Alligator Branch	C
Hardy Creek	From source to Rocky River	C
Big Cedar Creek	From source to Rocky River	C
Alternative 1B:		
Pee Dee River (including Lake Tillery below normal operating levels)	From mouth of Uwharrie River to Norwood Dam	WS-IV, B; CA
Cedar Creek	From source to a point 0.5 mile upstream of Stanly County SR 1740	WS-IV
Rocky River	From source to Pee Dee River	C
Coldwater Branch	From source to Rocky River	C
Long Creek	From source to Rocky River	C
Little Bear Creek	From source to Long Creek	C
Little Long Creek	From source to Long Creek	C
Big Bear Creek	From source to Long Creek	C
Stony Run	From source to Big Bear Creek	C
Hardy Creek	From source to Rocky River	C
Alternative 2A:		
Yadkin River (including lower portion of High Rock Lake, Tuckertown Lake, and Narrows Reservoir)	From a point 0.6 mile upstream of dam of High Rock Lake to Badin Dam	WS-IV, B; CA

Name	Description	Class
Rocky River	From source to Pee Dee River	C
Coldwater Branch	From source to Rocky River	C
Long Creek	From source to Rocky River	C
Little Long Creek	From source to Long Creek	C
Town Creek	From source to Little Long Creek	C
Coley Branch	From source to Little Long Creek	C
Scaly Bark Creek	From source to Long Creek	C
Little Bear Creek	From source to Long Creek	C
Big Bear Creek	From source to Long Creek	C
Stony Run	From source to Big Bear Creek	C
Mountain Creek	From source to Stanly County SR 1542	C
Alternative 2B:		
Yadkin River (including lower portion of High Rock Lake, Tuckertown Lake, and Narrows Reservoir)	From a point 0.6 mile upstream of dam of High Rock Lake to Badin Dam	WS-IV, B; CA
Rocky River	From source to Pee Dee River	C
Coldwater Branch	From source to Rocky River	C
Long Creek	From source to Rocky River	C
Town Creek	From source to Little Long Creek	C
Coley Branch	From source to Little Long Creek	C
Scaly Bark Creek	From source to Long Creek	C
Little Bear Creek	From source to Long Creek	C
Big Bear Creek	From source to Long Creek	C
Stony Run	From source to Big Bear Creek	C
Alternative 3A:		
Pee Dee River (including Blewett Falls Lake below normal operating levels)	From a point 0.8 mile downstream of mouth of Savannah Creek to Blewett Falls Dam	WS-IV, B; CA
Richardson Creek	From Monroe Water Supply Dam (Lake Lee) to Rocky River	C
Pine Log Creek	From source to Richardson Creek	C
Cribs Creek	From source to Rocky River	C
Big Branch	From source to Cribs Creek	C
Lanes Creek	From Marshville Water Supply Dam (located 0.1 mile downstream of Beaverdam Creek) to Rocky River	C
Deep Bottom Branch	From source to Lanes Creek	C
Brown Creek	From NC-SC state line to Pee Dee River	C
Jacks Branch	From source to Brown Creek	C
Goulds Fork	From source to Brown Creek	C
Hurricane Creek	From source to Brown Creek	C
Flat Fork	From source to Brown Creek	C
Cedar Creek	From source to Pee Dee River	C

Name	Description	Class
Savannah Creek	From source to Pee Dee River	WS-IV
Smith Creek	From source to North Fork Smith Creek	WS-IV
Alternative 3B:		
Pee Dee River (including Blewett Falls Lake below normal operating levels)	From a point 0.8 mile downstream of mouth of Savannah Creek to Blewett Falls Dam	WS-IV, B; CA
Lanes Creek	From Marshville Water Supply Dam (located 0.1 mile downstream of Beaverdam Creek) to Rocky River	C
Lick Branch	From source to Lanes Creek	C
Wide Mouth Branch	From source to Lanes Creek	C
Brown Creek	From NC-SC state line to Pee Dee River	C
Pinch Gut Creek	From source to Brown Creek	C
Tanyard Branch	From source to Pinch Gut Creek	C
Goulds Fork	From source to Brown Creek	C
Culpepper Creek	From source to Goulds Fork	C
Swans Branch	From source to Brown Creek	C
Ledbetter Branch	From source to Brown Creek	C
Little Brown Creek	From source to Brown Creek	C
McCoy Creek	From source to Pee Dee River	C
Brush Fork	From source to Bailey Creek	C
Derita Creek	From source to Brush Fork	C
Reedy Fork	From source to Bailey Creek	C
Alternative 4:		
Pee Dee River	From Norwood Dam to mouth of Turkey Top Creek	WS-V, B
Richardson Creek	From Monroe Water Supply Dam (Lake Lee) to Rocky River	C
Pine Log Creek	From source to Richardson Creek	C
Cribs Creek	From source to Rocky River	C
Big Branch	From source to Cribs Creek	C
Lanes Creek	From Marshville Water Supply Dam (located 0.1 mile downstream of Beaverdam Creek) to Rocky River	C
Dula Thoroughfare	From source to Pee Dee River	C
Buffalo Creek	From source to Dula Thoroughfare	C

Name	Description	Class
Alternative 5:		
Rocky River	From source to Pee Dee River	C
Alternative 6:		
Little Twelvemile Creek	From source to East Fork Twelvemile Creek	C
Lee Branch	From source to Bates Branch	C
Bearskin Creek	From source to Richardson Creek	C
Camp Branch	From source to Bearskin Creek	C
Dry Fork	From source to Bearskin Creek	C
Todd Branch	From source to Twelvemile Creek	FW
Millstone Branch	From source to Twelvemile Creek	FW
Alternative 7:		
Goose Creek	From source to Rocky River	C
Duck Creek	From source to Goose Creek	C
Alternative 8:		
Richardson Creek	From source to a point 0.2 mile downstream of mouth of Beaverdam Creek	WS-IV
Richardson Creek (Lake Lee)	From a point 0.2 mile downstream of mouth of Beaverdam Creek to Monroe Water Supply Dam	WS-IV; CA
Adams Branch	From source to Richardson Creek	WS-IV
Beaverdam Creek	From source to Richardson Creek	WS-IV
Little Richardson Creek (Lake Monroe)	From source to a point 0.6 mile upstream of Buck Branch	WS-IV
Little Richardson Creek (Lake Monroe)	From a point 0.6 mile upstream of Buck Creek to Richardson Creek	WS-IV; CA
Buck Branch	From source to a point 0.5 mile upstream of mouth	WS-IV
Buck Branch	From a point 0.5 mile upstream of mouth to Little Richardson Creek	WS-IV; CA
Rays Fork	From source to Richardson Creek	C
Middle Fork Rays Fork	From source to Rays Fork	C
Flag Branch	From source to Rays Fork	C
Lanes Creek	From source to dam at Marshville former water supply (0.1 mile downstream of Beaverdam Creek)	WS-V
Beaverdam Creek	From source to Lanes Creek	WS-V
Reedy Branch	From source to Beaverdam Creek	WS-V
Maple Springs Branch	From source to Beaverdam Creek	WS-V
Gum Log Branch	From source to Lanes Creek	WS-V
Mill Creek	From NC-SC state line to Lanes Creek	WS-V
Gibbs Branch	From source to Mill Creek	WS-V
Wicker Branch	From source to Lanes Creek	WS-V
Mountain Springs Branch	From source to Wicker Branch	WS-V

Name	Description	Class
Cowpens Branch	From source to Wicker Branch	WS-V
Waxhaw Branch	From source to Lanes Creek	WS-V
Lynches River	From source to NC-SC state line	B
Buffalo Creek	From source to NC-SC state line	C
Raccoon Branch	From source to Buffalo Creek	C
Dead Pine Creek	From source to NC-SC state line	C
Alternative 11:		
Pee Dee River (including Lake Tillery below normal operating levels)	From mouth of Uwharrie River to Norwood Dam	WS-IV, B; CA
Davids Creek	From a point 0.6 mile upstream of mouth to Lake Tillery, Pee Dee River	WS-IV; CA
Cedar Creek	From a point 0.5 mile upstream of Stanly County SR 1740 to Lake Tillery, Pee Dee River	WS-IV; CA
Rocky River	From source to Pee Dee River	C
Coldwater Branch	From source to Rocky River	C
Gilberts Creek	From source to Rocky River	C
Long Creek	From source to Rocky River	C
Horse Branch	From source to Long Creek	C
Long Branch	From source to Long Creek	C
Murray Branch	From source to Rocky River	C
Alligator Branch	From source to Murray Branch	C
Haw Branch	From source to Alligator Branch	C
Richardson Creek	From Monroe Water Supply Dam (Lake Lee) to Rocky River	C
Meadow Branch	From source to Richardson Creek	C
Jacks Branch	From source to Salem Creek	C
Flag Branch	From source to Rays Fork	C
Hardy Creek	From source to Rocky River	C
Big Cedar Creek	From source to Rocky River	C
Jacobs Creek	From a point 0.3 mile upstream of Stanly County SR 1740 to Lake Tillery, Pee Dee River	WS-IV; CA
WTP A:		
Crisco Branch	From source to Rocky River	C
WTP B:		
Crisco Branch	From source to Rocky River	C
Brandon Branch	From source to Gold Branch	C
WTP C:		
Gold Branch	From source to Richardson Creek	C
Brandon Branch	From source to Gold Branch	C
Watson Creek	From source to Richardson Creek	C

4.12.3 Existing Surface Water Quality

DWR and DHEC monitor water quality using physical, chemical, and biological sampling and rates each monitored stream segment or lake with respect to its designated usage classification (DENR, 2008; DENR 2010; DHEC, 2012a). Biological monitoring, including benthic macroinvertebrate (benthos) and fish samples, is particularly useful in tracking water quality trends because these organisms reflect long-term interactions among many water quality and habitat parameters, including factors not detected by infrequent physical and chemical sampling. The data collected during ambient water quality monitoring supports evaluations and reporting requirements under the Clean Water Act (CWA).

Based on the Catawba River Basinwide Water Quality Plan (NCDENR, 2010), Watershed Water Quality Assessment: Catawba River Basin (SCDHEC, 2012b), and Yadkin Pee-Dee River Basinwide Water Quality Plan (NCDENR, 2008), one fish community and one benthic community sampling site are located within 0.1 mile of a project corridor. No ambient water quality monitoring sites are located within 0.1 mile of a project corridor stream crossing. Several fish, benthic, and ambient monitoring sites are located on streams crossed by the proposed alternatives but are located a substantial distance either upstream or downstream of the alternative crossing thereof. The monitoring sites are depicted on Figure 4-10.

Per Section 303(d) of the CWA, if a surface water quality standard is exceeded and the impaired waters do not have a total maximum daily load (TMDL) approved by the EPA, an integrated reporting category of “5” is assigned to those waters, and the waters are incorporated into the Section 303(d) list. All waters in NC are Category 5 designated due to mercury. Additionally, six streams in the project areas have been designated as Category 5 waters for parameters other than mercury (NCDENR, 2012; SCDHEC, 2012a) The portion of the Yadkin River that forms Narrows Reservoir (Badin Lake) has been designated as Category 5 for fish consumption due to a standard violation of polychlorinated biphenyls (PCBs) standards. Little Long Creek in Stanly County, NC, and a reach of Lanes Creek extending from the Marshville Water Supply Dam (located 0.1 mile downstream of Beaverdam Creek) to Rocky River have been designated as Category 5 due to a Fair bioclassification resulting from benthic community sampling. Long Creek in Stanly County and a reach of Richardson Creek extending from Watson Creek to Negro Head Creek (Salem Creek) have been designated as Category 5 for aquatic life due to a standard violation of copper levels. A reach of Rocky River extending from the mouth of Dutch Buffalo Creek to the mouth of Island Creek is designated as Category 5 for aquatic life due to standard violations of copper, zinc, and turbidity standards. If a TMDL is approved for the parameter resulting in the impairment of the Category 5 waters, then the waterbody would be reclassified as Category 4 waters. Listed waters are illustrated on Figure 4-9.

Impaired waters that have an EPA-approved TMDL or other management strategy in place to address the impairment are assigned an integrated reporting category of “4.” Three streams in the project areas have been designated as Category 4 waters (NCDENR, 2012; SCDHEC, 2012a). Duck Creek has been designated as Category 4 for aquatic life due to a fair bioclassification based on benthic community sampling results. A reach of Goose Creek extending from SR 1524 to Rocky River is rated as Category 4 for aquatic life due to a standard violation of turbidity limits. A reach of Brown Creek extending from the mouth of Lick Creek to Pee Dee River is designated as Category 4 for aquatic life due to a standard violation for low dissolved oxygen (DO) levels and to a fair bioclassification based on benthic community sampling results.

Point-source dischargers located throughout North and South Carolina are regulated through the National Pollutant Discharge Elimination System (NPDES) program and may be required to register for a permit. Two major NPDES permit holders (i.e., authorized to discharge in excess of 1 mgd) are located in the project area (NCDENR , 2014; SCDHEC, 2014). The major dischargers in the project area are the Twelve Mile Creek WWTP and the Crooked Creek WWTP #2. Both facilities are owned by Union County Public Works Department and operated by Charlotte Mecklenburg Utilities. One major NPDES discharger, the City of Monroe WWTP, is located within a project area. Minor dischargers are permitted to discharge less than 1 mgd or are not limited. There are nine minor dischargers in the immediate vicinity of a proposed pipe corridor. The minor dischargers include two WTPs, two WWTPs, three small domestic wastewater discharges, and two groundwater remediation sites.

Significant Aquatic Endangered Species Habitats (SAESH) are designated by North Carolina Wildlife Resources Commission (WRC) to enhance planning, siting, and impact analysis for areas that are determined to be critical due to the presence of endangered or threatened aquatic species populations. SAESHs have been designated for three named streams in the project area and numerous UTs thereto. The designated streams are Goose Creek, Duck Creek, and Waxhaw Creek and UTs to these three streams. Two SAESH-designated UTs to Waxhaw Creek are crossed by the corridor associated with Alternative 6. The Alternative 7 corridor crosses Goose Creek, Duck Creek, and two SAESH-designated UTs to Duck Creek.

No wild and scenic rivers are listed in the project area. There are no areas designated as fish nursery areas or anadromous fish spawning areas in the vicinity of the project area. No ORWs or High Quality Waters (HQW) are listed in the project area.

4.12.4 Existing Surface Water Quantity (Reservoir Levels and Hydropower)

The project area is located in the Yadkin-Pee Dee and Catawba River basins. Within these respective basins, the Yadkin-Pee Dee and Catawba Rivers consist of a series of regulated surface water impoundments with primary functions of hydropower generation, water supply, and flood control. The Yadkin-Pee Dee River consists of seven surface water impoundments within North Carolina, while the Catawba River consists of eleven surface water impoundments within North and South Carolina.

W. KERR SCOTT PROJECT

W. Kerr Scott Reservoir is the northernmost impoundment of the Yadkin-Pee Dee River system, located in Wilkes County, North Carolina, near the City of Wilkesboro. This reservoir is operated by the US Army Corps of Engineers and does not generate hydropower. The W. Kerr Scott project is authorized for the purposes of flood control, water supply, recreation, and fish and wildlife.

W. Kerr Scott Dam is located on the Yadkin River about five river miles upstream of Wilkesboro, NC. The dam is about 55 miles west of Winston-Salem, NC and about 65 miles north of Charlotte, NC. W. Kerr Scott Dam is an earthen structure having a top elevation of 1107.5 feet, msl and an overall length of 1,750 feet. The height about the streambed is 148 feet. The drainage area above W. Kerr Scott Dam is 367 square miles. The watershed covers parts of Wilkes, Caldwell, and Watauga counties. W. Kerr Scott Reservoir extends about 9.7 miles up the Yadkin River. At the normal pool elevation of 1030 feet, msl, the length of the shoreline is about 55 miles and the reservoir covers an area of about 1,475 acres. The mean depth at normal pool is about 28 feet, but the depth at the dam is about 65 feet. At the normal pool, there is about 41,000 acre-feet of water stored behind W. Kerr Scott Dam (USACE, 2015).

YADKIN HYDROELECTRIC PROJECT

Alcoa Power Generating, Inc. (APGI) operates the Yadkin Hydroelectric Project, Federal Energy Regulatory Commission (FERC) No. 2197, which is comprised of four hydroelectric stations, dams and reservoirs along a 38-mile stretch of the Yadkin River in central North Carolina. The four reservoirs are High Rock, Tuckertown, Narrows (Badin Lake) and Falls (Alcoa Power Generating Inc., 2015).

High Rock Development

The High Rock development is located on the Yadkin River at river mile 253 in Davidson, Davie, and Rowan counties, North Carolina. Completed in 1927, the High Rock development was the third of the Yadkin Project developments to be built and is the most upstream of the four Yadkin Project developments. The High Rock development consists of a dam, powerhouse, and reservoir. High Rock Reservoir has a normal full pool area of approximately 15,180 acres and a drainage area of 3,973 square miles. The normal full pool elevation of High Rock Reservoir is 623.9 feet (USGS datum) (Alcoa Power Generating Inc., 2015).

Tuckertown Development

The Tuckertown development is located in Rowan, Davidson, Stanly, and Montgomery counties, North Carolina on the Yadkin River at river mile 244.3. Completed in 1962, the Tuckertown development was the last of the Yadkin Project developments to be built. The Tuckertown development consists of a dam, powerhouse, and reservoir. Tuckertown Reservoir has a normal full pool area of 2,560 acres and a drainage area of 4,080 square miles. The normal full pool elevation of Tuckertown Reservoir is 564.7 feet (USGS datum) (Alcoa Power Generating, Inc., 2015).

Narrows Development

The Narrows development is located in Davidson, Stanly and Montgomery counties, North Carolina on the Yadkin River at river mile 236.5. Completed in 1917, the Narrows development was the first of the Yadkin Project developments to be built. Narrows Dam consists of a main dam section and a bypass spillway section. Four steel penstocks convey water from the intake section to the powerhouse. The dam impounds a reservoir (Narrows Reservoir or Badin Lake) that has a normal full pool area of 5,355 acres and a drainage area of 4,180 square miles. The normal full pool elevation of Narrows Reservoir is 509.8 feet (USGS datum) (Alcoa Power Generating Inc., 2015).

Falls Development

The Falls development is located in Stanly and Montgomery counties, North Carolina on the Yadkin River at river mile 234. Completed in 1919, the Falls development was the second of the Yadkin Project developments to be built and is the most downstream of the four Yadkin Project developments. The Falls development consists of a dam, a gate controlled spillway, powerhouse and reservoir. Falls Reservoir has a normal full pool area of 204 acres and a drainage area of 4,190 square miles. The normal full pool elevation of Falls Reservoir is 332.8 feet (USGS datum) (Alcoa Power Generating Inc., 2015) .

YADKIN-PEE DEE HYDROELECTRIC PROJECT

Duke Energy Progress operates the Yadkin-Pee Dee Hydroelectric Project. The Tillery and Blewett Hydroelectric Plants together comprise the Yadkin-Pee Dee River Project. These plants are operated as an integrated unit under FERC Project License No. 2206. The Tillery and Blewett Plants are located in the Southern Piedmont area of North Carolina.

Tillery Development

Lake Tillery is located in Montgomery and Stanly counties and is formed by the dam at the Tillery Hydroelectric Plant on the Pee Dee River. The lake extends approximately 15 miles upstream from the dam to APGI's Falls Hydroelectric Development. At normal operating levels, Lake Tillery is about 72 feet deep at the dam. The reservoir surface area is 5,260 acres at that level (elevation 278.17), and the usable storage with 22 foot drawdown is 88,000 acre-feet (Duke Energy, 2015). The Tillery Hydroelectric Plant is located on the Pee Dee River approximately four miles west of Mt. Gilead, NC, 17 miles south of Narrows Reservoir and 25 miles above the Blewett Plant. The plant began service in 1928, with additions in 1960. It features a dam 2,800 feet long and 86 feet high, that forms Lake Tillery, as well as flood-control gates. Its four generators are capable of producing a total of 87 megawatts. By regulating the river's flow, the Tillery plant also helps to increase the efficiency of the Blewett Plant downstream (Duke Energy, 2015).

Blewett Falls Development

The Blewett Falls impoundment, also known as Blewett Falls Lake, extends approximately 11 miles upstream from the dam. Construction of the Blewett Falls Development began in 1905 and was completed in June 1912. Blewett Falls Lake has a reservoir surface area of 2,866 acres at a normal pool elevation of 178.1' msl and a usable storage capacity of 30,893 acre-feet. The Blewett Falls development is licensed for a drawdown of 17 feet, but generally operates with drawdowns of 2 to 4 feet (Duke Energy, 2014).

The Blewett Hydroelectric Plant is located in Richmond and Anson counties on the Pee Dee River in Lilesville, NC, near the North Carolina/South Carolina border, and was originally constructed to supply power to the textile industry in Rockingham, NC The plant includes a gravity dam that is 60 feet high and 650 feet long, creating Blewett Falls Lake. It houses six generators capable of producing a total of approximately 22 megawatts. In addition, the oil-fired combustion turbines on the site can generate another 52 megawatts. The Blewett Hydroelectric Plant began commercial service in 1912, with additions in 1971 (Duke Energy, 2015).

CATAWBA-WATEREE HYDROELECTRIC PROJECT

Duke Energy operates the Catawba-Wateree Hydroelectric Project in the Catawba River Basin, FERC Project License No. 2232. The Catawba River begins in western North Carolina and flows easterly and southerly into South Carolina, where it joins Big Wateree Creek to form the Wateree River. The Catawba-Wateree Hydroelectric Project is comprised of 13 hydropower stations and 11 reservoirs, including the James, Rhodhiss, Hickory, Lookout Shoals, Norman, Mountain Island, Wylie, Fishing Creek, Great Falls, Rocky Creek, and Wateree lakes. The Catawba-Wateree Hydro Project spans over 200 river miles and encompasses approximately 1,700 miles of shoreline within nine counties in North Carolina and five counties in South Carolina. It is the backbone of Duke Energy's generation fleet, providing 841 megawatts of renewable hydropower and cooling water to more than 8,100 megawatts of fossil and nuclear generation (Duke Energy, 2015).

Bridgewater Development

Built over a seven-year period beginning in 1916, Lake James required the construction of three dams: Linville, Paddy Creek and Catawba. Linville Dam is 160 feet high and 1,325 feet long. Paddy Creek Dam is 165 feet high and 1,610 feet long. Catawba Dam is 150 feet high and 3,155 feet long. The lake straddles the McDowell-Burke county line. Lake James has a surface area of approximately 6,812 acres, with 150 miles of shoreline. Full pond elevation is 1,200 feet (Duke Energy, 2015).

In 1919, the original Bridgewater powerhouse entered commercial operation and was decommissioned in 2011. Located on Lake James which spans McDowell and Burke counties, NC, Bridgewater Hydro Station is the first of 13 hydro stations that stretch from Morganton, NC to Wateree Hydro Station located near Wateree, SC. The new Bridgewater Hydro Station, completed in 2011, is capable of producing 31.5 megawatts of hydroelectricity (Duke Energy, 2015).

Rhodhiss Development

Lake Rhodhiss was built in 1925. The Rhodhiss dam is 65 feet high and 1,500 feet long. A relatively small lake, Rhodhiss has 90 miles of shoreline and a surface area of approximately 3,060 acres. Full pond elevation is 995.1 feet. Lake Rhodhiss is also a reliable source of water for the nearby cities of Granite Falls, Lenoir, Morganton and Valdese, North Carolina (Duke Energy, 2015).

Rhodhiss Hydro Station is a three-unit generating, 26 megawatt facility located in Caldwell County, NC. This facility began operation in 1925 (Duke Energy, 2015).

Oxford Development

Lake Hickory was created in 1927 with the completion of the Oxford Dam. The dam parallels the NC Highway 16 bridge over the Catawba River between I-40 and Taylorsville. It is 122 feet high, with an overall length of 1,200 feet. The spillway section of the dam is 550 feet long. The lake covers almost 4,223 acres with 105 miles of shoreline. Full pond elevation is 935 feet. Lake Hickory is a reliable source of water for the nearby cities of Hickory and Long View, North Carolina (Duke Power, 2015).

Oxford Hydro Station is located on the south bank of the Catawba River in Catawba County, NC The facility has two generating units with a capacity of 36 megawatts and forms Lake Hickory. This facility first entered service in 1928 (Duke Energy, 2015).

Lookout Shoals Development

Lookout Shoals Lake was formed in 1915 with the construction of the Lookout Shoals Hydroelectric Station. The lake has approximately 1,305 acres of surface area and 37 miles of shoreline. Full pond elevation for Lookout Shoals Lake is 838.1 feet (Duke Energy, 2015).

Beginning service in 1915, Lookout Shoals Hydro Station has three generating units capable of producing 26 megawatts of hydroelectricity. This facility is located in Iredell County, NC (Duke Energy, 2015).

Cowans Ford Development

Cowans Ford Dam created the largest manmade body of fresh water in North Carolina when it dammed the Catawba River in 1963. The total length of the facility is 7,387 feet, including more than a mile of earthen dam. The concrete portion of the dam is 1,279 feet long and 130 feet high. Lake Norman includes 520 miles of shoreline and a surface area of more than 32,475 acres. The lake is nearly as large as the other ten lakes on the Catawba combined. Full pond elevation at Lake Norman is 760 feet. The lake provides a dependable supply of water to Lincoln County, Davidson, Mooresville, Charlotte-Mecklenburg and Huntersville, North Carolina (Duke Energy, 2015) .

Cowans Ford Hydro Station is located in Huntersville, NC (Mecklenburg County), approximately 20 miles north of Charlotte on Lake Norman. It is the largest conventional hydro station owned by Duke Energy and has a capacity of 350 megawatts. Three units began generating electricity in 1963, with a fourth unit beginning operation in 1967 (Duke Energy, 2015).

Mountain Island Development

Mountain Island Lake was built in 1924 with the construction of Mountain Island Hydroelectric Station. The lake has approximately 3,281 acres of surface area and 61 miles of shoreline. The lake provides a dependable water supply for Mount Holly, Gastonia and Charlotte-Mecklenburg, North Carolina. Full pond elevation is approximately 647.5 feet (Duke Energy, 2015).

Mountain Island Hydro Station is a four-unit generating facility located in Gaston County, NC. First put into service in 1923, this facility has a generating capacity of 60 megawatts (Duke Energy, 2015).

Wylie Development

Lake Wylie is the oldest lake on the Catawba River. The lake was first created in 1904 by a dam near Fort Mill, South Carolina. The dam was rebuilt in 1924 and the lake's surface expanded to approximately 13,443 acres and 325 miles of shoreline. In addition to supporting Wylie Hydroelectric Station, Lake Wylie also supports Allen Steam Station and Catawba Nuclear Station with cooling water and provides a dependable water supply for Belmont and Rock Hill. Full pond elevation at Lake Wylie is approximately 569.4 feet (Duke Energy, 2015).

Lake Wylie Hydro Station is located in Mecklenburg County, NC and York County, SC. First put into service in 1925, this facility has four generating units capable of producing 60 megawatts (Duke Energy, 2015).

Fishing Creek Development
Fishing Creek Lake was created in 1916 and has approximately 3,112 surface acres of water and 61 miles of shoreline. The Fishing Creek Hydroelectric Station dam is 1,770 feet long with 22 floodgates. The lake also provides a dependable water supply for Chester County, South Carolina. Full pond elevation is 417.2 feet (Duke Energy, 2015).

Fishing Creek Hydro Station is a five-unit generating facility located on the Catawba River in Chester County, SC. The station first began service in 1916 and has a capacity of 37 megawatts (Duke Energy, 2015).

Great Falls Development
The Great Falls and Dearborn Hydroelectric Stations are both located on the Great Falls Lake in Chester County, SC. The lake was completed in 1907 and has a surface area of 477 acres and 24 miles of shoreline. Full pond elevation is 355.8 feet (Duke Energy, 2015).

Great Falls Hydro Station first began service in 1907 and has eight generating units capable of producing 24 megawatts. Dearborn Hydro Station first began service in 1923 and has three generating units, capable of producing up to 46 megawatts (Duke Energy, 2015).

Cedar Creek Development
The Rocky Creek and Cedar Creek Hydroelectric Stations are both located on Rocky Creek Lake. With 847 acres of surface area and 20 miles of shoreline, the lake was completed in 1909 with the operation of the Rocky Creek Hydroelectric Station. The Cedar Creek Hydroelectric Station was later built in 1926. Full pond elevation is 284.4 feet (Duke Energy, 2015).

Rocky Creek Hydro Station is an eight-unit generating facility located on the Catawba River in Fairfield County, SC. It first began service in 1909 and has a capacity of 28 megawatts. Cedar Creek Hydro Station is a three-unit generating facility located on the Catawba River in Lancaster County, SC. It first began service in 1926 and has a capacity of 45 megawatts (Duke Energy, 2015).

Wateree Development
Lake Wateree was created in 1920 with the operation of Wateree Hydroelectric Station. The Wateree Dam is 3,380 feet long. Lake Wateree has 13,864 surface acres and 242 miles of shoreline and is the largest of the lower lakes. The lake also provides a dependable water supply for Lugoff and Camden, South Carolina. Full pond elevation is 225.5 feet (Duke Energy, 2015).

The Wateree Hydro Station is a five-unit generating facility located on the Wateree River in Fairfield and Kershaw Counties, SC. The Catawba River becomes the Wateree River at the upper end of Lake Wateree. The hydro station first began service in 1919 and has a capacity of 56 megawatts (Duke Energy, 2015).

4.12.5 Groundwater Supplies

The principal aquifer in the Piedmont and Blue Ridge provinces of North Carolina is the crystalline rock aquifer (Coble, Giese, & Elmers, 1985). In the Piedmont province of North Carolina, aquifers are localized and consist of complex fractured metamorphic, igneous, and sedimentary rocks from the Triassic Basin. Regolith overlies most of the rocks and consists of soil, saprolite, alluvium, and colluvium. In the project area, groundwater is held in the regolith/fractured crystalline rock aquifer system. The fractured, crystalline, igneous and metamorphic rock generally has low porosity and therefore little storage capacity. As a result, the majority of the groundwater is located in the regolith that sits atop the bedrock.

Groundwater in the regolith recharges the water-holding fractures in the underlying bedrock. The water held in the regolith is recharged from infiltration of precipitation. The infiltration and recharge rates vary across the physiographic province as well as the project area based on variations in regolith thickness, arrangement of fractures in the regolith, and geology (Trapp & Horn, 1997).

The principal aquifer in the portion of the project area in South Carolina is the Piedmont Bedrock Aquifer (SCDHEC, 2012b). The aquifer extends from the Fall Line to the Blue Ridge Mountains. Piedmont bedrock is similar to the crystalline rock associated with the aquifer underlying the North Carolina portions of the project area, consisting of fractured crystalline rock overlain by a saprolitic regolith and limited alluvial valley fill deposits.

Groundwater yields from the Piedmont Bedrock Aquifer vary greatly within the region, depending primarily on the layout and interconnection of joints and fractures in the rock where water is stored. Groundwater of the aquifer can be obtained from the regolith and from fractures in the bedrock. Variability in the geology of the regolith and in the fractures results in considerable differences in the occurrence and availability of groundwater throughout the area underlain by the Piedmont Bedrock Aquifer. Recharge to the aquifer is mainly provided via the hydrologic connection between the overlying saprolite and the underlying bedrock.

Portions of the project areas obtain potable water from private or community groundwater wells, while the remainder of the project areas purchases water from the local municipalities or county-level utilities. Groundwater well placement relative to bedrock and regolith fracture patterns is critical to maintain adequate and reliable yields. The most reliable yields are realized from wells that either penetrate several small fractures as well as one large fracture in intensely fractured rock or encounter numerous closely spaced fractures (Miller, 1990; Trapp & Horn, 1997). Groundwater quality from the aquifers underlying the project areas is generally suitable for drinking and other uses. Dissolved constituents, typically including iron, manganese, fluoride, and sulfur, may require filtering and/or oxidation to make the water potable.

Private groundwater wells are present in the vicinity of the project areas. However, mapping of the wells is not available. Data on the location and number of private wells are not readily available.

4.13 Shellfish or Fish and Their Habitats

Aquatic habitats in the project areas include streams, which provide free-flowing, warm-water habitats, and ponds, which also provide warm-water habitat. Several named, perennial streams are located in the project area, including Yadkin River, Pee Dee River, Rocky River, Goose Creek, Duck Creek, Big Bear Creek, Long Creek, Lanes Creek, Richardson Creek, and Brown Creek. Numerous unnamed perennial, intermittent, and ephemeral streams that are tributaries to the aforementioned major streams are also present in the project area and provide habitat for various species of fish and shellfish.

In order to protect fish resources, WRC and/or USFWS may request one or more moratoria on instream construction activities. The moratoria impose schedule restrictions as to when it is permissible to perform work in streams that are known to support important fish resources. The moratoria are timed to coincide with spawning and early development of the year's fry, supporting the annual reproductive cycle and contributing to the success thereof. Fish groups that are commonly protected by a construction moratorium in inland waters include eastern and western sunfish, rainbow trout, brook or brown trout, anadromous fish, spotfin chub, and Cape Fear shiner.

WRC has listed the priority aquatic species in the North Carolina portions of the Catawba and Yadkin-Pee Dee River basins and performs periodic fish community sampling within some of the wadeable streams in the Catawba and Yadkin-Pee Dee River basins (NCWRC, 2005). The fish species collected by WRC between April 1996 and May 2011 in sampled streams traversed by the project areas are listed in Table 4-16. The priority aquatic species that were collected are also indicated in Table 4-16. Of the priority species listed by WRC, one species listed as a Federal Species of Concern (FSC), Carolina darter (*Etheostoma collis collis*), was collected within Big Bear Creek, Crooked Creek, Lanes Creek, and Richardson Creek. No other state or federally listed fish species were noted during sampling activities. One additional priority species, notchlip redhorse (*Moxostoma collapsum*), was collected in Big Bear Creek in Stanly County.

Four of the state and federally protected mussel species listed for the project area counties are listed as priority aquatic species by WRC. Two of the four species have been documented in streams crossed by a proposed pipe corridor (NCNHP, 2014). Additional information regarding the state and federally protected species and their documented occurrences is provided in Section 4.15 – Wildlife and Natural Vegetation.

Table 4-16 Fish Collected by WRC in Streams Crossed by a Proposed Alternative

Common Name	Scientific Name	Priority Species
White catfish	*Ameiurus catus*	
Yellow bullhead	*Ameiurus natalis*	
Flat bullhead	*Ameiurus platycephalus*	
American eel	*Anguilla rostrata*	
Pirate perch	*Aphredoderus sayanus*	
White sucker	*Catostomus commersonii*	
Rosyside dace	*Clinostomus funduloides*	
Satinfin shiner	*Cyprinella analostana*	
Eastern creek chubsucker	*Erimyzon oblongus*	
Carolina darter	*Etheostoma collis*	✓
Fantail darter	*Etheostoma flabellare*	
Tessellated darter	*Etheostoma olmstedi*	
Eastern mosquitofish	*Gambusia holbrooki*	
Highback chub	*Hybopsis hypsinotus*	
Redbreast sunfish	*Lepomis auritus*	
Green sunfish	*Lepomis cyanellus*	
Pumpkinseed	*Lepomis gibbosus*	
Warmouth	*Lepomis gulosus*	
Bluegill	*Lepomis macrochirus*	
Largemouth bass	*Micropterus salmoides*	
Notchlip redhorse	*Moxostoma collapsum*	✓
Bluehead chub	*Nocomis leptocephalus*	
Golden shiner	*Notemigonus crysoleucas*	
Whitemouth shiner	*Notropis alborus*	
Highfin shiner	*Notropis altipinnis*	
Redlip shiner	*Notropis chiliticus*	
Spottail shiner	*Notropis hudsonius*	
Coastal shiner	*Notropis petersoni*	
Sandbar shiner	*Notropis scepticus*	
Margined madtom	*Noturus insignis*	
Piedmont darter	*Percina crassa*	
Black crappie	*Pomoxis nigromaculatus*	
Greater jumprock	*Scartomyzon sp. cf. lachneri*	
Creek chub	*Semotilus atromaculatus*	

4.14 Forest Resources

Natural forested communities are scattered throughout the undeveloped and developed portions of the project area (Figure 4-3). The forested areas include conifer forests, bottomland forests, and mixed hardwood forests. The project area consists of developed land with small wooded areas (i.e., mature soft and hardwoods) primarily located along riparian corridors, agricultural land, and wooded, undeveloped land. The North Carolina Division of Forest Resources (DFR) has mapped Important Forest Lands throughout the state. Important Forest Lands are defined by DFR as "… those which are important for sustaining the forest products sector of our economy and providing ecosystem services that are compatible with forest management, such as protecting drinking water supplies." Within components of each alternative, portions of the areas denoted as Important Forest Lands have been converted to non-forested uses such as farm fields and residential development. Additionally, some of the areas designated as Important Forest Land encroach into maintained roadway easements, in which a large portion of the pipe corridors are located.

4.14.1 Alternative 1A

The pipe corridor associated with Alternative 1A is mainly located along maintained roadway easements. Several small portions of the pipe corridor traverse undeveloped areas that consist of agricultural and forested land. Approximately 141 acres of the Alternative 1A corridor is located in areas denoted as Important Forest Land. The pump station site and access road associated with this alternative are not located in areas denoted as Important Forest Lands.

4.14.2 Alternative 1B

The Alternative 1B pipe corridor is mainly located outside of roadway easements and traverses numerous agricultural fields and wooded areas. Approximately 244 acres of the Alternative 1B corridor is located in areas denoted as Important Forest Lands. The pump station site and access road associated with this alternative are not located in areas denoted as Important Forest Lands.

4.14.3 Alternative 2A

The pipe corridor associated with Alternative 2A is located entirely along maintained roadway easements. The pipe corridor traverses approximately 130 acres of area denoted as Important Forest Lands. Approximately 533 feet of the pump station access road traverses Important Forest Lands and The pump station site associated with this alternative is not located in an area denoted as Important Forest Lands.

4.14.4 Alternative 2B

The Alternative 2B pipe corridor is located entirely along roadway easements. The pipe corridor traverses approximately 135 acres of area denoted as Important Forest Land. Approximately 1,630 feet of the access road and all of the pump station site are depicted as Important Forest Land.

4.14.5 Alternative 3A

Portions of the Alternative 3A pipe corridor are located adjacent to roadways, with the remainder of the corridor traversing agricultural and wooded land. Approximately 352 acres of the Alternative 3A pipe corridor traverses areas denoted as Important Forest Lands. The pump station site and approximately 1,234 feet of the access road are located in areas designated as Important Forest Land.

4.14.6 Alternative 3B

The pipe corridor associated with Alternative 3B is located entirely along maintained roadway easements. Approximately 119 acres of the Alternative 3A pipe corridor traverses an area denoted as Important Forest Lands. The pump station site and approximately 1,234 feet of the access road are located in areas designated as Important Forest Lands. The WTP D area is comprised mainly of forested areas and is depicted as containing approximately 354 acres of Important Forest Lands.

4.14.7 Alternative 4

The Alternative 4 pipe corridor is mainly located along maintained roadway easements. Two portions of the pipe corridor are not located along roadway easement and traverse mainly agricultural land and some undeveloped, wooded land. Approximately 132 acres of the Alternative 4 pipe corridor is denoted as Important Forest Land. Approximately 0.18 acre of the access road, all of the pump station site, and approximately 0.4 acre of the intake pipe corridor are in areas denoted as Important Forest Land.

4.14.8 Alternative 5

The pipe corridor associated with Alternative 5 is located entirely along maintained roadway easements. The pipe corridor traverses approximately 4 acres of area denoted as Important Forest Lands, most of which is presently forested. The pump station site and access road associated with this alternative are not located in Important Forest Land areas.

4.14.9 Alternative 6

The pipe corridor associated with Alternative 6 is located entirely along maintained roadway easements. The portion of the pipe corridor located within North Carolina traverses approximately 9 acres of area denoted as Important Forest Lands. Published data relative to forest resources in South Carolina deemed important by the state was not available for inclusion in this report. Forest resources within the project areas were calculated from visual assessment and electronic measurement of forested areas shown on recent aerial photographs. Approximately 54 acres of forested land that appear similar in composition to the areas depicted in North Carolina were calculated within the portion of the pipe corridor located in South Carolina.

4.14.10 Alternative 7

The pipe corridor associated with Alternative 7 is located entirely along maintained roadway easements. The pipe corridor traverses approximately 37 acres of Important Forest Lands. No additional infrastructure is proposed relative to Alternative 7.

4.14.11 Alternative 8

The Alternative 8 pipe corridor is located entirely along maintained roadway easements. The well field site is dominated by agricultural land with developed and undeveloped areas present. Approximately 15 acres of land located along the pipe corridor and approximately 19,295 acres within the well field site are denoted as Important Forest Lands. The WTP D area is comprised mainly of forested areas and is depicted as containing approximately 354 acres of Important Forest Lands. Quantification of forest resources within the areas of impact associated with the well sites cannot be calculated since the footprints of project components is not known at this time. However, the forest resources within the disturbed areas of the WTP D site and the cumulative forest resource areas associated with the individual well sites that would be impacted if the alternative is selected and implemented will be significantly lower than the acreage of the study areas provided herein.

4.14.12 Alternative 11

The pipe corridor associated with Alternative 11 is mainly located along maintained roadway easements. Approximately 176 acres of the pipe corridor traverse areas designated as

Important Forest Lands. Neither the area in which the discharge is located nor the City of Monroe WWTP site contain Important Forest Lands.

4.14.13 Alternative WTP A

The WTP A facility area is bisected by several roadways and their associated maintained easements. A majority of the WTP A area is presently in use for agriculture. With the exception of a group of structures, the portions of the WTP A area not in use for agriculture are forested. The WTP A area is shown to contain approximately 168 acres of Important Forest Lands.

4.14.14 Alternative WTP B

The WTP A facility area is bisected by several roadways and their associated maintained easements. A majority of the WTP A area is presently in use for agriculture. With the exception of a group of structures, the portions of the WTP A area not in use for agriculture are forested. The WTP A area is shown to contain approximately 168 acres of Important Forest Lands.

4.14.15 Alternative WTP C

The WTP C Alternative pipe corridor is located entirely adjacent to maintained roadway easements. Approximately 29 acres of the pipe corridor traverses areas denoted as Important Forest Lands. A majority of the WTP C area is in use for agriculture and only two wooded areas are present. Important Forest Lands comprise approximately 159 acres of the WTP C area.

4.15 Wildlife and Natural Vegetation

4.15.1 Wildlife Habitat and Resources

The availability and distribution of wildlife habitat can be determined by assessing the land cover of an area. For the purposes of the Environmental Impact Statement (EIS), primary land cover classes are combined into major community types. The major community types in the project area are typical of urbanized areas in the piedmont and include disturbed lands and forested areas. General descriptions of the flora and fauna that are commonly observed in the major community types are provided in the following paragraphs.

4.15.1.1 DISTURBED LANDS

Disturbed lands are present in portions of the project area. Urban disturbed land includes residential areas with maintained grass lawns and sporadically planted hardwood trees and shrubs, industrial buildings with wide-open cultivated grass lawns, and various rights-of-way or otherwise disturbed lands. Agricultural lands are included in the disturbed land category as well. Trees and shrubs in urban areas include many non-native species. Common woody species include silver maple (*Acer saccharinum*), Bradford pear (*Pyrus calleryana*), sawtooth oak (*Quercus acutissima*), willow oak (*Q. phellos*), pecan (*Carya illinoinensis*), hybrid azaleas (*Rhododendron* spp.), Chinese privet (*Ligustrum sinense*), Russian olive (*Eleagnus angustifolia*), and crepe myrtle (*Lagerstroemia indica*). Agricultural lands include plowed fields of planted crops and pasturelands for livestock.

Cats, dogs, and introduced species are abundant in these areas, reducing habitat suitability for native species. Reptile and amphibian species are limited to a few small, secretive species, such as the rough earth snake (*Virginia striatula*), northern brown snake (*Storeria dekayi*), and ground skink (*Scincella lateralis*). Predominant birds include the introduced house sparrow (*Passer* *domesticus*), European starling (*Sturnus vulgaris*), and feral pigeon (*Columba livia*) in addition to the native cardinal (*Cardinalis cardinalis*), American robin (*Turdus migratorius*), white-throated sparrow (*Zonotrichia albicollis*), blue jay (*Cyanocitta cristata*), Carolina wren (*Thryothorus ludovicianus*), mourning dove (*Zenaida macroura*), and northern mockingbird (*Mimus polyglottos*). Typical mammals of these areas are gray squirrel (*Sciurus carolinensis*), house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphus virginiana*), and big brown bat (*Eptesicus fuscus*).

4.15.1.2 FORESTED AREAS

Forested areas in the project area include both mixed hardwood and pine forest. Wildlife in hardwood and mixed hardwood forests may be more diverse in woods that are less disturbed and that have greater stratification. The spotted (*Ambystoma maculatum*), white-spotted slimy (*Plethodon cylindraceus*), and marbled (*Ambystoma opacum*) salamanders may be found in the project area. The five-lined skink (*Eumeces fasciatus*) and eastern worm snake (*Carphophis amoenus amoenus*) are found in hardwood forests. The multi-strata structure of mixed hardwood and bottomland hardwood forests typically support high densities and diversities of neotropical migratory birds such as wood thrush (*Hylocichla mustelina*), ovenbird (*Seiurus aurocapillus*), Swainson's warbler (*Limnothlypis swainsonii*), worm-eating warbler (*Helmitheros vermivora*), prothonotary warbler (*Protonotaria citrea*), hooded warbler (*Wilsonia citrina*), and white-breasted nuthatch (*Sitta carolinensis*). Mammals such as the white-tail deer (*Odocoileus virginianus*), raccoon, eastern cottontail (*Sylvilagus floridanus*), gray squirrel, and white-footed mouse (*Peromyscus leucopus*) are likely to be found in the forests of the project area.

Pine forests in the Piedmont tend to support a relatively sparse animal community because of their lower plant species diversity compared with hardwood forest. Characteristic amphibians and reptiles are Fowler's toad (*Bufo woodhousei*), eastern box turtle (*Terrapene carolina*), rough green snake (*Opheodrys aestiva*), fence lizard (*Sceloporus undulatus*), six-lined racerunner (*Cnemidophorus sexlineatus*), five-lined skink, black rat snake (*Elaphe obsoleta*), kingsnakes (*Lampropeltis* spp.), and black racer (*Coluber constrictor*). Birds of pine forests include sharp-shinned hawk (*Accipiter striatus*), downy woodpecker (*Picoides pubescens*), yellow-bellied sapsucker (*Sphyrapicus varius*), pine warbler (*Dendroica pinus*), yellow-rumped warbler (*Dendroica coronata*), white-breasted nuthatch, and several finch and sparrow species (*Fringillidae* spp.). Pine forest mammals include Virginia opossum, raccoon, gray squirrel, woodland vole (*Microtus pinetorum*), white-footed mouse, and red fox (*Vulpes vulpes*).

4.15.2 Rare and Protected Species or Habitats

Some populations of fauna and flora have been, or are, in the process of decline due to either natural forces or their inability to coexist with humans. Federal law, under the provisions of Section 7 of the Endangered Species Act (ESA) of 1973, as amended, requires that any action likely to adversely affect a federally protected species be subject to review by USFWS. Other species may receive additional protection under separate federal laws.

The project area is located in the portions of Anson, Mecklenburg, Stanly, and Union Counties, North Carolina and Lancaster County, South Carolina. The USFWS lists of federally protected species were updated July 14, 2015 for Anson County, April 2, 2015 for Mecklenburg and Stanly counties, March 25, 2015 for Union County, and February 18, 2015 for Lancaster County. Seven federally endangered (E) species, one federally threatened (T) species, eighteen

Federal Species of Concern (FSC), and two federal candidate (C) species have been identified as within the five counties (USFWS, 2015). The bald eagle has been de-listed from the USFWS list, but remains protected by the Bald and Golden Eagle Protection Act of 1940 (BGPA), as amended, and the Migratory Bird Treaty Act of 1918 (MBTA), as amended. In addition to the federally protected species, NHP has identified sixteen endangered species, fourteen threatened species, and nineteen species of special concern in the four North Carolina counties (2015). DNR has identified one additional threatened species in Lancaster County (2015). As state-listed species are not afforded legal protection, species that are listed by the state agencies only are not discussed further herein. Each species included on the USFWS Endangered Species, Threatened Species, Federal Species of Concern, and Candidate Species list and their state and federal status are provided in Table 4-17.

A review of available NHP data from natural heritage shape files revealed there are eight FSC, nine candidate, and one E species occurrences in the project area (2015). One population each of Carolina redhorse, Carolina darter, and Carolina heelsplitter as well as two populations of Carolina creekshell have been documented in or along a waterbody that is touched or crossed by a proposed project corridor or is within the well field area.

Additional occurrences of three federally endangered species, one candidate species, and nine FSC have been documented within a two-mile radius of the proposed project corridors. The endangered species that have been documented in the two-mile radius of the corridors are Schweinitz's sunflower, Carolina heelsplitter, and red-cockaded woodpecker. The candidate species, Georgia aster, has also been identified within the project areas.

Table 4-17 Species Identified by USFWS for Anson, Mecklenburg, Stanly, and Union Counties, North Carolina and Lancaster County, South Carolina

Scientific Name	Common Name	State Status	Federal Status	County of Occurrence
Vertebrates				
Acipenser brevirostrum	Shortnose sturgeon	E	E	A
Acipenser oxyrinchus oxyrinchus	Atlantic sturgeon	-	E	A
Anguilla rostrata	American eel	-	FSC	A, M, S, U
Etheostoma collis collis	Carolina darter	SC	FSC	A, M, S, U
Haliaeetus leucocephalus	Bald eagle	T	BGPA	A, M, S, U [4]
Moxostoma robustum	Robust redhorse	E	FSC	A, S [1, 4], U [1, 4]
Moxostoma sp. 2	Carolina redhorse	-	FSC	A, S
Myotis septentrionalis	Northern long-eared bat	-	T	M [2], S [2]
Picoides borealis	Red-cockaded woodpecker	E	E	A [4]
Invertebrates				
Alasmidonta varicosa	Brook floater	-	FSC	A, S
Fusconaia masoni	Atlantic pigtoe	E	FSC	U
Lampsilis cariosa	Yellow lampmussel	E	FSC	A, S [4], U
Lasmigona decorata	Carolina heelsplitter	E	E	L, M, U
Toxolasma pullus	Savannah lilliput	E	FSC	S [4], U
Villosa vaughaniana	Carolina creekshell	E	FSC	A, M, S, U
Vascular Plants				
Amphianthus pusillus	Little amphianthus	-	T	L
Delphinium exaltatum	Tall larkspur	E	FSC	M [1], U [1, 4]
Echinacea laevigata	Smooth coneflower	E	E	L, M
Eurybia mirabilis	Dwarf aster	SR-T	FSC	A, M, S, U
Helianthus schweinitzii	Schweinitz's sunflower	E	E	A, L, M, S, U
Hymenocallis coronaria	Shoals spiderlily	-	FSC	M [2], U [2]
Isoetes melanospora	Black-spored quillwort	-	E	L
Isoetes virginica	Virginia quillwort	SR-L	FSC	S [1], U [1]
Juglans cinerea	Butternut	-	FSC	S[1]
Lindera subcoriacea	Bog spicebush	SR-T	FSC	A [1, 5]
Lotus unifoliolatus var. helleri	Prairie birdsfoot-trefoil	-	FSC	M, S, U
Panicum lithophilum	Flatrock panic grass	SR-T	FSC	A
Rhus michauxii	Michaux's sumac	E	E	M, U [5]
Solidago plumosa	Yadkin River goldenrod	T	C	S
Symphyotrichum georgianum	Georgia aster	T	C	L, M, S [1], U
Verbena riparia	Riparian vervain	-	FSC	S [3]

***Key to County of Occurrence*:**
A – Anson County, NC
L – Lancaster County, SC
M – Mecklenburg County, NC
S – Stanly County, NC
U – Union County, NC

Key to Federal Status:
E– Endangered. A taxon "in danger of extinction throughout all or a significant portion of its range."
T – Threatened. A taxon likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
C – Candidate. A taxon under consideration for official listing for which there is sufficient information to support listing.
FSC – Federal species of concern. A species under consideration for listing, for which there is insufficient information to support listing.
BGPA – Bald and Golden Eagle Protection Act. The bald eagle was de-listed from the Federal List of Threatened and Endangered wildlife, and the primary law protecting the bald eagle became the BGPA.
[1] – Historic: The species was last observed in the county more than 50 years ago.
[2] – Probable/Potential: The species is considered likely to occur in this county based on the proximity of known records (in adjacent counties), the presence of potentially suitable habitat, or both.
[3] – Obscure: The date and/or location of observation is uncertain.

Key to State Status:
E – Endangered: "Any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy" (GS 19B 106:202.12).
T – Threatened: "Any resident species of plant which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (GS 19B 106:202.12).
SC – Special Concern: Any species of plant in North Carolina which requires monitoring but which may be collected and sold under regulations adopted under the provisions of the Plant Protection and Conservation Act (GS 19B 106:202.12).
SR – Significantly Rare: Species which are rare in North Carolina, generally with 1-100 populations in the state, frequently substantially reduced in numbers by habitat destruction (and sometimes also by direct exploitation or disease).
-L – Limited: The range of the species is limited to North Carolina and adjacent state (endemic or near endemic). These are species, which may have 20-50 populations in North Carolina, but fewer than 100 populations rangewide. The preponderance of their distribution is in North Carolina, and their fate depends largely on conservation here.
-T – Throughout: These species are rare throughout their ranges (fewer than 100 populations total).
[4] – Species is listed for the county by the state only. USFWS does not include the species on its list for the county.
[5] – Historic: Either the element has not been found in recent surveys in the region; or it has not been surveyed recently enough to be confident they are still present; or the occurrence is thought to be destroyed.

4.15.2.1 VERTEBRATES

Shortnose sturgeon *(Acipenser brevirostrum)*

The shortnose sturgeon, a member of the family Acipenseridae, is a small species of sturgeon and seldom exceeds 3.3 feet in length. Shortnose sturgeon have an elongated, flattened body and a subterminal mouth with barbells, which are suited to their bottom feeding and generally benthic existence. The shortnose sturgeon is found sporadically in coastal rivers along the East Coast from Canada to Florida. These are anadromous fish; however, as the adults seldom travel from their natal river and associated estuary, each river's population is genetically distinct. The preferred habitat of the shortnose sturgeon is deep pools with soft substrates and vegetated bottoms. The shortnose sturgeon spawn in fast-moving, freshwater, riverine reaches with gravel bottoms. Current threats to habitat are from discharges, dredging, or disposal of materials into rivers, or related development activities involving estuarine and riverine mudflats. Shortnose sturgeon occurs in most major river systems along the eastern seaboard of the United States. However, data are lacking for the rivers of North Carolina (NMFS and USFWS, 1998).

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)

Atlantic sturgeon is an estuarine-dependent fish that can reach a length of 14 feet and weight of 800 pounds. Their coloration is bluish-black to olive brown dorsally, paler sides, and a white belly. Dermal scutes are arranged in five major rows. Atlantic sturgeon differ from shortnose sturgeon in larger body, smaller mouth, different mouth shape, and scutes. Atlantic sturgeon are benthic feeders, generally consuming crustaceans, worms, and mollusks. The fish are anadromous, spawning in freshwaters and migrating to estuarine or marine waters for the remainder of the year. The fish will travel from their natal rivers. Atlantic sturgeon generally inhabit estuarine or nearshore marine waters not exceeding 165 feet in depth, preferring gravel and sand substrates.

American eel (*Anguilla rostrata*)

The American eel has an elongated, snakelike body with a small, pointed head. The American eel has no pelvic fins, but has one long dorsal fin that extends more than half of the body. The dorsal fin is continuous with the caudal and anal fin. Coloration varies with age and ranges from yellow to olive-brown during the adult form. The adult males are dark brown and gray dorsally, with a silver to white ventral side. Adults reach lengths up to 5 feet (Page & Burr, 1991). The American eel is a catadromous species that spawn in the Atlantic Ocean and ascend stream and rivers in North and South America. The American eel is found in the Atlantic Ocean, Great Lakes, Mississippi River, the Gulf Basin, and south to South America. American eel lives in freshwater as an adult, usually in larger rivers or lakes, primarily swimming near the bottom in search of food. American eel hunts mainly at night and resides in crevices or other shelter to avoid light during the day, and often buries in substrate consisting of mud, sand, or gravel (Landau, 1992).

Carolina darter (*Etheostoma collis collis*)

The Carolina darter is a small fish that grows to only 2½ inches in length and is endemic to the Piedmont of Virginia and the Carolinas. It is typically found in pools and very slow runs of small upland creeks and rivulets. Habitats are often against the banks or in backwater areas over beds of sand, mud, or rubble substrate covered by silt or detritus. It forages on microcrustaceans and small insect larvae. Spawning occurs in early spring and peaks at the end of March. The fish inhabits small streams from the Roanoke River basin in Virginia to the Santee River system in South Carolina.

Bald eagle (*Haliaeetus leucocephalus*)

The mature bald eagle (usually more than 4 years of age) can be identified by its large white head and short white tail. The body plumage is dark brown to chocolate-brown in color. Bald eagles can easily be distinguished from other birds by their flat wing soar. They are primarily associated with large bodies of water where food is plentiful. Eagle nests are found in proximity to water (usually within 0.5 mile) with a clear flight path to the water, in the largest living tree in an area with an open view of the surrounding land. Human disturbance may cause nest abandonment. The breeding season for the bald eagle begins in December and January. Fish are the major food source, although forage items include coots, herons, wounded ducks, and carrion.

The bald eagle was delisted from the ESA on June 28, 2007. Populations were monitored for a period of five years, which ended on June 27, 2012, to ensure that delisting the species did not result in a decline. Bald eagles remain protected under two federal laws, the MBTA and the

BGPA. In North and South Carolina, the bald eagle is listed as threatened; however, state listing does not confer additional protection to the species.

Robust redhorse (*Moxostoma robustum*)

The robust redhorse is a 10- to 19-inch long fish, weighing up to 10 pounds with a stout body and thick lips. The caudal and dorsal fins are red or slate-colored, and other fins are cream or yellow to red. Preferred habitat for this fish is medium to large creeks and rivers, usually in deep and fast water, over gravel, rock, and boulders. Clean, silt-free, gravel beds in shallow waters are required for breeding, which occurs during May. The name *Moxostoma robustum* has been misapplied in the past to the smallfin redhorse, which is now identified as the brassy jumprock in the genus *Scartomyzon*. Small populations (one or two fishes) of the true robust redhorse have been found in the Pee Dee River in North Carolina and the Savannah River downstream of Augusta, Georgia. A large population, and potentially the only breeding population, of the robust redhorse is found in the Oconee River south of Milledgeville, Georgia.

Carolina redhorse (*Moxostoma* sp. 2)

The Carolina redhorse is a species of freshwater ray-finned fish in the Catostomidae family. Species within the Catostomidae family have mouths located on the underside of the head, thick fleshy distensible lips, and paired fins attached low on the body (Rohde, Arndt, Lindquist, & Parnell, 1994). The Carolina redhorse is found in medium sized rivers with moderate gradient and prefers deep pool areas along shorelines that contain woody debris. The Carolina redhorse is only known to be present in the Pee Dee and Cape Fear River basins.

Northern long-eared bat (Myotis septentrionalis)

The northern long-eared bat is a medium-sized bat that is distinguished by its long ears. The bat is medium to dark brown on the back and tawny to pale brown on the underside. Its body is three to four inches long with a wingspan of nine to ten inches. Northern long-eared bats hibernate in caves and mines with high humidity, constant temperatures, and no air currents through the winter. Summer roosting occurs singly or in colonies under bark, in cavities, or in crevices of live or dead trees. Males and nonreproductive females may also roost in manmade structures, like barns and sheds, or in caves and mines. The northern long-eared bat is known to inhabit much of the eastern and north-central United States and Canada.

Red-cockaded woodpecker (*Picoides borealis*)

The red-cockaded woodpecker (RCW) is a medium-sized bird with entirely black and white plumage, except for small red streaks on the nape of the male. The back of the RCW is striped, and the bird has a large white cheek patch surrounded by a black cap, nape, and throat. This woodpecker's diet is composed mainly of insects, including ants, beetles, wood-boring insects, caterpillars, and corn earworms, if available. The RCW lays its eggs in April, May, and June; the eggs hatch approximately 38 days later.

The RCW is found in the southeastern United States. It is unique among woodpeckers because it nests exclusively in living pine trees. The RCW uses open, old-growth stands of southern pines, particularly longleaf pine, for foraging and nesting habitat. Slash, pond, or loblolly pines will also be utilized if longleaf is not available. The preferred forested stand contains at least 50 percent pine and lacks a thick understory. These birds usually excavate nests in pines greater than 60 years old and contiguous with pine stands at least 30 years of age. Living pines infected with red-heart disease (*Formes pini*) are often selected for cavity excavation because the inner heartwood is usually weakened. Cavities are located from 12 to 100 feet above ground level and below live branches. These trees may be identified by candles, large encrustations of running sap that surrounds the tree. Clusters consist of one to many of these candle trees. The foraging range of the red-cockaded woodpecker may extend 500 acres and must be contiguous with suitable nesting sites.

4.15.2.2 INVERTEBRATES

Brook floater (*Alasmidonta varicosa*)

The brook floater is a freshwater mussel that has a kidney-shaped shell, an abruptly curved anterior margin, and a straight to slightly concave ventral margin. The shell of the brook floater is firm but not thick and contains numerous short, low corrugations or ridges on the posterior slope that tend to be oriented radially. Adult brook floaters are essentially sessile, although passive movement downstream may occur. The brook floater typically occurs in riffles and rapids of creeks and small rivers among rock in gravel substrates and in sandy shoals.

Atlantic pigtoe (*Fusconaia masoni*)

The Atlantic pigtoe is a freshwater mussel with a shell that reaches a length of 2.3 inches. The mussel has a medium, rhomboidal shaped shell that has a distinctive, angular posterior ridge. The periostracum is yellowish brown to greenish brown, and the nacre color ranges from iridescent blue or white to salmon. The adults are essentially sessile. Some passive movement downstream may occur. The Atlantic pigtoe inhabits relatively fast waters with high quality riverine/large creek habitat. The Atlantic pigtoe is typically found in headwater or rural watersheds in sand or gravel substrates below riffles.

Yellow lampmussel (*Lampsilis cariosa*)

The yellow lampmussel is a bright yellow, medium-sized freshwater mussel with an inflated shell and smooth periostracum with rays that are restricted to the posterior slope, if present. The shell of the yellow lampmussel is heavy with well-developed dentition. The adults of the yellow lampmussel are essentially sessile, although some passive movement downstream may occur. The yellow lampmussel is typically found in medium to large streams and rivers in areas with good current and in areas underlain by sand, silt, cobble, and gravel.

Carolina heelsplitter (*Lasmigona decorata*)

The Carolina heelsplitter is a relatively large, freshwater mussel endemic to several river drainages in North and South Carolina. The shells are ovate to trapezoidal in shape, up to 4½ inches in length and 1½ inches in width. The outer surface is greenish brown to dark brown with faint darker rays. The interior nacre is pearly to bluish white, grading to orange or orange mottled in the area of the umbo. The species is reported to inhabit small to large streams and rivers. They are usually found near stable, well-shaded stream banks in muddy sand, muddy gravel, or mixed sand and gravel. The current range is a very fragmented, relict distribution within the known historic range. Historically, the range included the Catawba and Pee Dee systems in North Carolina, and the Pee Dee, Savannah and possibly the Saluda River systems in South Carolina. Only four small populations are currently known to exist: two in Union County, North Carolina and two in South Carolina.

Savannah lilliput (*Toxolasma pullus*)

The savannah lilliput is a small freshwater mussel with an oval or elliptical shell and a double posterior ridge. The ridge is usually angular but may be broadly rounded. Females have a broader, more truncated posterior end than males of the species. The outer surface of the shell is usually blackish but may be brownish, greenish, or olive with very fine, obscure green rays. The inner surface of the shell is bluish white with pink to purplish iridescence at the posterior end. This mussel has been recorded from the Neuse River in North Carolina south to the Altamaha River in Georgia. The savannah lilliput is found in shallow water along the banks of rivers, streams, ponds, and lakes. The savannah lilliput moves up and down the banks as the water levels fluctuate.

Carolina creekshell (*Villosa vaughaniana*)

The Carolina creekshell is a freshwater mussel for which the shell morphology can be used to determine gender. The male shell is elliptical and approximately 2.4 inches in length, and the female shell is ovate and approximately 2.2 inches in length. Male Carolina creekshells have a gently curved ventral margin, and the female has a distinct posterior basal swelling and a straight ventral margin. The outer shell of the Carolina creekshell is moderately shiny and greenish yellow to dark brownish yellow with numerous continuous green rays. The inner surface of the shell of the Carolina creekshell is shiny iridescent white or bluish white. The anterior margin of the shell is rounded in both sexes, and the posterior end is pointed about two-thirds of the way from the ventral margin. The Carolina creekshell is endemic to North and South Carolina, is found in mud or sand near stream banks, and is occasionally found in gravelly sand in the main channel of streams and medium rivers.

4.15.2.3 VASCULAR PLANTS

Little amphianthus (*Amphianthus pusillus*)

Little amphianthus or pool-sprite is a tiny, annual, emergent plant endemic to ephemeral pools on granite flatrock outcrops. The submerged portion of the plant consists of lanceolate, less than 0.5-inch long leaves, arranged in a basal rosette. The emergent leaves are ovate, 0.16 to 0.32 inches long, and arranged as an opposite pair at the end of long, delicate stems. The tiny (0.16-0.2 inch diameter), white to pale violet flowers are borne in the axils of both submerged and emergent leaves. The flowers exist from March through April. This species is known from only Alabama, Georgia and South Carolina. The habitat, as previously mentioned, consists of ephemeral pools on granite flatrock outcrops. Most of these pools are 5.4 to 10.8 square feet in diameter, ranging up to 108 square feet. These depressions are less than one foot in depth and usually contain soil at least one inch deep. They are generally dry much of the summer, except during rainy periods.

Tall larkspur (*Delphinium exaltatum*)

Tall larkspur is an herbaceous perennial that grows to a height of four to six feet. The plant is characterized by loose, terminal racemes of gentian blue flowers that bloom in summer. Individual flowers are complex and asymmetrical, with one of the five sepals being spurred into a distinctive prong. Leaves are deep green in color with three to five lobes. Tall larkspur grows in sunny to partially shady areas with fertile, well-drained, rocky limestone soils that have moderate moisture.

Smooth coneflower (*Echinacea laevigata*)

Smooth coneflower is a rhizomatous perennial herb of the Aster family. These robust plants can grow to five feet tall. They have large basal leaves (up to nine inches long and three inches wide) that are sparse and reduced upwards. The flower heads are solitary on a stem and consist of long, narrow, drooping, pale to deep pink ray flowers and dark purple-brown disk flowers on a conic receptacle. Flowering occurs from May to July. Historically, this plant ranged from Pennsylvania south through Alabama and Arkansas. Currently, it is extant in only four states (Virginia, North and South Carolina, and Georgia) that comprise the central portion of the historic range. This plant is shade intolerant, preferring open sunny habitats maintained by periodic disturbance to reduce the shade and competition of woody species. These habitats include open woods, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and cleared rights-of-way. It is usually found on magnesium- or calcium-rich soils associated with limestone, gabbro, diabase and marble rocks.

Dwarf aster (*Eurybia mirabilis*)

Dwarf aster is a perennial plant with coarse, short, woody rhizomes (Dwarf Aster, 2014). Stems are erect and simple with stiff hairs that are proximally sparse and distally dense. The dwarf aster has dense hairs on both surfaces of the basal and cauline leaves. Flowers are borne in three to ten loose, flat-topped, corymbiform arrays. Ray flowers are white to lavender, and disc flowers are pale yellow with a purplish tinge on the lobes. The dwarf aster inhabits deciduous or mixed deciduous woods on slopes or alluvial plains, usually on basic or circumneutral soils.

Schweinitz's sunflower (*Helianthus schweinitzii*)

Schweinitz's sunflower is perennial aster arising from a cluster of carrot-like tuberous roots. Plants at maturity may stand as tall as 10 feet and support 100 or more two-inch wide flowers. The yellow ray and disc flowers appear from late August through October. Leaves are opposite on the lower stem changing to alternate above, narrow, and pubescent on both surfaces (a distinctive, diagnostic feature). The upper leaf surface is scabrous. Schweinitz's sunflower occurred historically in Piedmont prairies in the Charlotte geologic belt of North and South Carolina. Only 90 populations are presently known to exist, and all occur within 60 miles of Charlotte, North Carolina. Currently, most populations occur in dry, open, artificial habitats, such as roadsides, utility rights-of-way, and edges of pastures (Weakley, 1993). These remaining populations have been observed growing on Enon, Iredell, and Mecklenburg soils.

Shoals spiderlily (*Hymenocallis coronaria*)

Shoals spiderlily is an aquatic, perennial flowering plant (LWF, 2011). It grows to a height of up to three feet from a bulb that lodges between rocks in the shoals. This spiderlily blooms from early May to late June, and each flower blooms for one day. The shoals spiderlily requires swift, shallow water current and direct sunlight to flourish.

Black-spored quillwort (*Isoetes melanospora*)

Black-spored quillwort is a small perennial grass-like pteridophyte occurring is the Piedmont region of Georgia and in South Carolina. Black-spored quillwort is an inconspicuous plant, generally under 8 cm tall. The roots are of a single form and evenly forked. The leaves arise spirally from a bulbous base and are bunched, linear, slender-tipped and resemble quills. They are 0.4 to 1.2 inches (rarely to 2.4 inches) long, less than 0.1-inch wide, and pale at the base grading to green above. This quillwort is restricted to shallow, flat-bottomed depressions on granite outcrops, where water collects as pools after rain. These depressions are generally less than one foot in depth, are entirely rock-rimmed, and usually contain soils at least one inch deep. These pools may be dry much of the summer, except during rainy periods.

Virginia quillwort (*Isoetes virginica*)

Virginia quillwort is a grass-like pteridophyte. Leaves have four longitudinal air chambers and irregular transverse chambers, giving a segmented appearance. The base of each leaf has a large cavity with a solitary sporangium containing numerous female megaspores (in the oldest, outermost leaves) or male microspores (in the younger, middle leaves). Species of *Isoetes* are distinguished by the pattern of ridges, tubercles, and reticulations on the megaspores (Cobb, 1963; Ahles, Radford, & Bell, 1968). Virginia quillwort is found in upland depressional swamp forests over clayey soils in North and South Carolina and Virginia.

Butternut (*Juglans cinerea*)

This tree is part of the walnut family, Juglandaceae, and is often called white walnut. It is a small to medium sized tree, growing to a height of 30 to 50 feet, with alternate, compound leaves that can reach five feet in length. All portions of the leaf and buds are conspicuously hairy and sometimes sticky. The bark is dark grey, deeply furrowed with wide, smooth, flat-topped ridges. This species is most commonly found along stream banks, in floodplains and in rich, mesic bottomlands and hillsides. This tree is threatened by the butternut canker, which is thought to be caused by an Asian fungus that was introduced to the United States in the 1950s.

Bog spicebush (*Lindera subcoriacea*)

Bog spicebush is a multi-stemmed, deciduous shrub. It produces tiny, bright yellow-green flowers in March, and the vivid-red berries are visible in the late fall. Like all the species in the Laurel family, bog spicebush is aromatic. The crushed leaves and twigs smell like lemon furniture polish. This plant grows primarily in wet sandy soils of the southeastern Coastal Plain.

Prairie birdsfoot-trefoil (*Lotus unifoliolatus* var. *helleri*)

The prairie birdsfoot-trefoil is a variety of American birdsfoot-trefoil. Prairie birdsfoot-trefoil is an annual forb that grows from eight to 32 inches in height and has alternate, nearly sessile, trifoliolate leaves. The leaflets are lanceolate or ovate-lanceolate and 0.4 to one inch long. Branches and stems are glabrous to moderately villous. Prairie birdsfoot-trefoil flowers from June through August and has one to two flowers on stalks in the upper leaf axils. Flower color may be white, yellow, red, rose, or purple. Habitat for the prairie birdsfoot-trefoil consists of dry woodlands, prairie plains, rocky hillsides, stream valleys, roadsides, and open or cleared areas.

Flatrock panic grass (*Panicum lithophilum*)

Flatrock panic grass is an annual graminoid that inhabits soil on granitic flatrocks. The plant's simple leaves are alternate in arrangement with parallel venation. The species is native to the eastern United States and Canada. No further information describing the plant is available for inclusion in this document.

Michaux's sumac (*Rhus michauxii*)

Michaux's sumac is a densely pubescent, dioecious, rhizomatous shrub. It has a low stature, growing up to 2 feet high. The leaves are compound with 7 to 13, serrately edged, hairy leaflets on a hairy rachis. Male or female flowers are found in the dense terminal panicles typical of the genus. Flowers bloom in June and seed heads are visible from August to September. Due to habitat fragmentation, colonies of this dioecious plant, when they occur, often are only one large clone representing a single sex. Unfortunately, this quality is a serious limitation to the reproduction and repopulation of this species. Michaux's sumac grows in dry, open woodlands and forest edges in scattered locations from Virginia to Georgia. In the Piedmont region, it is usually associated with acidic to subacidic clay loam or sandy clay loam soils over granite and occasionally found on clayey soils derived from mafic rock such as Carolina slate or gabbro.

Yadkin River goldenrod (*Solidago plumosa*)

The Yadkin River goldenrod is a perennial plant that is native to North Carolina. The leaves are simple and arranged alternately; they are oblanceolate, serrate, and petiolate. Many, yellow, star-shaped flowers are produced in panicles in August and September. The plant grows to a height ranging from 16 to 40 inches. The goldenrod prefers a sunny location on moderately moist, sandy loam or sandy clay soil.

Georgia aster (*Symphyotrichum georgianum*)

Georgia aster is a perennial dicot that can reach 39 inches in height. The leaves of the Georgia aster grow to 3 inches in length and are alternate, elliptic, and entire. The flowers are violet, have numerous parts, and are up to 2 inches wide. The Georgia aster blooms from early fall through mid-fall. Habitat for the Georgia aster consists of dry open areas. This species is often found on disturbed sites.

Riparian vervain (*Verbena riparia*)

Riparian vervain is an annual forb/herb species that is native to North Carolina and Virginia. Habitat for the plant is described as rich thickets and stream banks. Little information is available describing the species; no additional information is available for inclusion in the document.

4.16 Environmental Justice

Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (1994) requires the applicant to determine the impacts that the project will have on minority and low-income populations. The EPA defines Environmental Justice as equitable treatment and involvement of all people regardless of race or income. Guidance provided by DENR states that the minority and low-income populations must be identified and disparities in the provision and location of sewer treatment and transport facilities between the general population and the minority and/or low-income populations documented.

The Environmental Justice assessment for the project was performed based on data from the 2010 Census for minority populations and from the 2011 American Community Survey, reported by the U.S. Census Bureau, for income data. The minority population assessment for the project area includes data from fourteen block groups in seven census tracts (USCB, 2010). The Minority Demographic Study Area (MDSA) consists of the 2010 Census block groups in which the footprint of the project alternatives is located. Figure 4-11 illustrates the MDSA, the block groups therein, and the census tracts associated therewith. The low-income population assessment considered the same census tracts (USCB, 2010) as the minority population analysis, and the Income Demographic Study Area (IDSA) consists of the census tracts in which the footprint of the project alternatives is located. Figure 4-12 illustrates the IDSA and the census tracts thereof.

4.16.1 Minority Populations

The EPA defines minorities as individuals of American Indian, Alaskan Native, Asian or Pacific Islander, Black, or Hispanic descent. Demographic information for the five project counties was obtained from the U.S. Census Bureau's 2010 Census and analyzed on a block group level. Table 4-18 provides the population demographics by race for each alternative. Figure 4-13 provides an illustration of the percentage of minority populations within each block group of the MDSA.

The 2010 Census determined that the minority population percentages of each of the five project counties are 53 percent in Anson, 28 percent in Lancaster, 45 percent in Mecklenburg, 16 percent in Stanly, and 21 percent in Union. The states of North and South Carolina have minority populations of 32 and 34 percent, respectively. The minority population percentages in the block groups associated with each of the proposed alternatives are compared against the aforementioned statewide percentages to determine if the alternative may disproportionately impact a minority population. The data for each block group in the MDSA is provided in Table 4-18.

Table 4-18 Minority Populations for Each Alternative Based on 2010 U.S. Census Block Groups

Alternative	Census Tract	Block Group	Total Population	White Only	Black or African American Only	American Indian or Alaskan Native Only	Asian Only	Native Hawaiian or Other Pacific Islander Only	Other Single Race	Two or More Races	Hispanic or Latino	Total Minority Population	Percent Minority Population
1A	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	9309	3	1,691	1,449	161	4	23	0	39	15	62	242	14%
	9309	4	790	659	66	3	1	0	52	9	65	131	17%
	9310	2	969	874	3	1	72	0	0	19	12	95	10%
	9310	3	1,492	1,342	116	4	18	0	9	3	14	150	10%
	9311	2	1,472	978	439	6	12	0	13	24	22	494	34%
	9311	3	1,045	788	179	7	4	0	59	8	77	257	25%
	9311	4	724	517	124	3	11	0	60	9	71	207	29%
	9311	5	1,523	1,311	142	7	2	0	48	13	52	212	14%
	Alternative Total		**13,606**	**11,508**	**1,376**	**48**	**154**	**1**	**369**	**150**	**502**	**2,098**	**15%**
1B	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	9307	3	1,310	1,284	8	1	1	0	6	10	18	26	2%
	9309	1	832	803	11	1	2	0	10	5	23	29	3%
	9309	2	2,476	2,252	41	14	9	0	128	32	170	224	9%
	9309	3	1,691	1,449	161	4	23	0	39	15	62	242	14%
	9309	4	790	659	66	3	1	0	52	9	65	131	17%
	9310	1	1,027	954	19	5	13	0	29	7	36	73	7%
	9310	2	969	874	3	1	72	0	0	19	12	95	10%
	9310	3	1,492	1,342	116	4	18	0	9	3	14	150	10%
	9311	2	1,472	978	439	6	12	0	13	24	22	494	34%
	9311	3	1,045	788	179	7	4	0	59	8	77	257	25%
	9311	4	724	517	124	3	11	0	60	9	71	207	29%

Alternative	Census Tract	Block Group	Total Population	White Only	Black or African American Only	American Indian or Alaskan Native Only	Asian Only	Native Hawaiian or Other Pacific Islander Only	Other Single Race	Two or More Races	Hispanic or Latino	Total Minority Population	Percent Minority Population
	9311	5	1,523	1,311	142	7	2	0	48	13	52	212	14%
	Alternative Total		**19,251**	**16,801**	**1,455**	**69**	**179**	**1**	**542**	**204**	**749**	**2,450**	**13%**
2A	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	9301.02	1	1,321	1,102	159	0	43	0	12	5	20	219	17%
	9301.02	2	1,144	883	215	9	22	0	6	9	17	261	23%
	9301.02	3	1,339	1,112	199	5	10	0	2	11	15	227	17%
	9303	2	1,044	897	64	3	54	0	3	23	21	147	14%
	9303	3	1,222	1,079	77	2	34	0	11	19	24	143	12%
	9305	1	757	585	91	2	41	0	28	10	37	172	23%
	9305	3	1,069	779	196	7	49	0	18	20	67	290	27%
	9307	3	1,310	1,284	8	1	1	0	6	10	18	26	2%
	9309	1	832	803	11	1	2	0	10	5	23	29	3%
	9309	2	2,476	2,252	41	14	9	0	128	32	170	224	9%
	9309	3	1,691	1,449	161	4	23	0	39	15	62	242	14%
	9309	4	790	659	66	3	1	0	52	9	65	131	17%
	9312.02	1	1,541	1,397	47	2	45	0	29	21	59	144	9%
	9312.02	2	1,007	774	110	0	45	0	52	26	78	233	23%
	9312.02	3	669	547	59	3	44	0	11	5	25	122	18%
	Alternative Total		**22,112**	**19,192**	**1,650**	**69**	**434**	**1**	**496**	**270**	**828**	**2,920**	**13%**
2B	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	9301.01	1	1,216	1,104	52	3	27	0	11	19	32	112	9%
	9301.01	2	1,190	1,000	100	7	59	0	7	17	11	190	16%
	9301.02	1	1,321	1,102	159	0	43	0	12	5	20	219	17%

Alternative	Census Tract	Block Group	Total Population	White Only	Black or African American Only	American Indian or Alaskan Native Only	Asian Only	Native Hawaiian or Other Pacific Islander Only	Other Single Race	Two or More Races	Hispanic or Latino	Total Minority Population	Percent Minority Population
	9301.02	2	1,144	883	215	9	22	0	6	9	17	261	23%
	9301.02	3	1,339	1,112	199	5	10	0	2	11	15	227	17%
	9303	2	1,044	897	64	3	54	0	3	23	21	147	14%
	9303	3	1,222	1,079	77	2	34	0	11	19	24	143	12%
	9305	1	757	585	91	2	41	0	28	10	37	172	23%
	9305	2	1,762	1,551	91	7	58	0	25	30	32	211	12%
	9305	3	1,069	779	196	7	49	0	18	20	67	290	27%
	9307	3	1,310	1,284	8	1	1	0	6	10	18	26	2%
	9309	1	832	803	11	1	2	0	10	5	23	29	3%
	9309	2	2,476	2,252	41	14	9	0	128	32	170	224	9%
	9309	3	1,691	1,449	161	4	23	0	39	15	62	242	14%
	9309	4	790	659	66	3	1	0	52	9	65	131	17%
	9312.02	1	1,541	1,397	47	2	45	0	29	21	59	144	9%
	9312.02	2	1,007	774	110	0	45	0	52	26	78	233	23%
	9312.02	3	669	547	59	3	44	0	11	5	25	122	18%
	Alternative Total		**26,280**	**22,847**	**1,893**	**86**	**578**	**1**	**539**	**336**	**903**	**3,433**	**13%**
3A	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	9201	1	719	507	174	17	4	0	1	16	6	212	29%
	9201	3	1,357	395	928	1	4	0	11	18	22	962	71%
	9202	1	1,738	977	676	10	43	0	23	9	36	761	44%
	9203	1	1,467	1,118	288	6	23	0	21	11	30	349	24%
	9204	1	932	343	545	10	2	0	20	12	28	589	63%
	9204	2	931	246	662	2	6	0	14	1	15	685	74%
	Alternative Total		**11,044**	**7,176**	**3,419**	**59**	**93**	**1**	**179**	**117**	**264**	**3,868**	**35%**

Alternative	Census Tract	Block Group	Total Population	White Only	Black or African American Only	American Indian or Alaskan Native Only	Asian Only	Native Hawaiian or Other Pacific Islander Only	Other Single Race	Two or More Races	Hispanic or Latino	Total Minority Population	Percent Minority Population
3B	208	1	710	539	133	0	1	0	24	13	39	171	24%
	208	4	1,558	849	601	14	4	0	69	21	172	709	46%
	9201	1	719	507	174	17	4	0	1	16	6	212	29%
	9201	2	1,335	637	660	9	1	0	0	28	8	698	52%
	9201	3	1,357	395	928	1	4	0	11	18	22	962	71%
	9203	2	1,633	792	777	14	11	0	3	36	18	841	52%
	9203	3	2,197	1,764	299	8	57	3	43	23	64	433	20%
	9203	4	2,881	1,339	1,403	46	18	1	68	6	289	1,542	54%
	9204	1	932	343	545	10	2	0	20	12	28	589	63%
	9204	2	931	246	662	2	6	0	14	1	15	685	74%
	9204	3	1,169	202	952	2	1	0	3	9	11	967	83%
	9205	1	1,100	461	611	5	2	0	2	19	7	639	58%
	9205	2	1,060	350	672	3	22	0	5	8	19	710	67%
	9205	4	1,508	687	740	2	33	0	9	37	18	821	54%
	9205	5	1,735	975	675	3	35	0	15	32	28	760	44%
	Alternative Total		**20,825**	**10,086**	**9,832**	**136**	**201**	**4**	**287**	**279**	**744**	**10,739**	**52%**
4	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	9202	1	1,738	977	676	10	43	0	23	9	36	761	44%
	9203	1	1,467	1,118	288	6	23	0	21	11	30	349	24%
	Alternative Total		**7,105**	**5,685**	**1,110**	**29**	**77**	**1**	**133**	**70**	**193**	**1,420**	**20%**
5	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	9309	3	1,691	1,449	161	4	23	0	39	15	62	242	14%
	Alternative Total		**5,591**	**5,039**	**307**	**17**	**34**	**1**	**128**	**65**	**189**	**552**	**10%**

Alternative	Census Tract	Block Group	Total Population	White Only	Black or African American Only	American Indian or Alaskan Native Only	Asian Only	Native Hawaiian or Other Pacific Islander Only	Other Single Race	Two or More Races	Hispanic or Latino	Total Minority Population	Percent Minority Population
6	203.06	3	2,617	1,794	455	13	26	1	239	89	495	823	31%
	203.07	1	2,281	1,755	318	7	18	0	127	56	332	526	23%
	203.08	2	2,747	2,094	314	9	39	2	189	100	453	653	24%
	203.08	3	1,448	1,240	132	9	28	0	21	18	53	208	14%
	204.01	1	3,316	2,759	347	14	79	0	67	50	156	557	17%
	204.03	1	1,408	1,121	146	12	9	2	92	26	207	287	20%
	204.03	2	1,892	1,394	244	12	16	0	190	36	291	498	26%
	204.03	3	1,135	834	172	8	8	0	92	21	179	301	27%
	204.04	1	2,030	1,286	330	20	24	0	319	51	553	744	37%
	210.05	1	1,675	1,306	220	11	4	0	102	32	157	369	22%
	210.05	2	1,571	1,456	63	3	5	0	32	12	62	115	7%
	210.05	3	1,384	1,143	204	1	4	0	18	14	44	241	17%
	210.14	1	1,954	1,632	225	1	6	2	23	65	65	322	16%
	210.14	2	749	615	115	2	4	3	4	6	25	134	18%
	210.15	1	2,415	2,227	94	5	24	2	36	27	55	188	8%
	210.15	2	2,143	1,931	124	8	16	0	20	44	43	212	10%
	112.02	2	1,424	943	431	2	4	0	8	36	33	481	34%
	Alternative Total		**32,189**	**25,530**	**3,934**	**137**	**314**	**12**	**1,579**	**683**	**3,203**	**6,659**	**21%**
7	57.14	2	1,746	1,519	131	11	44	0	26	15	75	227	13%
	57.14	3	1,158	1,064	49	1	32	0	1	11	17	94	8%
	202.03	1	1,147	1,102	12	2	8	0	15	8	24	45	4%
	202.03	2	2,648	2,220	238	2	103	4	42	39	131	428	16%
	202.04	1	1,543	1,513	10	0	0	0	13	7	18	30	2%
	202.04	2	1,005	986	13	3	1	0	1	1	11	19	2%
	202.04	3	1,301	1,279	1	2	3	0	7	9	12	22	2%

Alternative	Census Tract	Block Group	Total Population	White Only	Black or African American Only	American Indian or Alaskan Native Only	Asian Only	Native Hawaiian or Other Pacific Islander Only	Other Single Race	Two or More Races	Hispanic or Latino	Total Minority Population	Percent Minority Population
	Alternative Total		**10,548**	**9,683**	**454**	**21**	**191**	**4**	**105**	**90**	**288**	**865**	**8%**
8	205.02	2	2,153	1,663	280	6	6	1	138	59	259	490	23%
	206.01	3	892	395	324	1	10	0	136	26	242	497	56%
	206.02	1	2,608	1,753	457	5	19	0	322	52	568	855	33%
	207.02	1	1,921	940	796	7	5	0	148	25	221	981	51%
	207.02	2	2,105	1,825	158	18	10	0	60	34	128	280	13%
	208	4	1,558	849	601	14	4	0	69	21	172	709	46%
	209.01	1	1,987	1,607	253	11	19	3	58	36	145	380	19%
	209.01	2	1,362	1,201	101	16	1	0	16	27	42	161	12%
	209.01	3	1,775	1,607	43	11	1	0	78	35	110	168	9%
	209.02	1	2,188	1,869	211	14	5	1	65	23	98	319	15%
	209.02	2	2,111	1,965	63	6	2	0	53	22	101	146	7%
	210.05	2	1,571	1,456	63	3	5	0	32	12	62	115	7%
	Alternative Total		**22,231**	**17,130**	**3,350**	**112**	**87**	**5**	**1,175**	**372**	**2,148**	**5,101**	**23%**
11	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	206.01	1	2,703	1,406	539	3	22	0	650	83	928	1,297	48%
	206.01	3	892	395	324	1	10	0	136	26	242	497	56%
	207.01	1	1,727	1,005	468	4	6	0	226	18	373	722	42%
	207.01	2	3,656	2,002	1,128	14	33	3	400	76	602	1,654	45%
	208	1	710	539	133	0	1	0	24	13	39	171	24%
	208	1	710	539	133	0	1	0	24	13	39	171	24%
	208	2	879	478	362	2	0	0	31	6	72	401	46%
	9302	2	1,974	1,694	144	3	107	1	10	15	28	280	14%
	9309	3	1,691	1,449	161	4	23	0	39	15	62	242	14%

Alternative	Census Tract	Block Group	Total Population	White Only	Black or African American Only	American Indian or Alaskan Native Only	Asian Only	Native Hawaiian or Other Pacific Islander Only	Other Single Race	Two or More Races	Hispanic or Latino	Total Minority Population	Percent Minority Population
	9309	4	790	659	66	3	1	0	52	9	65	131	17%
	9310	2	969	874	3	1	72	0	0	19	12	95	10%
	9310	3	1,492	1,342	116	4	18	0	9	3	14	150	10%
	9310	5	1,674	1,373	230	4	26	0	14	27	23	301	18%
	9311	1	990	950	33	0	3	0	2	2	6	40	4%
	9311	2	1,472	978	439	6	12	0	13	24	22	494	34%
	9311	3	1,045	788	179	7	4	0	59	8	77	257	25%
	9311	4	724	517	124	3	11	0	60	9	71	207	29%
	Alternative Total		**27,288**	**20,039**	**4,595**	**72**	**360**	**5**	**1,814**	**403**	**2,763**	**7,249**	**27%**
WTP A	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	Alternative Total		**3,900**	**3,590**	**146**	**13**	**11**	**1**	**89**	**50**	**127**	**310**	**8%**
WTP B	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	201	3	2,366	2,244	46	7	16	2	27	24	55	122	5%
	202.02	4	2,073	1,976	23	2	11	0	40	21	64	97	5%
	202.04	3	1,301	1,279	1	2	3	0	7	9	12	22	2%
	Alternative Total		**9,640**	**9,089**	**216**	**24**	**41**	**3**	**163**	**104**	**258**	**551**	**6%**
WTP C	201	1	1,805	1,664	70	8	2	1	33	27	51	141	8%
	201	2	2,095	1,926	76	5	9	0	56	23	76	169	8%
	201	3	2,366	2,244	46	7	16	2	27	24	55	122	5%
	Alternative Total		**6,266**	**5,834**	**192**	**20**	**27**	**3**	**116**	**74**	**182**	**432**	**7%**

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4.16.1.1 ALTERNATIVE 1A

The pump station, access roads, and pipe corridor associated with Alternative 1A traverses four U.S. census tracts and a total of ten block groups. Of these ten block groups, nine have minority populations below the North Carolina state average of 32 percent. Block group 2 of census track 9311 has an overall minority population 34 percent, which is two percent higher than the state average. The total minority population percentage in the block groups associated with the Alternative 1A infrastructure is 15 percent.

4.16.1.2 ALTERNATIVE 1B

The infrastructure associated with Alternative 1B crosses five census tracts and fourteen block groups. Of these fourteen block groups, only block group 2 of census tract 9311 has a minority population greater than the state average. The total minority population percentage in the block groups associated with Alternative 1B is 13 percent.

4.16.1.3 ALTERNATIVE 2A

The infrastructure associated with Alternative 2A travels through seven census tracts and seventeen block groups. The block groups associated with Alternative 2A all have minority population percentages that are below the state average. The total minority population percentage within the block groups associated with this alternative is 13 percent.

4.16.1.4 ALTERNATIVE 2B

There are twenty block groups and eight census tracts that are traversed by the infrastructure associated with Alternative 2B. No block groups associated with this alternative have a minority population that exceeds the state average. The total minority population percentage in the block groups associated with this alternative is 13 percent.

4.16.1.5 ALTERNATIVE 3A

The pump station, access roads, and pipe corridor associated with Alternative 3A traverses five U.S. census tracts and eight block groups. Of these eight block groups, four have minority populations above the state average. Block group 2 of census track 9204 has the highest percentage minority population in the group with an overall minority population of 74 percent, which is 42 percent higher than the state average. The total minority population percentage in the block groups associated with the Alternative 3A infrastructure is 35 percent.

4.16.1.6 ALTERNATIVE 3B

The infrastructure associated with Alternative 3B crosses five census tracts and fifteen block groups. Of these fifteen block groups, twelve have a minority population greater than the state average with percentages ranging from 44 to 83. The total minority population percentage in the block groups associated with Alternative 3B is 52 percent.

4.16.1.7 ALTERNATIVE 4

There are four block groups and three census tracts that are traversed by the infrastructure associated with Alternative 4. One block group associated with this alternative has a minority population that exceeds the state average, which is block group 1 of census tract 9202 with a minority percentage of 44. The total minority population percentage in the block groups associated with this alternative is 20 percent.

4.16.1.8 ALTERNATIVE 5

The infrastructure associated with Alternative 5 travels through two census tracts and three block groups. The block groups associated with Alternative 5 all have minority population percentages that are below the state average. The total minority population percentage within the block groups associated with this alternative is 10 percent.

4.16.1.9 ALTERNATIVE 6

There are seventeen block groups and ten census tracts that are traversed by the infrastructure associated with Alternative 6, including one block group in South Carolina. Only block group 1 of census tract 204.04 has a percent minority population greater than its state's average as minority populations represent 37 percent of the block group. The total minority population percentage in the block groups associated with this alternative is 21 percent.

4.16.1.10 ALTERNATIVE 7

The infrastructure associated with Alternative 7 crosses three census tracts and seven block groups. No block groups associated with this alternative have a minority population that exceeds the state average. The total minority population percentage in the block groups associated with Alternative 7 is 8 percent.

4.16.1.11 ALTERNATIVE 8

There are twelve block groups and eight census tracts that are traversed by the infrastructure associated with Alternative 8. Four block groups associated with this alternative have a minority population percentage that exceeds the state average. The total minority population percentage in the block groups associated with this alternative is 23 percent.

4.16.1.12 ALTERNATIVE 11

The infrastructure associated with Alternative 11 travels through eight census tracts and nineteen block groups. Six block groups associated with Alternative 11 have minority population percentages that are greater than the state average, ranging from 34 to 56 percent. The total minority population percentage within the block groups associated with this alternative is 27 percent.

4.16.1.13 ALTERNATIVE WTP A

The WTP A facility area is located in two block groups of one census tract. The population of both block groups is comprised of a lower percentage of minorities than the state as a whole. The total minority population in the two block groups represents 8 percent of the total population thereof.

4.16.1.14 ALTERNATIVE WTP B

The infrastructure associated with WTP B crosses three census tracts and five block groups. No block groups associated with this alternative have a minority population that exceeds the state average. The total minority population percentage in the block groups associated with Alternative WTP B is 6 percent.

4.16.1.15 ALTERNATIVE WTP C

There are three block groups and one census tract that are traversed by the infrastructure associated with Alternative WTP C. None of the block groups associated with this alternative have a minority population percentage that exceeds the state average. The total minority population percentage in the block groups associated with this alternative is 7 percent.

4.16.2 Low-Income Populations

Low-income is defined by the U.S. Health and Human Services poverty guidelines. The census poverty thresholds are similar to the U.S. Health and Human Services thresholds. For the purpose of this analysis, low-income populations were identified as populations below the poverty level as reported in the U.S. census data. Low-income population data was extracted from the American Community Survey data available from the U.S. Census Bureau for 2011 and is presented relative to the census tracts from the 2010 Census. The U.S. Census does not provide income data at the block group level. Therefore, the analysis of the population below the poverty level was performed relative to the census tracts in which the proposed project alternatives are designed.

Low-income populations comprise approximately 17.9 percent of the total population in North Carolina and 18.9 percent of the total population in South Carolina. The census tracts containing the proposed project elements are herein collectively referred to as the IDSA. The percentage of the population in the IDSA is compared against the statewide percentages in order to evaluate the possibility of a disproportionate impact on low-income individuals. Data relative to the number of people and the percent of the population with income below the poverty threshold in 2011 in each census tract of the IDSA is provided in Table 4-19. Figure 4-14 illustrates the percentage of low-income people in each census tract of the IDSA.

Table 4-19 Low-Income Populations For Each Alternative Based on Census Tract and U.S. Census Bureau Data

Alternative	Census Tract	Total Population	Population Below Poverty Level	% Below Poverty Level
1A	201	5,986	529	9%
	9309	6,105	680	11%
	9310	5,885	642	11%
	9311	4,924	820	17%
	Alternative Total	**22,900**	**2,671**	**12%**
1B	201	5,986	529	9%
	9307	4,267	379	9%
	9309	6,105	680	11%
	9310	5,885	642	11%
	9311	4,924	820	17%
	Alternative Total	**27,167**	**3,050**	**11%**

Alternative	Census Tract	Total Population	Population Below Poverty Level	% Below Poverty Level
2A	9312.02	3,309	341	10%
	201	5,986	529	9%
	9301.02	4,046	774	19%
	9303	3,493	309	9%
	9305	3,534	368	10%
	9307	4,267	379	9%
	9309	6,105	680	11%
	Alternative Total	**30,740**	**3,380**	**11%**
2B	9312.02	3,309	341	10%
	201	5,986	529	9%
	9301.01	3,570	333	9%
	9301.02	4,046	774	19%
	9303	3,493	309	9%
	9305	3,534	368	10%
	9307	4,267	379	9%
	9309	6,105	680	11%
	Alternative Total	**34,310**	**3,713**	**11%**
3A	201	5,986	529	9%
	9201	3,427	763	22%
	9202	2,061	691	34%
	9203	5,839	1,143	20%
	9204	3,183	559	18%
	Alternative Total	**20,496**	**3,685**	**18%**
3B	208	5,261	606	12%
	9201	3,427	763	22%
	9203	5,839	1,143	20%
	9204	3,183	559	18%
	9205	5,648	1,452	26%
	Alternative Total	**23,358**	**4,523**	**19%**
4	201	5,986	529	9%
	9202	2,061	691	34%
	9203	5,839	1,143	20%
	Alternative Total	**13,886**	**2,363**	**17%**
5	9309	6,105	680	11%
	201	5,986	529	9%
	Alternative Total	**12,091**	**1,209**	**10%**
6	203.06	6,124	254	4%
	203.07	6,290	246	4%
	203.08	5,096	195	4%
	204.01	6,105	879	14%

Alternative	Census Tract	Total Population	Population Below Poverty Level	% Below Poverty Level
	204.03	4,674	748	16%
	204.04	6,533	2,161	33%
	210.05	3,817	252	7%
	210.14	2,932	293	10%
	210.15	4,191	493	12%
	112.02	8,928	858	10%
	Alternative Total	**54,690**	**6,379**	**12%**
7	57.14	4,701	314	7%
	202.03	3,558	70	2%
	202.04	3,597	233	6%
	Alternative Total	**11,856**	**617**	**5%**
8	205.02	3,773	472	13%
	206.01	4,749	1,363	29%
	206.02	4,476	1,118	25%
	207.02	3,743	697	19%
	208	5,261	606	12%
	209.01	4,641	267	6%
	209.02	5,879	762	13%
	210.05	3,817	252	7%
	Alternative Total	**36,339**	**5,537**	**15%**
11	201	5,986	529	9%
	206.01	4,749	1,363	29%
	207.01	4,764	582	12%
	208	5,261	606	12%
	9302	3,149	512	16%
	9309	6,105	680	11%
	9310	5,885	642	11%
	9311	4,924	820	17%
	Alternative Total	**40,823**	**5,734**	**14%**
WTP A	201	5,986	529	9%
	Alternative Total	**5,986**	**529**	**9%**
WTP B	201	5,986	529	9%
	202.02	6,300	172	3%
	202.04	3,597	233	6%
	Alternative Total	**15,883**	**934**	**6%**
WTP C	201	5,986	529	9%
	Alternative Total	**5,986**	**529**	**9%**

4.16.2.1 ALTERNATIVE 1A

Four census tracts are traversed by the infrastructure that comprises Alternative 1A. None of these census tracts has a low-income population that is greater than that of the North Carolina state average, which is 17.9 percent. The overall low-income population in the Alternative 1A census tracts is 12 percent.

4.16.2.2 ALTERNATIVE 1B

The infrastructure associated with Alternative 1B traverses five census tracts. Each one of these census tracts has a low-income population percentage, which is below the state average. The census tracts associated with Alternative 1B have an overall low-income population percentage of 11 percent.

4.16.2.3 ALTERNATIVE 2A

Alternative 2A infrastructure passes through seven census tracts. Of these seven tracts, only census tract 9301.02, with a low-income population of 19 percent, has a higher low-income population percentage than the state average. When combined, the census tracts associated with Alternative 2A have an 11 percent low-income population.

4.16.2.4 ALTERNATIVE 2B

The infrastructure associated with Alternative 2B traverses eight census tracts. One of these census tracts has a low-income population percentage that is above the state average. The census tracts associated with Alternative 2B have an overall low-income population percentage of 11 percent.

4.16.2.5 ALTERNATIVE 3A

Alternative 3A infrastructure passes through five census tracts. Of these five tracts, four have low-income population percentages greater than the state average. Census tract 9202, with a low-income population of 34 percent, has the highest low-income population percentage of the census tracts associated with Alternative 3A. When combined, the census tracts associated with Alternative 3A have an 18 percent low-income population percentage.

4.16.2.6 ALTERNATIVE 3B

The infrastructure associated with Alternative 3B traverses five census tracts. Of these five tracts, four have low-income population percentages greater than the state average. Census tract 9205, with a low-income population of 26 percent, has the highest low-income population percentage of the census tracts associated with Alternative 3B. The census tracts associated with Alternative 3B have an overall low-income population percentage of 19 percent.

4.16.2.7 ALTERNATIVE 4

Three census tracts are traversed by the infrastructure that comprises Alternative 4. Two of these census tracts have a low-income population percentage that is greater than the state average, ranging from 20 to 34 percent. The overall low-income population in the Alternative 4 census tracts is 17 percent.

4.16.2.8 ALTERNATIVE 5

Alternative 5 infrastructure passes through two census tracts. Neither of these two tracts has a low-income population percentage above the state average. When combined, the census tracts associated with Alternative 5 have a 10 percent low-income population percentage.

4.16.2.9 ALTERNATIVE 6

Ten census tracts are traversed by the infrastructure that comprises Alternative 6. One of these census tracts has a low-income population that is greater than state average, with a low-income population representing 33 percent of the total. The overall low-income population in the Alternative 6 census tracts is 12 percent.

4.16.2.10 ALTERNATIVE 7

Alternative 7 infrastructure passes through three census tracts. Each one of these census tracts has a low-income population percentage below the state average. When combined, the census tracts associated with Alternative 7 have a 5 percent low-income population.

4.16.2.11 ALTERNATIVE 8

Eight census tracts are traversed by the infrastructure that comprises Alternative 8. Three of these census tracts have a low-income population that is greater than the state average and ranges from 19 to 29 percent. The overall low-income population in the Alternative 8 census tracts is 15 percent.

4.16.2.12 ALTERNATIVE 11

The infrastructure associated with Alternative 11 traverses eight census tracts. One of these census tracts has a low-income population percentage that is greater than the state average, representing 29 percent of the tract's total population. The census tracts associated with Alternative 11 have an overall low-income population percentage of 14 percent.

4.16.2.13 ALTERNATIVE WTP A

The infrastructure associated with the WTP A Alternative is located in a single census tract. The low-income population percentage of the census tract is lower than the state average. Nine percent of the population of the census tract has a household income below the poverty level.

4.16.2.14 WTP B

The infrastructure associated with the WTP B Alternative traverses three census tracts. None of these three census tracts has a low-income population percentage greater than the state average. The census tracts associated with the WTP B Alternative have an overall low-income population percentage of 6 percent.

4.16.2.15 WTP C

One census tract is traversed by the infrastructure that comprises the WTP C Alternative. This census tract has a low-income population percentage that is lower than the state average. The overall low-income population in the WTP C Alternative census tract is 9 percent.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1. Introduction

An assessment of the potential direct, indirect, and cumulative impacts that may result from the proposed project is provided in this section. Direct impacts are immediate impacts related to construction associated with the proposed project. Indirect impacts are the result of a specific activity that occurs later in time and are reasonably foreseeable. Cumulative effects result from the incremental impact of the proposed activity when added to other past, present, and reasonably foreseeable future activities regardless of the constituents originating from any other activity.

The duration of an impact is denoted in this EIS as temporary or permanent. Temporary impacts are those impacts that are not expected to persist more than one year following completion of construction activities associated with the proposed project. Permanent impacts are those impacts that are expected to last longer than one year after completion of construction and may not have a definite end.

The relative severity of an impact is denoted in this EIS as negligible, minor, moderate, or major. Negligible impacts are those impacts that may occur but may not be detectable. Minor impacts are those impacts that are measurable but are clearly not significant. Moderate impacts are impacts whose effects may require additional care, employment of best management practices (BMPs), application of precautionary measures to minimize adverse impacts, or have some uncertainty inherent in whether the effects forecast by a predictive model would occur. Major Significant impacts are defined by the Council on Environmental Quality regulations 40 CFR 1508.27 as requiring consideration of both context and intensity of the effect.

A detailed discussion of each of the project alternatives is provided in Section 3. Alternative 9 is located exclusively within areas currently in use as water treatment facilities. This alternative does not require new infrastructure or the use of land outside of the treatment facilities, so direct impacts to natural resources are not anticipated. As such, a discussion of direct impacts for Alternative 9 is not provided in this section. Alternative 10, direct potable reuse, is also not assessed in this section due to this alternative being eliminated from consideration on current regulatory framework.

With the exception of Alternatives 9 and 10, discussion of the affected environment for each alternative is provided in in this section. The easement locations and widths as well as the pump station and WTP site boundaries used for quantification of the project alternative impacts are within the accuracy of conceptual design. Revisions to portions of the easements are anticipated during the design and construction phases of the project to account for construction width required for installation of pipe at depth and relocation around infrastructure constraints, such as fiber optic lines. Slight modifications to the easement width and location of an alternative are not anticipated to have significant impact to the resources discussed herein. Any modifications to easement location and width during later phases of the project will take into account impacts to natural resources via the appropriate construction permits. As previously stated, the well field associated with Alternative 8 consists of 28,300 acres. Implementation of Alternative 8 will not require development of the entire 28,300 acre area; however, the location and size of the infrastructure associated with each individual well and the associated manifold system and infrastructure is not known at this time. Therefore, quantification of impacts associated with the well field for Alternative 8 is not provided herein.

5.2. Topography and Geology

5.2.1. Common Elements of Alternatives

Temporary and permanent direct impacts to topography and geology from construction of the proposed transmission line, raw water intake or discharge structure, pump station, access road, and WTP alternatives are expected to be minor. Installation of the transmission line will involve excavation of soils, placement of the pipe, and backfilling of the trenches to original grade and elevation. Installation of the proposed transmission line will not significantly modify the existing topography, as all areas disturbed for this purpose will be returned as nearly as possible to original grade and elevation. Stream crossings in the Goose Creek watershed proposed for Alternative 7 will be constructed using trenchless installation methods, in accordance with the Site-Specific Water Quality Management Plan for Goose Creek Watershed (GCWQMP) (NCDENR, 2009).

Construction of a pump station and construction or expansion of a WTP will require excavation of soils, concrete construction, installation of equipment, and final grading. Grading of small areas to accommodate the raw water intake, discharge structure, or access road portions of each alternative may be necessary. Minor indirect and cumulative impacts due to the anticipated growth and development in the service area are expected to occur.

5.2.2. Alternative 5

An approximately 200-foot long low-head dam associated with Alternative 5 will extend across the Rocky River upstream of NC 205. The low-head dam is anticipated to rise approximately 24 inches above ordinary high water. Construction of the low-head dam will have direct, permanent, minor impacts to topography (Table 5-1).

5.2.3. Alternative 8

Impacts to geology from construction and operation of Alternative 8 are anticipated. The purpose of the groundwater wells proposed under Alternative 8 will be to extract water from the fractured regolith crystalline rock aquifer. In order to install the well to the required depth, geology will be impacted. The impacts are expected to be direct, minor, and permanent.

5.2.4. No-Action Alternative

The No-Action Alternative includes no excavation, grading, or other disturbance of the existing land surface and will therefore not directly impact topography or geology. The anticipated growth and development is expected to occur even with implementation of the No-Action

Alternative. Minor indirect and cumulative impacts to topography and geology from future growth and development in the service area are expected to occur.

Table 5-1 Impacts to Topography per Alternative

Alternative	Temporary Impact Area, acres	Permanent Impact Area, acres
1A	551.9	0.1
1B	623.8	0.1
2A	758.5	0.1
2B	783.0	0.1
3A	709.6	0.1
3B	831.1	0.1 [1]
4	484.7	1.4
5	67.2	0.3
6	576.1	0.1 [1]
7	137.8	0.1
8 [2]	325.7	0.1 [1]
11	1,065.4	0.1
WTP A	----	----[1]
WTP B	167.4	----[1]
WTP C	149.3	----[1]

[1] Impacts do not include the WTPs as the layouts thereof have not yet been determined.
[2] The well field area is not included since the footprint of impact for the infrastructure will be significantly less than the study area.

5.3. Soils

5.3.1. Common Elements of Alternatives

Impacts to soils from construction activities associated with the proposed alternatives are anticipated to be direct, minor, adverse, and temporary. The impacts may result from land clearing, excavation and grading, and temporary construction access roads. Fuel, oil, and other emissions from construction vehicles may also cause minor, localized impacts. The construction-related effects will be minimized to the extent practicable via the implementation of an Erosion and Sediment Control Plan, which will be approved by DENR prior to the commencement of work.

Long-term, permanent impacts to soils will result from the above ground structures proposed for Alternatives 1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 8, 11, WTP A, WTP B, and WTP C (Table 5-2). The aboveground structures include the proposed pump stations, access roads, low-head dam, wells, and WTPs. The impacts will be confined to the footprint of the proposed structures and the immediately adjacent areas. Permanent impacts are expected to be direct, minor, and adverse. Minor indirect and cumulative impacts to soils from anticipated growth and development in the service area are expected to occur.

Table 5-2 Impacts to Soils per Alternative

Alternative	Temporary Impact Area, acres	Permanent Impact Area, acres
1A	551.9	0.1
1B	623.8	0.1
2A	758.5	0.1
2B	783.0	0.1
3A	709.6	0.1
3B	831.1	0.1 [1]
4	484.7	1.4
5	67.2	0.1
6	576.1	0.1 [1]
7	137.8	0.1
8 [2]	325.7	0.1 [1]
11	1,065.4	0.1
WTP A	----	----[1]
WTP B	167.4	----[1]
WTP C	149.3	----[1]

[1] Impacts do not include the WTPs as the layouts thereof have not yet been determined.
[2] The well field area is not included since the footprint of impact for the infrastructure will be significantly less than the study area.

5.3.2. No-Action Alternative

The No-Action Alternative includes no land disturbance activities and will therefore have no direct impact to soils. Growth and development in the service area is expected to occur even with implementation of the No-Action Alternative. Therefore, minor indirect and cumulative impacts to soils due to growth and development are anticipated to occur.

5.4. Land Use

5.4.1. Zoning

5.4.1.1. COMMON ELEMENTS TO ALL ALTERNATIVES

The current zoning of the project areas is primarily residential, commercial, industrial, and agricultural. Small areas of office and apartments, manufacturing, institutional, special use and conditional, public and semi-public lands, wooded and undeveloped areas, and parks, recreation, and open space districts comprise the remainder of the project areas. Utility easements do not require rezoning of the easement or of the parcel in which the easement occurs. The proposed areas for WTP sites are located in residential zoning districts. County-owned utilities and government services are permitted by right within all zones in Unionville and in unincorporated Union County. Therefore, no rezoning is required for implementation of the proposed project, regardless of which alternative is selected. As some areas in which project alternatives are located are not zoned, the acreage of the zoning within each alternative's footprint cannot be calculated. Minor indirect and cumulative impacts due to the anticipated growth and development in the service area are expected to occur regardless of the selected alternative.

5.4.1.2. NO-ACTION ALTERNATIVE

The No-Action Alternative will not involve the acquisition of easements or change to an existing tract of land. Current compliance by the County with existing zoning classifications and restrictions will not be altered by implementing the No-Action Alternative. Future development may result in an increased need for private wells to ensure access to drinking water, which may affect future compliance with zoning classifications and development intensities. Minor indirect and cumulative impacts due to the anticipated growth and development in the service area are expected to occur under the No-Action Alternative.

5.4.2. Land Use Plans

Land Use Plans or other similar planning documents have been developed and approved by several municipalities and counties in which a portion of the project is located. Anson, Lancaster, Stanly, and Union County along with the municipalities of Waxhaw, Mineral Springs, Wesley Chapel, Marvin, Weddington, Indian Trail, Stallings, Hemby Bridge, Lake Park, Fairview, Unionville, Wingate, Norwood, Ansonville, New London, Wadesboro, and Peachland all have adopted a land use planning framework. Growth in the project service area is expected to continue, and demand for water provision is anticipated to increase accordingly. The proposed project is consistent with the existing and long-term land uses detailed in the aforementioned land use plans.

5.4.3. Existing Land Use

In the transmission line corridor areas where existing land cover is wooded, the corridor will be converted to an herbaceous and/or scrub-shrub cover type during construction. Where feasible, removal of large trees at the edges of construction areas will be avoided. A portion of the easements will be maintained as permanent easements to allow for unobstructed access for routine inspection and maintenance. The width of the maintained easement will be reduced to the extent feasible. The remainder of the easements, the temporary construction areas, will be allowed to re-vegetate to a natural wooded community.

Cleared areas associated with the proposed WTP sites and pump stations will be minimized to the extent feasible. Removal of vegetation will be limited to the areas necessary to accommodate the construction of the proposed infrastructure. A cleared buffer around the proposed aboveground infrastructure will be maintained in perpetuity to allow for unobstructed access to the structures for routine inspection and maintenance. An unaltered buffer around the perimeter of the WTP sites will be protected to provide a natural screen between the WTP and existing residences, commercial properties, and adjacent agricultural lands.

Tree Protection Area fences and/or signage will be placed along the clearing limits of the project areas to avoid accidental removal of trees. To improve habitat for wildlife, woody debris from corridor clearing will be used to establish brush piles, and downed logs will be placed adjacent to the maintained areas, where feasible. Impacts are not anticipated to be significant.

Existing land use on impacted private property will be allowed to continue to the greatest extent practicable. In agricultural areas, current land usage will be impeded for a brief period to accommodate installation of the proposed transmission line. Upon completion of construction within each area, previous agricultural activities may resume. Impacts to agricultural areas will be direct, temporary, adverse, and negligible.

In areas that are developed for residential, commercial, institutional, or industrial purposes, temporary direct impacts are expected to occur during construction. The impacts are likely to involve driveway and entrance crossings and excavation of lawn areas. Use of the properties for the existing uses may be hindered temporarily during construction on the respective parcels.

5.4.3.1. COMMON ELEMENTS OF ALL ALTERNATIVES

The project alternatives require the acquisition of easements from private owners, commercial entities, NCDOT, and other utility providers. Streams and roadways will be traversed by each alternative's transmission line corridor. The land area required for acquisition varies by alternative. The pump station sites and access road corridors are principally located in previously disturbed or currently maintained areas. The access roads associated with Alternatives 1A, 1B, 2A, 3A, 3B, and 4 are situated entirely within the proposed transmission line corridor, and the access roads for Alternatives 2B and 5 are partially within the proposed transmission line corridor. It is assumed that all areas within the transmission line corridors have the potential for disturbance. It is anticipated that the maintained access corridor within the permanent easement will be a reduced to the extent feasible.

All project alternatives will require clearing of wooded/undeveloped land. The wooded/undeveloped land consists of areas adjacent to infrequently maintained areas including roadways and existing utility easements as well as areas adjacent to more regularly maintained areas such as residential, commercial, and agricultural properties. Wooded/undeveloped areas in the proposed project footprints range from large tracts of mature forest to narrow strips of trees between farm fields or developed properties. More than 50 percent of the pump station and access road footprints for Alternatives 2B, 3A, and 3B as well as WTPs B and D require conversion of wooded/undeveloped land to either maintained herbaceous or built-upon area. Due to existing development or land usage, less than 50 percent of the remaining project areas require conversion of the existing land cover from wooded/undeveloped to maintained.

Siting of the transmission line corridors and aboveground infrastructure was conducted with preference given to existing maintained corridors for the alignments, including roadsides and existing utility easements, and to existing pump station sites or otherwise disturbed sites for the proposed pump stations, respective access roads, and WTPs. Utilizing areas that are currently maintained reduces the land area that will be converted from wooded/undeveloped to herbaceous or scrub-shrub to accommodate the proposed infrastructure. Impacts to residential, commercial, institutional, and industrial land uses are expected to occur as a result of any of the build alternatives. Developed areas will be affected by increased use of existing infrastructure and facilities as well as a rise in development pressures. It is expected that development pressures will also affect agricultural lands in the project areas.

Table 5-3 provides a summary of temporary and permanent direct impacts to presently wooded/undeveloped lands for each alternative. Temporary and permanent impacts to land use during and after construction of the project alternatives will be localized, adverse, and moderate.

Minor, indirect and cumulative impacts to existing land use will result from the increased volume of available drinking water within the service area, which will support future growth and development. Minor, indirect and cumulative impacts to land use are also expected to occur in the form of further conversion of wooded/undeveloped and agricultural lands to residential, commercial, institutional and industrial lands for all alternatives.

5.4.3.2. COMMON ELEMENTS OF ALTERNATIVES 1A AND 1B

Alternatives 1A and 1B utilize portions of the existing water and overhead electric easements and require the acquisition of additional easements from private owners, commercial entities, and NCDOT. These alternatives will require crossing streams and roadways. Approximately 27 and 31 percent of the corridor for Alternatives 1A and 1B, respectively, are located in existing wooded/undeveloped areas that would be converted to utility easement. The pump station and access road for Alternatives 1A and 1B will be constructed within the currently maintained area associated with the existing Town of Norwood pump station. Direct impacts to land use from implementation of Alternatives 1A or 1B are anticipated to be temporary and permanent, adverse, and moderate.

5.4.3.3. COMMON ELEMENTS OF ALTERNATIVES 2A AND 2B

Alternatives 2A and 2B utilize portions of the existing water easements and will require the acquisition of additional easements from private owners, commercial entities, and NCDOT. These alternatives will require crossing streams and roadways. Approximately 22 and 20 percent of the water main corridors, respectively, are sited in wooded/undeveloped areas that would be converted to utility easement. While new easements will be necessary through the agricultural, residential, commercial, and institutional portions of the water main corridor, existing land uses will be allowed to continue post-construction. The pump station and access road for Alternative 2A will be constructed within the currently maintained area associated with the existing City of Albemarle pump station. The pump station and access road for Alternative 2B have been sited in a wooded/undeveloped area adjacent to the existing Tuckertown WTP pump station and access road. Temporary and permanent, adverse, moderate, direct impacts to land use will occur if Alternatives 2A or 2B are implemented.

5.4.3.4. ALTERNATIVE 3A

Alternative 3A utilizes portions of an existing overhead utility easement and requires the acquisition of additional easements from NCDOT as well as private property owners. Streams and roadways will be crossed by the water main corridor. Approximately 36 percent of the corridor's wooded/undeveloped areas would be converted to a utility easement. The proposed pump station and access road will be constructed in a wooded/undeveloped area abutting the existing Anson County emergency raw water intake and pump station. Moderate, adverse, temporary and permanent, direct impacts to wooded/undeveloped land use are anticipated to occur relative to implementation of Alternative 3A.

5.4.3.5. ALTERNATIVE 3B

Alternative 3B is primarily located adjacent to U.S. 74 and abuts existing utility easements. Additional easements may be required from other utilities, NCDOT, or private individuals and commercial entities. Streams and roadways will be crossed by the water main corridor.

Approximately 37 percent of the corridor consists of wooded/undeveloped lands, which would be converted to a utility easement. The pump station and access road locations are identical to Alternative 3A. The WTP D area will be modified from its current condition to accommodate construction of the proposed WTP, an area which is primarily wooded/undeveloped with some agricultural use and a small number of residences. Temporary and permanent, moderate, direct impacts to wooded/undeveloped land use are anticipated from Alternative 3B implementation.

5.4.3.6. ALTERNATIVE 4

Alternative 4 requires the acquisition of easements from NCDOT, private property owners, and commercial entities. Streams and roadways will be crossed by the water main corridor. Wooded/undeveloped lands converted to a utility easement represent approximately 35 percent of the Alternative 4 corridor. The pump station and access road are located on private property that is currently agricultural and wooded/undeveloped land. Direct, adverse impacts to land use from Alternative 4 are anticipated to be temporary and permanent, and moderate.

5.4.3.7. ALTERNATIVE 5

Alternative 5 is located adjacent to existing roadways and requires the acquisition of easements from NCDOT and private property owners along the water main corridor. Coordination with other utility providers who may have existing easements in the same location may be necessary, if applicable. Streams and roadways will be crossed by the water main corridor. Approximately 21 percent of the corridor is located in wooded/undeveloped areas and will be converted to a utility easement if Alternative 5 is implemented. The pump station, access road, and low-head dam are located adjacent to an NCDOT right-of-way (ROW) and may also require private property easements. The area of inundation associated with the low-head dam will be confined to within the existing river banks. No newly inundated areas are expected to develop as a result of the proposed dam. Therefore, no change in land use is expected to result from the water level rise associated with the operation of the proposed dam. Moderate, direct, adverse impacts that will be temporary and permanent are anticipated relative to implementation of Alternative 5.

5.4.3.8. ALTERNATIVE 6

Alternative 6 is located at the existing Catawba River WTP in Lancaster County, South Carolina and in South Carolina DOT and NCDOT ROWs. Easements from the respective DOTs will be required. Additional easements may be necessary from private property owners and commercial or institutional entities. Construction of the water main will require stream and roadway crossings. Wooded/undeveloped areas converted to utility easement comprise approximately 35 percent of the Alternative 6 corridor. The pump station and access road will be located within areas currently being operated and maintained as part of the Catawba River WTP. Temporary and permanent, moderate, direct impacts to land use are anticipated from implementation of Alternative 6.

5.4.3.9. ALTERNATIVE 7

Alternative 7 connects two existing water distribution networks and requires acquisition of easements from NCDOT. Additional easement acquisition may be necessary from private and commercial property owners along the water main corridor. Roadway and stream crossings will be necessary for the installation of the water main. The stream crossings located within the Goose Creek watershed will have restrictions on construction and land disturbing activities per the GCWQMP (NCDENR, 2009). The GCWQMP and the applicable restrictions are discussed in Section 6. Approximately 23 percent of the proposed Alternative 7 corridor is sited in wooded/undeveloped areas. Some of the wooded/undeveloped areas in the project area are protected under the GCWQMP and will not be permanently impacted. Direct, adverse impacts to land use from Alternative 7 are anticipated to be temporary and permanent, and moderate.

5.4.3.10. ALTERNATIVE 8

Alternative 8 includes the proposed groundwater well field, water main corridor connecting the well field to the proposed WTP D, and the WTP D site. Land use in the well field is a mix of agricultural and wooded/undeveloped. The network of wells and raw water mains for the well field system has not been determined; however, developed parcels would not be pursued as locations for groundwater wells. The water main corridor includes agricultural, residential, and undeveloped areas. Approximately 18 percent of the corridor is located in wooded/undeveloped areas. The WTP D area will be modified from its current condition, which is primarily wooded/undeveloped with some agricultural use and a small number of residences. Temporary and permanent, adverse, and direct impacts to land use from implementation of Alternative 8 are anticipated to be moderate.

5.4.3.11. ALTERNATIVE 11

Alternative 11 follows existing roads from the City of Monroe WWTP to Lake Tillery at the NC 27/NC 24 Bridge. Approximately 49 percent of the proposed transmission line corridor is located in developed areas, including NCDOT ROWs, residential parcels, institutional and commercial sites, and an industrial facility. Agricultural lands and forest areas comprise approximately 29 percent and 22 percent of the transmission line corridor, respectively. Construction of the transmission line will require stream and roadway crossings. Acquisition of utility easement will be required. The pump station required for the alternative will be located within the existing City of Monroe WWTP site. Direct, adverse impacts to land use from implementation of Alternative 11 are anticipated to be temporary and permanent, and moderate.

5.4.3.12. ALTERNATIVE WTP A

The WTP A area is used primarily for agricultural purposes, which represents approximately 80 percent of the area. Wooded/undeveloped and residential areas account for approximately 18 percent and 2 percent of the area, respectively. Conversion of agricultural and/or wooded/undeveloped lands to built-upon area and maintained herbaceous areas is anticipated to occur within a portion of the impact area of Alternative WTP A. Avoidance of the residences in the WTP A area is expected. Temporary and permanent, adverse, direct impacts to land use from Alternative WTP A are anticipated to be moderate.

5.4.3.13. ALTERNATIVE WTP B

The water main corridor associated with WTP B follows existing roadways. Developed and agricultural lands comprise approximately 73 percent of the corridor. Wooded/undeveloped areas cover the remaining 27 percent. The WTP area is approximately 67 percent agricultural, 30 percent wooded, and 3 percent residential. A portion of the area is proposed to be converted to built-upon land and maintained lawn areas. Direct impacts to land use from implementation of Alternative WTP B are anticipated to be temporary and permanent, adverse, and moderate.

5.4.3.14. ALTERNATIVE WTP C

The WTP C water main corridor follows existing roadways adjacent to wooded/undeveloped and agricultural lands. Wooded/undeveloped, agricultural, and developed areas each comprise approximately one-third of the corridor. A portion of the wooded/undeveloped and agricultural areas is proposed to be converted to a maintained utility easement. WTP C is approximately 25 percent residential, 20 percent wooded/undeveloped, and 55 percent agricultural land. A portion of the agricultural and wooded/undeveloped areas are proposed to be converted to built-upon land and maintained lawn. Avoidance of the residences is expected to be incorporated into the design of the facility. Adverse, direct impacts to land use anticipated to occur relative to Alternative WTP B will be temporary and permanent, and moderate.

Table 5-3 Presently Wooded/Undeveloped Area Impacts in Project Area

Project Component	Alternative(s)	Temporary Impact Area, acres	Permanent Impact Area, acres
Transmission line Corridor	1A	146.0	4.7
	1B	184.9	6.6
	2A	162.7	2.0
	2B	154.8	2.0
	3A	255.0	3.0
	3B	245.6	1.0
	4	161.4	4.5
	5	13.2	0.4
	6	201.8	1.5
	7	30.9	0.5
	8	15.9	0.1
	11	230.5	3.5
	WTP B	20.9	0.6
	WTP C	27.9	1.0
Pump Station	1A and 1B	<0.1	<0.1
	2A	<0.1	<0.1
	2B	<0.1	<0.1
	3A and 3B	<0.1	<0.1
	4	<0.1	<0.1
	5	<0.1	<0.1
Access Road [1]	2B	----	0.1
	3A and 3B	----	<0.1
	5	----	<0.1
Water Treatment Plant [2]	WTP A	----	----
	3B and 8 (WTP D)	----	----
	6 (Catawba River WTP)	----	----
	WTP B	----	----
	WTP C	----	----

[1] The areas provided for the access roads include only the portion of the access road footprint that is not located in the permanent easement portion of the pipe corridor.
[2] Impacts do not include the well field or WTPs as the layouts thereof have not yet been determined.

5.4.3.15. NO-ACTION ALTERNATIVE

The No-Action Alternative will not directly impact land use. Minor indirect and cumulative impacts due to the anticipated growth and development in the service area are expected to occur.

5.5. Public Lands and Scenic, Recreational, and State Natural Areas

5.5.1. Common Elements of All Alternatives

All of the transmission line corridors associated with the alternatives, except Alternatives 6, WTP B, and WTP C, traverse areas of parks, land managed for open space, or Significant Natural Heritage Areas (SNHA). All of the alternatives, except Alternative WTP A, have project components within streams or reservoirs. Table 5-4 provides a summary of the public lands and scenic, recreational, and state natural areas by alternative. Recreational bike routes are listed separately in Table 5-4, as quantification of the area impacted by the proposed alternatives is provided by length of bike route within the transmission line corridors versus acreage of impact. A permanent easement that allows unobstructed access to the transmission line for routine inspection and maintenance will be required in the corridors. Impacts associated with the permanent easement include conversion of forest to herbaceous and scrub-shrub land covers.

Moderate temporary impacts to recreational boating and fishing within the streams traversed by the transmission line corridors associated with the alternatives will occur during construction of the proposed project. Moderate, temporary impacts will also occur to the visitors of the parks, other open space, and public lands in the proposed transmission line corridors associated with the alternatives during construction activities. However, the resources will be restored to their full functionality upon completion of construction.

Negligible, permanent impact will occur to the future use or development in the transmission line corridors from development restrictions that will be imposed on the corridors such that routine inspection and maintenance of the corridor is not impeded. Permanent impacts to parks, open space, and public lands in the project areas or project vicinity are anticipated to be negligible. Moderate, permanent impacts to SNHAs, which vary slightly between the alternatives, will occur from construction of most of the transmission line corridors. Following construction, potential direct impacts to recreational use of the streams, parks, and bike routes will be limited to visual impacts due to the need to maintain a mowed permanent access corridor.

With the exception of the pump station and access road associated with Alternatives 3A and 3B, the pump stations and access roads associated with the project alternatives will not occur on public lands, in parks or recreation areas, or in SNHAs. Construction of the pump station and access road associated with Alternatives 3A and 3B will have a minor, permanent, adverse impact to approximately 0.5 and 0.8 acre of land within the Pee Dee River State Game Land, respectively.

Minor indirect and cumulative impacts to public lands and scenic, recreational, and state natural areas are anticipated to occur from future growth in the service area. Growth is anticipated to occur in the service area regardless of implementation of the proposed project. Minor indirect and cumulative impacts to the previously mentioned resources associated with the project areas of all alternatives are anticipated to include an increase in public use of parks, greenways, and other public lands in the project area as the population grows.

Table 5-4 Public Lands and Scenic, Recreational, and State Natural Areas

Alternative	Bike Routes, miles		Parks and Open Space, acres		Other Public Lands, acres		Significant Natural Heritage Areas, acres	
	Temporary Impacts	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	Permanent Impacts
Alternative 1A	5.3	----	----	----	----	----	7.2	----
Alternative 1B	0.3	----	0.9	----	----	----	5.6	----
Alternative 2A	14.0	----	----	----	----	----	5.6	----
Alternative 2B	14.0	----	----	----	----	----	9.4	----
Alternative 3A	----	----	----	----	5.5	0.5	41.0	----
Alternative 3B	----	----	----	----	9.8	0.8	5.7	----
Alternative 4	----	----	----	----	----	----	0.5	----
Alternative 5	----	----	----	----	----	----	5.5	----
Alternative 6	----	----	----	----	----	----	----	----
Alternative 7	----	----	0.4	----	----	----	0.2	----
Alternative 8 [1]	----	----	----	----	----	----	----	----
Alternative 11	10.6	----	----	----	----	----	8.4	----
WTP A	----	----	----	----	----	----	----	----
WTP B	----	----	----	----	----	----	----	----
WTP C	----	----	----	----	----	----	7.2	----

[1] Impacts do not include the well field as the layout thereof has not yet been determined.

5.5.2. No-Action Alternative

Direct impacts to public lands and scenic, recreational, or state natural areas will not occur from the No-Action Alternative. The No-Action Alternative will not include land disturbance on public lands or scenic, recreational, or state natural areas. No indirect or cumulative impacts to public lands or scenic, recreational, or state natural areas are anticipated to occur as a result to the No-Action Alternative. Growth is projected to occur in the areas presently served by the water system. The projected growth is anticipated occur regardless of the selected alternative.

5.6. Prime or Unique Agricultural Lands

5.6.1. Common Elements to All Alternatives

Direct impacts to prime agricultural lands are likely to occur due to implementation of any of the alternatives. Minor direct impacts will result from excavation, grading, and other construction activities necessary to install the proposed transmission line, pump station, access road(s), and WTP. Impacts associated with the proposed transmission line installation will be temporary, and the impacts associated with construction of the pump station, access road(s), well field and WTP will be permanent.

Minor indirect and cumulative impacts of alternatives are anticipated due to the growth and development that will be supported by the increased water capacity. The growth and development may result in additional direct and indirect impacts to prime agricultural lands. Details regarding the area of prime agricultural lands within the project areas of each alternative are summarized in Table 5-5.

Table 5-5 Prime Farmland Soils within Project Areas

Alternative	Pipe Corridor, acres [1]	Pump Station, acres [2]	Access Road, acres [2]	Current Agricultural Use, acres [4]
1A	93.6	----	----	18.9
1B	106.3	----	----	22.8
2A	156.0	----	----	30.8
2B	127.5	<0.1	0.1	23.1
3A	145.5	----	----	25.4
3B [3]	207.3	----	----	6.2 [5]
4	83.4	----	0.9	25.5
5	0.4	----	----	----
6	282.0	----	----	41.4
7	41.8	----	----	4.8
8 [3]	13.0	----	----	5.2 [5]
11	193.2	----	----	41.9
WTP A	----	----	----	----
WTP B [3]	9.7	----	----	12.5 [5]
WTP C [3]	29.6	----	----	3.6 [5]

[1] Temporary impacts to prime farmland soils.
[2] Permanent impacts to prime farmland soils.
[3] Impacts to prime farmland soils present within the WTP sites and the well field cannot be quantified at this time since the layouts thereof have not yet been determined.
[4] Current agricultural use areas include those areas that are mapped as prime farmland soils and are currently being used for agricultural or pastoral purposes.
[5] WTP sites and the well field are not included since the footprint of impact for the infrastructure will be significantly less than the study area.

5.6.2. Alternative 1A

For Alternative 1A, the temporary impacts to prime agricultural lands are anticipated to affect six prime agricultural land soil types. The greatest area of impact will be to Kirksey and Tarrus soils, representing approximately 75 percent of the prime agricultural lands underlying the proposed water main corridor of Alternative 1A. The total acreage of prime agricultural lands to be impacted by the proposed alternative is 93.6 acres. The current use of the land within the water main corridor for either agricultural or pastoral purposes is approximately 18.9 acres. Direct impacts to the current agricultural use of prime agricultural lands in the water main corridor will be temporary and negligible as maintenance of the corridor will continue after installation of the water main. No permanent, direct, adverse impacts are anticipated to occur to agricultural land from implementation of Alternative 1A.

5.6.3. Alternative 1B

For Alternative 1B, the temporary impacts to prime agricultural lands are anticipated to affect six prime agricultural land soil types. The greatest area of impact will be to Kirksey and Oakboro soils, representing approximately 80 percent of the prime agricultural lands underlying the proposed water main corridor of Alternative 1B. The total acreage of prime agricultural lands to be impacted by the proposed alternative is approximately 106.3 acres. The current use of the land within the water main corridor for either agricultural or pastoral purposes is approximately 22.8 acres. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible since agricultural and pastoral use of the corridor will continue after installation of the water main. No permanent, direct, adverse impacts are anticipated to occur to agricultural land from implementation of Alternative 1B.

5.6.4. Alternative 2A

Within the water main corridor for Alternative 2A, the temporary impacts to prime agricultural lands are anticipated to affect eight prime agricultural land soil types. The greatest area of impact will be to Tarrus soils, representing approximately 60 percent of the prime agricultural lands underlying the proposed corridor for Alternative 2A. The total acreage of designated prime agricultural lands is approximately 156 acres. The current use of the land within the corridor for either agricultural or pastoral purposes is approximately 30.8 acres. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible since agricultural and pastoral use of the corridor will continue after installation of the water main. No permanent, direct, adverse impacts are anticipated to occur to agricultural land from implementation of Alternative 2A.

5.6.5. Alternative 2B

The temporary and permanent impacts to prime agricultural lands are anticipated to affect five prime agricultural land soil types within the water main corridor for Alternative 2B. The greatest area of impact will be to Tarrus soils, representing approximately 65 percent of the prime agricultural lands underlying the proposed water main corridor, pump station, and access road for Alternative 2B. The total acreage of designated prime agricultural lands is approximately 127.5 acres. The current use of the land within the corridor for either agricultural or pastoral purposes is approximately 23.1 acres. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible as agricultural and pastoral use of the corridor will continue after installation of the water main. No permanent, direct, adverse impacts are anticipated to occur to agricultural land from implementation of Alternative 2B.

5.6.6. Alternative 3A

For Alternative 3A, the temporary impacts to prime agricultural lands are anticipated to affect eight prime agricultural land soil types. The greatest area of impact will be to Chewacla soils, representing approximately 55 percent of the prime agricultural lands underlying the proposed water main corridor for Alternative 3A. The total acreage of prime agricultural lands is approximately 145.5 acres. The current use of the land within the corridor for either agricultural or pastoral purposes is approximately 25.4 acres. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible as agricultural and pastoral use of the corridor will continue after installation of the water main. No permanent, direct, adverse impacts are anticipated to occur to agricultural land from implementation of Alternative 3A.

5.6.7. Alternative 3B

For Alternative 3B, the temporary impacts to prime agricultural lands are anticipated to affect ten prime agricultural land soil types. The greatest area of impact will be to Mayodan and Emporia soil types, representing approximately 55 percent of the prime agricultural lands in the proposed water main corridor. The total acreage of prime agricultural lands in the footprint of Alternative 3B is approximately 207.3 acres. The current use of the land within the corridor for either agricultural or pastoral purposes is approximately 6.2 acres. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible as agricultural and pastoral use of the corridor will continue after installation of the water main. Permanent, direct, adverse impacts may occur to 1.2 acres of agricultural land from implementation of Alternative 3B.

5.6.8. Alternative 4

The temporary and permanent impacts to prime agricultural lands are anticipated to affect six prime agricultural land soil types for Alternative 4. The greatest area of impact will be to Tarrus and Mayodan soils, representing approximately 60 percent of the prime agricultural lands underlying the proposed water main corridor and access road of Alternative 4. The total acreage of prime agricultural lands in the Alternative 4 footprint is approximately 83.4 acres. The current use of prime agricultural lands for either agricultural or pastoral purposes is 25.5 acres. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible since agricultural and pastoral use of the corridor will continue after installation of the water main. Permanent, direct, minor adverse impacts are anticipated to occur to agricultural land from installation of the access road through agricultural land.

5.6.9. Alternative 5

The temporary impacts to prime agricultural lands are anticipated to affect two prime agricultural land soil types for Alternative 5. The greatest area of impact will be to Chewacla soils, representing approximately 90 percent of the prime agricultural lands underlying the proposed corridor. The total acreage of prime agricultural lands in the Alternative 5 footprint is 0.4 acre. No portion of the prime agricultural lands within the footprint of Alternative 5 is currently used for either agricultural or pastoral purposes. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible since agricultural and pastoral use of the corridor will continue after installation of the water main. No permanent, direct, adverse impacts are anticipated to occur to agricultural land from implementation of Alternative 5.

5.6.10. Alternative 6

For Alternative 6, the temporary impacts to prime agricultural lands are anticipated to affect seven prime agricultural land soil types. The greatest area of impact will be to Cecil and Tarrus soils, representing approximately 75 percent of the prime agricultural lands underlying the proposed corridor. The total acreage of prime agricultural lands in the Alternative 6 corridor is 282 acres. The current use of prime agricultural lands for either agricultural or pastoral purposes is approximately 41.4 acres. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible since agricultural and pastoral use of the corridor will continue after installation of the water main. No permanent, direct, adverse impacts are anticipated to occur to agricultural land from implementation of Alternative 6.

5.6.11. Alternative 7

For Alternative 7, the temporary impacts to prime agricultural lands are anticipated to affect five prime agricultural land soil types. The greatest area of impact will be to Cecil and Tarrus soils, representing approximately 80 percent of the prime agricultural lands underlying the Alternative 7 corridor. The total acreage of prime agricultural lands within Alternative 7 is 41.8 acres. The current use of prime agricultural lands for either agricultural or pastoral purposes is approximately 4.8 acres. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible since agricultural and pastoral use of the corridor will continue after installation of the water main. No permanent, direct, adverse impacts are anticipated to occur to agricultural land from implementation of Alternative 7.

5.6.12. Alternative 8

Within the water main corridor, WTP, and well field associated with Alternative 8, the temporary and permanent impacts to prime agricultural lands are anticipated to affect four prime agricultural land soil types. The greatest area of impact will be to Tarrus soils, representing approximately 80 percent of the prime agricultural lands underlying the well field area, footprint of the water main corridor, and WTP area for Alternative 8. The total acreage of prime agricultural lands within Alternative 8 is approximately 11,372 acres. Approximately 13 acres of prime agricultural lands are located in the corridor, of which 5.2 acres are currently used agricultural or pastoral purposes. The remaining 11,359 acres of prime agricultural land is located in the well field. The individual wells within the well field are anticipated to be located in undeveloped areas, which includes agricultural lands. A layout for the well field infrastructure has not been developed, so acreage of impacts cannot be determined at this time. Direct, temporary, adverse impacts to current agricultural use of prime agricultural lands due to the water main is expected to be negligible, being affected only during construction in the subject areas. Direct, permanent, adverse impacts to use of the prime agricultural lands resulting from the well field development is unknown.

5.6.13. Alternative 11

The temporary impacts to prime agricultural lands are anticipated to affect six prime agricultural land soil types for Alternative 11. The greatest area of impact will be to Tarrus and Kirksey soils, representing approximately 80 percent of the prime agricultural lands underlying the corridor for Alternative 11. The total acreage of prime agricultural lands within the alternative is approximately 193.2 acres. The current use of prime agricultural lands within the corridor for either agricultural or pastoral purposes is 41.9 acres. Direct impacts to the current agricultural use of prime agricultural lands in the corridor will be temporary and negligible since agricultural and pastoral use of the corridor will continue after installation of the transmission line. No permanent, direct, adverse impacts are anticipated to occur to agricultural land from implementation of Alternative 11.

5.6.14. Alternative WTP A

No prime agricultural lands are designated within the area associated with the WTP A site. Therefore, no impacts to prime agricultural lands will occur due to the implementation of Alternative WTP A.

5.6.15. Alternative WTP B

For the Alternative WTP B corridor and WTP B facility area, the temporary and permanent impacts to prime agricultural lands are anticipated to affect only the Tarrus prime agricultural land soil type. The total acreage of prime agricultural lands is 179.3 acres. The current use of the WTP B alternative area for either agricultural or pastoral purposes is 102.1 acres. The direct impacts to current agricultural use of prime agricultural lands within the Alternative WTP B corridor will be negligible. Impacts due to the WTP facility cannot be quantified at this time as the facility layout has not been developed.

5.6.16. Alternative WTP C

The temporary and permanent impacts to prime agricultural lands are anticipated to affect two prime agricultural land soil types for the Alternative WTP C corridor and WTP C facility area. The soil type expected to be impacted to a greater extent is Tarrus, representing approximately 85 percent of the prime agricultural lands for Alternative WTP C for a total acreage of approximately 211.0 acres. The current use of prime agricultural lands within the footprint of Alternative WTP C for either agricultural or pastoral purposes is approximately 36.9 acres. The direct impacts to current agricultural use of prime agricultural lands within the corridor will be negligible. Impacts due to the WTP facility cannot be quantified at this time as the facility layout has not been developed.

5.6.17. No-Action Alternative

The No-Action Alternative involves no disturbance of land regardless of the designation of prime agricultural lands. Therefore, the No-Action Alternative will not directly impact prime agricultural lands. Indirect and cumulative impacts due to future growth and development in the service area are expected to occur.

5.7. Areas of Archaeological or Historic Value

5.7.1. Archaeological Resources

5.7.1.1. COMMON ELEMENTS TO ALTERNATIVES

Direct adverse impacts to areas of archaeological value are not known at this time. In correspondence dated February 12, 2015, the SHPO stated that it is extremely unlikely they will request an archaeological survey if the preferred alternative is confined to existing, previously disturbed right-of-way (Appendix D). Once the preferred alternative is reviewed, coordination with the Office of State Archaeology will occur to determine if potential areas of concern are present and whether an archaeological survey is required within the project areas. The final determination of potential impacts to archaeological resources as a result of the preferred alternative will be made upon completion of the archaeological survey, if necessary. No indirect impacts to archaeological resources are anticipated to occur from the proposed project regardless of which alternative is chosen.

5.7.1.2. NO-ACTION ALTERNATIVE

No work is proposed under the No-Action Alternative. Growth within the service area will occur irrespective of the alternative selected for the project. Minor indirect and cumulative impacts are expected to occur to archaeological resources with the implementation of the No-Action Alternative.

5.7.2. Resources of Historic Value

5.7.2.1. COMMON ELEMENTS TO ALTERNATIVES EXCEPT ALTERNATIVE WTP A AND WTP C

At least one potential historic resource has been identified by the North Carolina State Historic Preservation Office (SHPO) in proximity to the project areas except WTP A and WTP C, as listed in Table 4-10. Of those, one listed site, Wadesboro Downtown Historic District, and one site that has been determined to be eligible for listing, Polkton Historic District, is located in proximity to the Alternative 3B project area. Other sites that have been determined eligible for listing are located near the proposed project alignments associated with Alternatives 4, 7, and 11. Several sites that have been added to the study list are located within the Alternative 1A, 1B, 2A, 2B, 3A, 4, 5, 6, 7, 8, 11, and WTP B project areas and one site, Norwood Railroad Complex has been listed as Blockface for Alternatives 1A, 1B, and 11. Blockface is a designation that was previously assigned by SHPO to identify a group of properties, usually on one block or one side of a block, that share a single survey site number. In correspondence dated February 12, 2015, the SHPO provided additional details regarding the structures within proximity to the project areas (Appendix D). No direct or indirect, permanent or temporary impacts to historic structures or districts will occur from the project alternatives.

5.7.2.2. NO-ACTION ALTERNATIVE

No impacts to resources of historic value will result from the implementation of the No-Action Alternative. Growth within the service area will occur irrespective of the alternative selected for the project. Therefore, minor indirect and cumulative impacts are expected to occur with the implementation of the No-Action Alternative.

5.8. Air Quality

5.8.1. Common Elements to Alternatives

All alternatives except for the No-Action Alternative are expected to have a minor impact on air quality during the period of construction. An increase in airborne particulates from land clearing and exhaust emissions from construction vehicles will occur during project construction. Proper vehicle maintenance, frequent wetting of exposed soil, and prompt soil stabilization will minimize these impacts. The public health impacts of these emissions are anticipated to be negligible. In addition to the direct impacts of construction, the alternatives were evaluated for their impacts on hydropower generation. Because all the alternatives resulted in negligible to minor impacts to hydropower generation, it is anticipated that there will be minimal impacts to air quality related to changes in hydropower generation.

Urban growth in the service area may cause an increase in air pollutant emissions from vehicles, industrial activities, and construction, thereby contributing to the cumulative impacts of the proposed project. Ozone, carbon monoxide, and particulate matter are the primary pollutants of concern in the service area, and the levels of ozone in the project area will likely be affected by the projected increasing growth. Since NOx is the limiting factor in ozone formation and an estimated 60 percent of NOx is emitted by automobiles, the additional vehicle miles traveled due to increased population will likely result in higher concentrations of ozone being formed during hot, summer months.

5.8.2. Common Elements to Alternatives except Alternative 7

Direct and cumulative impacts to air quality due to all Alternatives are as described in Section 5.8.1. Post-construction adverse impacts to air quality are anticipated for all alternatives except Alternative 7. Emergency onsite power generation is proposed to provide back-up power to the pump station and WTP in the event of an emergency. The proposed generators at the WTPs will require an air permit for standby emergency power generation. The proposed emergency generators present negligible impacts to local air quality. The negligible impacts due to the operation of emergency power generators is necessary in order to prevent the adverse impacts to public health and safety that would result from a disruption of power at one of the proposed pump stations or WTPs. Compliance with air quality standards will be required at both the state and local level.

5.8.3. No-Action Alternative

The No-Action Alternative proposes no construction or new sources of air pollutants. Growth within the service area will occur irrespective of the alternative selected for the project. Minor indirect and cumulative impacts, as described in Section 5.8.1, are expected to occur to air quality with the implementation of the No-Action Alternative.

5.9. Noise Levels

5.9.1. Common Elements to Alternatives

All alternatives are expected to have a minor impact on environmental noise conditions. Construction of any build alternative would result in short-term noise level increases due to operation of the construction equipment. In order to reduce disturbances to adjacent properties, temporary increases in noise levels will be limited to daylight hours in accordance with local noise ordinances. Construction will only occur during normal, weekday working hours (7am to 6 pm) and will be suspended on holidays. If more construction days are needed, they will be requested by the contractor and must be approved by the appropriate local jurisdiction.

Noise levels from the new conveyance system alternatives are expected to be negligible during operation. In emergency situations, a generator may be required to provide power to the pump station and WTP. Generator operation will slightly increase the noise level in the project areas when power has been disrupted and an emergency power source is required.

Urban growth in the service area may affect long-term noise levels. Growth in the service area may create nuisance noise levels from traffic and construction in rural areas that are presently relatively quiet. Careful planning and zoning, preservation of buffers, and construction of noise barriers for stationary sources such as highways and major commercial roads will help in protecting residential area from excessive noise.

5.9.2. No-Action Alternative

The No-Action Alternative proposes no construction or new sources of noise. Growth within the service area will occur irrespective of the alternative selected for the project. Negligible, indirect and cumulative impacts, as described in Section 5.9.1, are expected to occur with the implementation of the No-Action Alternative.

5.10. Floodways and 100-Year Floodplains

Direct impacts to the FEMA-designated floodways and 100-year floodplains in the project area are possible due to construction but are expected to be minor. Temporary and permanent, direct impacts for all the alternatives are provided in Table 5-6. Indirect and cumulative impacts are expected to be negligible, if present.

5.10.1. Common Elements to All Alternatives

Portions of five of the transmission line corridors are located in FEMA-designated floodways, and portions of each alternative’s transmission line corridor except for Alternative WTP B are located in FEMA-designated 100-year floodplain. Temporary, direct impacts will be adverse, and minor due to excavation and grading activities in the floodway that may occur as a result of the transmission line installation along the alignments associated with Alternatives 2A, 2B, 3B, 6, and 7. Similar temporary, direct impacts to the 100-year floodplain are expected to result from the transmission line installation along the alignments of each alternative except Alternative 8. Equipment and vehicles will be staged outside the floodway and 100-year floodplain in order to minimize potential impacts during construction. Upon completion of the installation of the proposed transmission line, the disturbed area will be graded to match the existing elevation and surface contours to the extent feasible, thereby eliminating a permanent modification of the floodway or 100-year floodplain.

All proposed pump stations and some of the access roads are located in designated 100-year floodplain areas. No pump station or access road is sited within a designated floodway. Permanent, direct, minor impacts to the 100-year floodplain will occur due to the construction of any of the proposed pump stations as well as the access roads that are part of Alternatives 3A, 3B, and 5. None of the raw water intakes or the discharge associated with Alternative 11 located in the Pee Dee River, Yadkin River, Rocky River, and the associated reservoirs are located within the designated floodway.

The low-head dam associated with Alternative 5 is located within the Rocky River's 100-year floodplain zone. No floodway has been designated by FEMA in the reach of the Rocky River that will be affected by the low-head dam construction or operation. Potential reclassification of the Rocky River from construction of a low-head dam is discussed in Section 5.12.

No impacts to floodways will occur as a result of the construction of any of the proposed water treatment facilities. Approximately 4.4 acres of the WTP D area is located in a designated 100-year floodplain. The other three new WTP locations and the Catawba River WTP are located outside of designated floodways and 100-year floodplain. As the layout of WTP D has not yet been developed, impacts cannot be quantified at this time. Efforts to avoid floodplain encroachment will be made during site design. Indirect or cumulative impacts, if any, will be negligible.

Table 5-6 Temporary and Permanent Impacts to Floodway and 100-Year Floodplain

	Alternative	Temporary Impact, acres [1]	Permanent Impact, acres [2]
Floodway	1A	----	----
	1B	----	----
	2A	1.6	----
	2B	1.0	----
	3A	----	----
	3B	6.7	----
	4	----	----
	5	----	----
	6	0.6	----
	7	0.2	----
	8 [3]	----	----
	11	0.6	----
	WTP A	----	----
	WTP B	----	----
	WTP C	----	----
100-Year Floodplain	1A	13.5	0.1
	1B	32.2	0.1
	2A	21.2	0.3
	2B	19.9	----
	3A	86.9	2.0
	3B	49.3	2.0
	4	33.4	0.2
	5	1.7	0.5
	6	7.6	----
	7	4.7	----
	8 [3]	0.2	----
	11	28.1	----
	WTP A	----	----
	WTP B	----	----
	WTP C	0.8	----

[1] Temporary impact areas include the transmission line corridor.
[2] Permanent impact areas include the raw water intakes, pump stations, access roads, treated effluent discharge, and low-head dam, as applicable, that are affiliated with each alternative. WTP sites are not included as the layouts thereof have not yet been developed.
[3] Floodway and 100-year floodplain impact areas listed do not include the area within the well field area as the layout of the wells and associated infrastructure is unknown at this time.

5.10.2. No-Action Alternative

The No-Action Alternative does not include any land disturbance or placement of new structures. Growth and development in the service area is anticipated to continue even if the No-Action Alternative is selected and implemented. Therefore, negligible indirect and cumulative impacts to the floodway or 100-year floodplain with the implementation of the No-Action Alternative are anticipated to occur.

5.11. Wetlands

The design and precise location of the proposed transmission line corridors and aboveground structures have not been adjusted to avoid wetlands at this time. Once a preferred alternative is selected, further investigation into the exact location of jurisdictional wetlands will be conducted and the design will be adjusted as needed to avoid and minimize permanent impacts to wetlands. The acreage of NWI wetlands that may be impacted temporarily or permanently by the proposed project alternatives is summarized in Table 5-7. Since the layouts of the WTPs and the well field have not yet been determined, impacts associated with these project components cannot be quantified. The wetland impacts associated with Alternative 8 are anticipated to be greater than the wetland acreage that will be impacted if another alternative is selected and implemented. Minor indirect and cumulative impacts to wetlands may occur due to growth and development in the service area.

During construction, existing vegetation will be removed by mechanical clearing, and the excavated soil will be temporarily stockpiled adjacent to the trench. Temporary fill material will be placed to provide temporary construction access, as needed. Pre-construction contours in wetland areas will be restored in accordance with USACE, DWR, and SCDHEC permit requirements, as applicable. The cleared corridor will be reseeded with an appropriate, native seed mixture of annual and/or perennial groundcover that does not include fescue. The permanent maintained access corridor will be restricted to 15 feet in width, according to DWR General Water Quality Certifications (WQC) and will be maintained as an herbaceous or scrub-shrub area. The disturbed wetlands located outside the permanent maintained access corridor will be allowed to re-vegetate naturally, returning to its pre-construction vegetative composition over time.

Forested wetlands within the permanent maintained access corridors associated with the proposed transmission line alignments for each alternative will be converted from a forested wetland to an herbaceous or scrub-shrub wetland. The area of forested wetland that will be converted for each alternative is provided in Table 5-7 and corresponds to the palustrine, forested wetland category (PFO1/4). It should be noted that the direct impacts summarized in Table 5-7 are based only on NWI mapping. Neither field verification of the NWI mapping nor wetland delineations independent of the NWI mapping have been performed for any alternative.

Compliance with Sections 401 and 404 of the CWA will require authorizations from DWR and USACE, respectively, for proposed impacts to jurisdictional waters. If Alternative 6 is selected for implementation, authorization from SCDHEC for jurisdictional waters impacts occurring in South Carolina will also be necessary under Section 401 of the CWA. Based on the NWI mapping of wetlands in the project area, permitting requirements are expected to be met with a Nationwide Permit (NWP) 12 and the corresponding WQC for all alternatives except Alternative 3A and 5, which are expected to require an Individual Permit (IP) from the USACE and DWR. The general conditions of the NWP or IP and the WQC will be followed during the design, construction, and post-construction phases of the project where jurisdictional waters occur.

Table 5-7 NWI Wetland Impacts in Proposed Transmission line Corridors

	Temporary Impacts, acres [1]		Permanent Impacts, acres [1]	
Alternative	**Forested**	**Non-forested**	**Forested**	**Non-forested**
1A	----	----	----	----
1B	7.5	----	0.5	----
2A	0.6	----	----	----
2B	0.6	----	----	----
3A	44.8	8.7	3.2	----
3B	2.8	0.5	----	----
4	----	----	----	----
5	----	----	----	----
6	0.5	0.1	<0.1	----
7	0.1	----	----	----
8 [2]	----	----	----	----
11	0.9	----	----	----
WTP A	----	----	----	----
WTP B	----	----	----	----
WTP C	----	----	----	----

[1] Wetland impacts due to aboveground infrastructure are expected to occur only under Alternative 8.
[2] Impacts do not include the well field or its associated infrastructure as the layouts thereof have not yet been determined.

5.11.1. Common Elements to Alternatives 1A and 4

NWI mapping of wetlands along the water main corridors associated with Alternatives 1A and 4 does not indicate the presence of wetlands within the areas that may be impacted by construction. No direct or indirect impacts to wetlands are expected.

5.11.2. Common Elements to Alternatives 1B and 3A

NWI mapping of wetlands along the water main corridors associated with Alternatives 1B and 3A indicates that forested wetlands are present within the anticipated footprint of the permanent maintained access corridor. The forested wetlands in the area to be maintained will be converted to herbaceous or scrub-shrub wetlands in order to ensure that access is available for future maintenance and repair work. Converted forested wetland areas will have permanent, direct impacts, which will be minor for Alternative 1B, affecting approximately 0.45 acre of forested wetlands, and moderate for Alternative 3A. Temporary impacts to herbaceous or scrub-shrub wetlands are anticipated to occur as a result of Alternative 3A. The impacted non-forested wetland areas will be returned to original grade and elevation and reseeded with an appropriate, native wetland seed mix upon completion of construction. The temporary impacts will be direct, minor, and adverse. Wetland areas adjacent to the permanent access easement and within the temporary construction easement are anticipated to incur minor and temporary impacts.

5.11.3. Common Elements to Alternatives 2A, 2B, 3B, 7, and 11

NWI mapping of wetlands along the transmission line corridors associated with Alternatives 2A, 2B, 3B, 7, and 11 shows forested wetlands present within the temporary construction easement only. Non-forested wetlands are present in the temporary construction area along the transmission line corridor for Alternative 3B. No wetlands are shown within the permanent maintained access easements associated with the noted alternatives. Therefore, based on NWI wetlands mapping, no permanent direct impacts are anticipated to occur as a result of the implementation of any of these alternatives. Temporary direct impacts will be minor for Alternatives 2A, 2B, 7, and 11 and moderate for Alternative 3B.

5.11.4. Alternative 5

NWI wetlands are not depicted along the water main corridor associated with Alternative 5. Operation of the low-head dam is expected to raise the groundwater table adjacent to the reach of the Rocky River that will be subject to higher water levels. The higher groundwater table may impact existing wetlands, altering the soil characteristics, hydrology, and plant community present within and abutting the wetland areas. Existing wetlands may be expanded, and new wetlands may be created where none currently exist. The extent of impacts to wetlands due to the proposed low-head dam cannot be determined at this time.

5.11.5. Alternative 6

NWI mapping of wetlands along the water main corridors associated with Alternative 6 indicates that forested wetlands are present within the anticipated footprint of the permanent maintained access corridor. The forested wetlands in the area to be maintained will be converted to herbaceous or scrub-shrub wetlands in order to ensure that access is available for future maintenance and repair work. Converted forested wetland areas will have permanent, direct impacts, which will be minor for Alternative 6. Temporary impacts to herbaceous or scrub-shrub wetlands are anticipated to occur as a result of Alternative 6. The impacted non-forested wetland areas will be returned to original grade and elevation and reseeded with an appropriate, native wetland seed mix upon completion of construction. The temporary impacts will be direct, minor, and adverse. Wetland areas adjacent to the permanent access easement and within the temporary construction easement are anticipated to incur minor and temporary impacts.

Buffers around the perimeter of wetlands are protected under Section 70 of the Union County Development Ordinance (UDO) (Union County, 2014). The buffer protections apply to wetlands that intersect an intermittent or perennial stream within the Twelve Mile Creek WWTP service area. Temporary and permanent, direct, adverse impacts to the protected buffer around the perimeter of the wetlands are expected to be minor, if present. The area of wetland buffer to be impacted will be determined if Alternative 6 is selected for the project.

5.11.6. Alternative 8

There are no wetlands shown on NWI mapping within the proposed water main corridor associated with Alternative 8. A large number and area of wetlands are depicted on the NWI maps within the well field area; however, wetland impacts from construction of the well field and associated infrastructure cannot be quantified at this time since the well field layout has not yet been developed. The area assessed for the well field contains more wetland areas than for the other alternatives. Jurisdictional areas will be avoided when possible, and impacts will be minimized to the extent practicable when avoidance is not possible. Direct, permanent impacts are expected to be minimized to the point of achieving an intensity level of minor. Direct, temporary impacts may range from minor to major, depending on final design and construction methods.

Buffers around the perimeter of wetlands are protected under Section 70 of the Union County UDO. The buffer protections apply only to those wetlands that intersect an intermittent or perennial stream within the Twelve Mile Creek WWTP service area. The well field area was selected partly based on the potential to avoid stream crossings by the proposed transmission line network. Therefore, it is unlikely that buffered streams or wetlands will be located within an impact footprint for the groundwater well system. Temporary and permanent, direct, adverse impacts to the protected buffer around the perimeter of the wetlands are expected to be minor, if present. Impacts may occur within the northern portion of the well field. The area of wetland buffer to be impacted will be determined if Alternative 8 is selected for the project.

5.11.7. Alternatives WTP A, WTP B, and WTP C

NWI mapping depicts wetlands within the WTP A, B, and C areas. As the layout of each proposed facility has not been developed, impacts to the mapped wetlands cannot be quantified at this time. During design, efforts will be made to avoid impacting wetlands if avoidance is feasible. There are no wetlands shown in the water main corridors associated with Alternatives WTP B and C.

5.11.8. No-Action Alternative

The No-Action Alternative does not include disturbance of or placement of fill material in jurisdictional wetlands. Minor indirect and cumulative impacts are anticipated to occur as a result of the growth and development anticipated in the service area regardless of the alternative chosen for the proposed project.

5.12. Water Resources (Surface Water and Groundwater)

5.12.1. Impacts to Surface Waters and Riparian Buffers

Direct impacts to perennial and intermittent streams in the project area are anticipated to result from construction of each of the proposed alternatives. Table 5-8 summarizes the number of perennial and intermittent streams crossings for each alternative and the length of temporary and perennial stream impacts that will occur for each alternative. For all alternatives except Alternative 7, stream crossings will be performed by excavating an open trench, installing the transmission line, and backfilling the trench. Instream work will be performed in dry stream conditions, using a pump-around system or diversion as necessary. The stream crossing will be installed using trenchless technologies if federally protected species or designated critical habitats are known to occur within the stream at the transmission line crossing location or where required by the GCWQMP (NCDENR, 2009).

The stream lengths of temporary impacts provided in Table 5-8 assume that the entire width of the transmission line corridor will impact the streams, which involves a 200-foot wide swath. Actual impacts are expected to be less than stated for the transmission line corridors as minimization measures will be incorporated into final design. Permanent impacts will not occur as all project elements will be below the stream bed and the stream will be returned to original condition. Permanent impacts to jurisdictional streams include the length of stream in the footprint of the proposed instream structures, which include the low-head dam associated with Alternative 5, the wastewater discharge associated with Alternative 11, and the raw water intake structures for Alternatives 1A through 5. As the aboveground structures have not been designed to the level at which impacts can be precisely calculated, the permanent impacts are stated as the maximum length of stream which may reasonably be expected to be impacted by the proposed infrastructure.

Direct impacts are not provided in Table 5-8 for the WTP facilities or the well field as these layouts have not yet been developed. It is currently unknown if the WTP facilities will impact jurisdictional streams or protected riparian buffers. Impacts to these resources will be determined once WTP facility layouts are developed. Efforts will be made during the design of the WTP facilities to avoid impacts to jurisdictional streams and protected riparian buffers to the extent feasible.

Table 5-8 Stream Crossings and Length of Stream Impacts

	Perennial Streams			Intermittent Streams		
Alternative	**Number of Crossings**	**Temporary Impacts, feet**	**Permanent Impacts, feet**	**Number of Crossings**	**Temporary Impacts, feet**	**Permanent Impacts, feet**
1A	11	2,848	50	20	11,014	----
1B	14	5,857	50	31	10,598	----
2A	11	2,339	50	22	9,498	----
2B	9	1,914	50	27	9,572	----
3A	20	5,242	50	22	8,194	----
3B [2]	16	4,634	50	24	7,683	----
4	7	1,715	50	14	6,979	----
5	----	----	100	3	1,343	----
6	7	1,509	50	18	3,913	----
7	2	---- [1]	----	7	---- [1]	----
8 [2]	2	407	----	5	1,530	----
11	18	4,508	50	25	17,449	----
WTP A	----	----	----	----	----	----
WTP B [2]	----	----	----	5	1,438	----
WTP C [2]	----	----	----	11	3,426	----

[1] All streams crossed by Alternative 7 by trenchless construction methods per the requirements of the GCWQMP. Therefore, no impacts will result from the transmission line installation.
[2] Stream crossings and impacts include only the crossings located along the transmission line corridor.

Use classifications of the streams that will be crossed by the proposed project alternatives will not be affected by the project. The proposed construction of a new raw water intake may require a reclassification of the water body into which the intake is proposed to be placed. Alternatives 2A and 2B each may require a reclassification of the Yadkin River. If Alternative 4 or 5 is selected, a reclassification of the respective river will be necessary as the stream will then function as a water supply source. All alternatives except the No-Action Alternative will have a short-term, minor, adverse impact on the streams' ability to fully support its designated uses. Additional details regarding the impact on supported uses are provided in the following, alternative-specific discussions (Sections 5.12.1 through 5.12.12).

Riparian buffers are protected under a variety of local ordinances, including Union County's Development Ordinance, the City of Monroe's Zoning Code, the Town of Mineral Springs' Zoning Ordinance, and the Town of Unionville's Land Use Ordinance. The riparian buffer protections in Union County's Development Ordinance apply to the streams, lakes, and ponds in the Twelve Mile Creek WWTP service area and to the streams in the unincorporated areas of Union County that are within a designated water supply watershed (WSW). Anson County and the Town of Albemarle protect riparian buffers within their respective jurisdictions. Stanly County protects riparian buffers within a WSW. Riparian buffers are protected in the Goose Creek watershed per the GCWQMP, which is administered and enforced by DENR (NCDENR, 2009). Mecklenburg County and the Town of Mint Hill protect riparian buffers under the Surface Water Improvement and Management initiative (SWIM). However, all proposed project elements in Mecklenburg County and the Town of Mint Hill are also located in the Goose Creek watershed and are subject to the restrictions of the GCWQMP, which are more stringent and apply to a larger area then those of the SWIM. The areas protected under each jurisdiction's ordinance and plan varies. While installation of utilities is an allowed use in the protected buffer areas, authorization may be required depending on the footprint of the proposed temporary and permanent disturbances in the protected riparian buffer areas. Additional information regarding the riparian buffers and protections is provided in Table 5-9 and in the following discussion of impacts to surface waters and riparian buffers.

Table 5-9 Impacts to Protected Riparian Buffer Areas Along Streams

Alternative	Jurisdiction	Temporary Impacts, acres	Permanent Impacts, acres
1A	Union County, Stanly County	0.3	<0.1
1B	Union County, Stanly County	1.7	0.1
2A	Union County, Stanly County, City of Albemarle	1.0	0.1
2B	Union County, Stanly County, City of Albemarle	0.9	0.1
3A	Union County, Anson County	4.1	0.2
3B	Union County, Anson County	8.2	0.3
4	Union County, Anson County	11.6	0.6
5	Union County	----	----
6	Union County, Town of Mineral Springs, City of Monroe	3.8	0.2
7	EMC (under GCWQMP)	6.4	0.3
8	Union County	----	----
11	Union County, Stanly County	3.7	0.2
WTP A	Union County	----	----
WTP B	Union County, Unionville	----	----
WTP C	Union County	----	----

5.12.1.1. COMMON ELEMENTS OF ALTERNATIVES 1A AND 1B

The proposed water main corridors for Alternatives 1A and 1B will cross perennial and intermittent streams. Alternative 1A will cross 11 perennial and 20 intermittent streams. Alternative 1B will cross 14 perennial and 31 intermittent streams. Temporary stream impacts will be direct, minor, and adverse and will affect 2,848 feet of perennial and 11,014 feet of intermittent streams for Alternative 1A and 5,857 feet of perennial and 10,598 feet of intermittent streams for Alternative 1B. Permanent, direct, minor, adverse impacts to no more than 50 feet of the Pee Dee River will result from the construction of the proposed raw water intake.

Temporary impacts to the waterbodies' support of their respective uses will occur for Alternatives 1A and 1B. The streams that are proposed to be crossed by the water main will be open-cut to accommodate installation of the water main and will be dewatered during construction. The uses of the waterbodies, including fishing, boating, and aquatic life support for most streams and water supply for Pee Dee River and Cedar Creek, will be unsupported in the construction area and partially supported immediately upstream and downstream of the construction area during construction. No change of best use classification is required for the two alternatives.

Riparian buffers are protected along the corridors of Alternatives 1A and 1B. Activities in riparian buffers are restricted by ordinances that are applicable to the unincorporated areas of Union and Stanly counties that are in a WSW. Temporary impacts to riparian buffers by Alternatives 1A and 1B are 0.3 and 1.7 acres, respectively. Permanent impacts due to the two alternatives will be less than or equal to 0.1 acre. Temporary and permanent impacts are expected to be minor and direct.

5.12.1.2. COMMON ELEMENTS OF ALTERNATIVES 2A AND 2B

Alternatives 2A and 2B water main corridors cross perennial and intermittent streams. Alternative 2A will cross 11 perennial streams and 22 intermittent streams. Alternative 2B will cross nine perennial streams and 27 intermittent streams. Direct impacts to the streams due to the construction of the crossings will be temporary, minor, and adverse. The direct impacts will affect 2,339 feet of perennial and 9,498 feet of intermittent streams for the Alternative 2A water main corridor and 1,914 feet of perennial and 9,572 feet of intermittent streams for the Alternative 2B water main corridor. Permanent impacts to the Yadkin River will result from the construction of the proposed raw water intake. The permanent impacts are expected to be minor and adverse, impacting no more than 50 feet of the Yadkin River.

Temporary impacts to the waterbodies' support of their respective uses will occur for Alternatives 2A and 2B. The streams that are proposed to be crossed by the water main will be open-cut to accommodate installation of the water main and will be dewatered during construction. The uses of the waterbodies, including fishing, boating, and aquatic life support for most streams and water supply for Yadkin River, will be unsupported in the construction area and partially supported immediately upstream and downstream of the construction area during construction. A change of best use classification may be needed for the two alternatives. A new raw water intake is proposed under Alternatives 2A and 2B, which requires review of the current best use classification and a determination as to whether a reclassification is necessary to accommodate the new intake and water withdrawals.

Riparian buffer protections are in place for streams in the WSW portions of unincorporated Union County, the City of Albemarle, and the unincorporated areas of Stanly County that are in a WSW. Temporary impacts to protected riparian buffers will be 1.0 and 0.9 acre for Alternatives 2A and 2B, respectively. Permanent impacts to protected riparian buffers are expected to be 0.1

acre for each of the two alternatives. The impacts are expected to be minor, adverse, and direct regardless of duration. Installation of utilities is allowable under the ordinances protecting the riparian buffers. Authorization of riparian buffer encroachment may be necessary, depending on the footprint of proposed temporary and permanent disturbances in the protected riparian buffer areas.

5.12.1.3. COMMON ELEMENTS OF ALTERNATIVES 3A, 3B, AND 4

The water main corridors of Alternatives 3A, 3B, and 4 all cross perennial and intermittent streams and will result in direct, temporary, minor, adverse impacts. Alternative 3A will cross 20 perennial streams for a total impact of 5,242 feet and 22 intermittent streams for a total impact of 8,194 feet. Alternative 3B will cross 16 perennial and 24 intermittent streams, resulting in impacts to 4,634 and 7,683 feet of perennial and intermittent streams, respectively. Alternative 4 will cross seven perennial and 14 intermittent streams and will impact 1,715 feet of perennial and 6,979 feet of intermittent streams. Direct, permanent impacts will result from the construction and installation of raw water intake structures along the Pee Dee River, downstream of the Lake Tillery Dam. The permanent impacts are anticipated to be minor and adverse, affecting up to 50 feet of the Pee Dee River downstream of the Lake Tillery Dam.

Temporary impacts to the waterbodies' support of their respective uses will occur for Alternatives 3A, 3B, and 4. The streams that are proposed to be crossed by the water main will be open-cut to accommodate installation of the water main and will be dewatered during construction. The uses of the waterbodies, including fishing, boating, and aquatic life support for most streams and water supply for Pee Dee River, Savannah Creek, and Smith Creek, will be unsupported in the construction area and partially supported immediately upstream and downstream of the construction area during construction. No change of best use classification is needed for Alternative 3A or 3B. The best use classification for Alternative 4 does not allow for the water body to be used as a public water supply source. Therefore, a reclassification of the PeeDee River will be necessary for the implementation of Alternative 4.

Riparian buffers are protected within Anson County and the unincorporated areas of Union County that are in a WSW. Riparian buffers in Anson County are protected 50 feet landward of the top of bank of perennial and intermittent streams shown on the USGS topographic quadrangle map or identified by local government. Unincorporated Union County's buffers comprise a 30-foot wide swath of vegetation along perennial streams located in WSWs. Anticipated temporary riparian buffer impacts will be moderate, adverse, and direct, affecting 4.1, 8.2, and 11.6 acres for Alternatives 3A, 3B, and 4, respectively. The permanent impacts are anticipated to be minor, adverse, and direct, affecting 0.2, 0.3, and 0.6 acre for Alternatives 3A, 3B, and 4, respectively.

5.12.1.4. ALTERNATIVE 5

The water main corridor associated with Alternative 5 will cross jurisdictional streams. Alternative 5 will cross three intermittent streams, impacting 1,343 feet. The stream crossings will result in direct, temporary impacts at the crossing locations due to the excavation and dewatering components of the water main installation work. The impacts due to construction of the water main will be minor and adverse.

Direct, permanent, moderate, adverse impacts are expected to result from the proposed raw water intake and low-head dam associated with Alternative 5. The permanent, instream structures will be placed in the Rocky River immediately upstream of the NC 205 Bridge over the river. The low-head dam will result in an increase in water depth and a decrease in flow rate extending approximately 6,000 feet upstream of the dam. Six streams empty into the affected reach of the Rocky River. The six tributaries are expected to also experience higher water levels and slower flow rates in their respective downstream-most reaches. The results of the raised water level and slowed flow rates will include increased deposition of the river's sediment load, alteration of instream habitat composition and availability, and loss of aquatic plants and animals that cannot tolerate the altered conditions. These aquatic life losses or population declines may have an adverse impact on other aquatic species or conditions. However, it is anticipated that non-sessile organisms will relocate themselves to a stream reach that provides preferable conditions. Additionally, it is anticipated that the altered stream reaches will experience a natural influx and proliferation of species that prefer the conditions that will be provided by the low-head dam. In the case of presence of protected species, consultation with USFWS and WRC would be conducted.

Temporary impacts to the waterbodies' support of their respective uses will occur for Alternative 5. The streams proposed to be crossed by the water main will be open-cut to accommodate installation of the water main and will be dewatered during construction. The uses of the waterbodies, including fishing, boating, and aquatic life support, will be unsupported in the construction area and partially supported immediately upstream and downstream of the construction area during construction. The best use classification of the Rocky River at and upstream of the proposed raw water intake will need to be changed from its current classification of 'C' to a water supply watershed designation. Additionally, the construction of the proposed low-head dam will permanently impact boating and aquatic life support by impeding passage by watercraft and fish to the river on the other side of the dam.

Riparian buffers are not protected by local or state regulations within the footprint of Alternative 5.

5.12.1.5. ALTERNATIVE 6

The water main corridor associated with Alternative 6 will cross seven perennial and 18 intermittent streams. The length of impacts to the crossed streams is 1,509 feet of perennial and 3,913 feet of intermittent streams. The impacts at the proposed stream crossings will be direct, temporary, minor, and adverse resulting from excavation of the streambed and dewatering of the construction area. Permanent, direct, minor, adverse impacts to the Catawba River in South Carolina are expected to occur due to the anticipated modification and expansion of the existing raw water intake for the Catawba River WTP.

Temporary impacts to the waterbodies' support of their respective uses will occur under Alternative 6. The streams proposed to be crossed by the water main will be open-cut to accommodate installation of the water main and will be dewatered during construction. The uses of the waterbodies, including fishing, boating, and aquatic life support, will be unsupported in the construction area and partially supported immediately upstream and downstream of the construction area during construction. No change of best use classification is required.

Riparian buffers are protected within the North Carolina portion of the proposed water main corridor. The Town of Mineral Springs protects a 100-foot wide riparian buffer on streams that have a watershed that is larger than 50 acres. The City of Monroe protects a 35-foot wide riparian area along all perennial and intermittent stream channels within the limits of its ETJ, requiring an undisturbed vegetated buffer be maintained. Additionally, the City of Monroe prohibits a building or fill material from being placed within a distance of the stream bank equal to five times the width of the stream at top of bank or 20 feet on each side, whichever is greater. The Union County Development Ordinance protects buffers adjacent to streams in the WSW areas of unincorporated Union County and in the Twelve Mile Creek WWTP service area. In the WSW areas of unincorporated Union County, the protected buffers extend 30 feet landward of the top of bank of perennial streams. The width of protected riparian buffers in the Twelve Mile Creek WWTP service area is 100 feet along perennial streams and 50 feet along intermittent streams. Within the Twelve Mile Creek WWTP service area, existing lakes and ponds that intersect a buffered stream are also buffered for the same width as the intersected stream.

Impacts to riparian buffers are expected to be direct, minor, and adverse. The temporary and permanent impacts to protected riparian buffers adjacent to streams will affect 3.8 and 0.2 acres, respectively. If an open water area is present in proximity to the pipe corridor and intersects a stream that is subject to the buffer protections, impacts to buffers abutting lakes and ponds in the Twelve Mile Creek WWTP service area may occur and are expected to be minor, direct, temporary, and adverse.

5.12.1.6. ALTERNATIVE 7

The water main corridor for Alternative 7 will cross two perennial and seven intermittent streams. The impacts at the proposed stream crossings will be avoided by installing the proposed pipeline via trenchless techniques in order to protect the critical habitat and existing beds of federally endangered mussels that may be located at the proposed crossing. Trenchless stream crossings and avoidance of impact to the stream is a requirement under the GCWQMP (NCDENR, 2009). No direct or indirect, permanent impacts to streams are anticipated to occur due to implementation of the proposed alternative.

No impacts to best use classification and support are expected to occur as a result of installation of the water main for Alternative 7. The alternative is located entirely within the Goose Creek Watershed and is protected under the GCWQMP. The Plan requires trenchless construction techniques for stream crossings in order to avoid disturbing the critical habitat areas and mussel beds that may be located at the proposed crossing (NCDENR, 2009). No change in best use classification is necessary for Alternative 7.

Alternative 7 is located in four jurisdictions that are subject to riparian buffer restrictions. The City of Mint Hill, Mecklenburg County, unincorporated Union County, and the Goose Creek watershed all have riparian buffer protection programs and requirements in place. Alternative 7 is located entirely within the Goose Creek watershed. The protections under the GCWQMP restrict activities and land disturbance in a larger area and are more stringent than the protections under the SWIM. Therefore, the riparian buffer protections that are applied to buffers for Alternative 7 are those under the GCWQMP. The riparian buffer restrictions in the Goose Creek watershed were enacted to protect the populations and habitat of federally protected freshwater mussels documented in Goose Creek. The area protected under the GCWQMP as riparian buffer extends 200 feet landward of waterbodies where there is a 100-year floodplain present and 100 feet landward of all other waterbodies. Authorized disturbances of protected riparian areas under the GCWQMP are required to include stormwater controls, as specified in the GCWQMP. Direct, minor, adverse impacts to the riparian buffers are expected to be 6.4 acres temporarily and 0.3 acre permanently. Authorization from the EMC is required to disturb the protected riparian areas.

5.12.1.7. ALTERNATIVE 8

Alternative 8 includes two perennial stream crossings and five intermittent stream crossings along the water main corridor. One jurisdictional stream is present within the WTP D area. The well field layout has not yet been developed; however, the well field location was selected such that impacts to streams will be avoided. The length of stream to be impacted by the water main corridor under Alternative 8 will be 407 feet of perennial and 1,530 feet of intermittent streams. The perennial and intermittent stream crossings will result in direct, temporary, adverse, minor impacts at the crossing locations. No direct, permanent impacts are expected to occur due to Alternative 8. Impacts resulting from construction of WTP D cannot be quantified at this time as the layout thereof has not yet been developed.

Temporary impacts to the waterbodies' support of their respective uses will occur for Alternative 8. The streams proposed to be crossed by the water main will be open-cut to accommodate installation of the water main and will be dewatered during construction. The uses of the waterbodies, including fishing, boating, aquatic life support, primary recreation, and water supply, will be unsupported in the construction area and partially supported immediately upstream and downstream of the construction area during construction. No change of best use classification is needed for the alternative.

Alternative 8 is located in an unincorporated area of Union County. Riparian buffer protections apply to a 30-foot wide area adjacent to perennial streams within the WSW areas. Within the Twelve Mile Creek WWTP service area portion of the well field, riparian buffers extending 50 feet landward of intermittent streams and 100 feet landward of perennial streams. Portions of the well field are subject to the riparian buffer restrictions. The wells require spacing of 1,000 feet from another well. In order to avoid impacting the water level in the streams, the well field was selected based on an assumed need of a 500-foot wide offset from streams to individual wells. Therefore, no riparian buffer impacts are expected within the well field.

5.12.1.8. ALTERNATIVE 11

The transmission line corridor for Alternative 11 will cross 18 perennial and 25 intermittent streams. The length of stream impacts will be 4,508 feet of perennial and 17,449 feet of intermittent streams. The impacts will be direct, temporary, minor, and adverse. Permanent impacts to the Pee Dee River will occur if Alternative 11 is implemented. The impacts will be associated with the operation of the proposed effluent discharge structure in the river. Permanent impacts will be direct, minor, and adverse.

Temporary impacts to the waterbodies' support of their respective uses will occur for Alternative 11. The streams that are proposed to be crossed by the transmission line will be open-cut to accommodate installation of the transmission line and will be dewatered during construction. The uses of the waterbodies, including fishing, boating, and aquatic life support for most streams and water supply for four streams, will be unsupported in the construction area and partially supported immediately upstream and downstream of the construction area during construction. No change of best use classification is needed for the alternative.

Riparian buffer protections in the Alternative 11 transmission line corridor are provided by Stanly and Union counties and apply to perennial streams in a water supply watershed. In the Alternative 11 transmission line corridor, there are five streams with riparian buffer protections in each county. Temporary impacts to protected riparian buffers will affect approximately 3.7 acres. Permanent impacts to protected riparian buffers are expected to occur to 0.2 acre thereof.

5.12.1.9. ALTERNATIVE WTP A

One perennial stream is located in the WTP A area and may be impacted by construction of the facility. The impacts will be direct, minor, and adverse if an impact occurs. Without a facility layout, the determination as to the duration of the impact cannot be made. Approximately 3,300 feet of perennial stream is mapped along the western boundary of the WTP A area. Efforts will be made during the design phase of the project to avoid impacting the perennial stream if it is feasible to do so.

Temporary impacts to best use classification and support may occur due to the implementation of Alternative WTP A. The stream is rated for use for fishing, boating, and aquatic life support. If impacts to the stream due to the proposed alternative are not avoidable, then temporary impacts to use support will result from construction within or across the stream channel. Impacts, if any, are expected to occur only during construction.

Riparian buffers in the WTP A area are not protected by Union County.

5.12.1.10. ALTERNATIVE WTP B

Alternative WTP B includes five intermittent stream crossings along the proposed water main corridor. The alternative will temporarily impact 1,438 feet of intermittent stream during construction. The impacts will be direct, minor, and adverse resulting from dewatering of the construction area and excavation of the trench. Direct, permanent impacts may occur to an intermittent stream located within the area proposed for the associated WTP. The design has not been developed to the level of detail necessary to quantify the impacts to the intermittent stream. Approximately 2,950 feet of intermittent stream are mapped along the western boundary of WTP B area. Efforts will be made to avoid and minimize impacts thereto during the design phase if Alternative WTP B is selected.

Temporary impacts to the waterbodies' support of their respective uses will occur for Alternative WTP B. The streams proposed to be crossed by the water main will be open-cut to accommodate installation and will be dewatered during construction. The uses of the waterbodies, including fishing, boating, and aquatic life support, will be unsupported in the construction area and partially supported immediately upstream and downstream of the construction area during construction. No change of best use classification is needed for the alternative.

Riparian buffers in the WTP B area are not protected by Union County.

5.12.1.11. ALTERNATIVE WTP C

The water main corridor for Alternative WTP C will cross 11 intermittent streams. The length of stream to be impacted is 3,426 feet of intermittent stream. The impacts will be direct, temporary, minor, and adverse and will be the result of dewatering the construction area and excavating the trench to install the proposed water main. No jurisdictional streams are known to occur within the WTP C facility area. Permanent impacts to streams will not occur for Alternative WTP C.

Temporary impacts to the waterbodies' support of their respective uses will occur for Alternative WTP C. The streams proposed to be crossed by the water main will be open-cut to accommodate installation of the water main and will be dewatered during construction. The uses of the waterbodies, including fishing, boating, and aquatic life support, will be unsupported in the construction area and partially supported immediately upstream and downstream of the construction area during construction. No change of best use classification is needed for the alternative.

Riparian buffers in the WTP C area are not protected by Union County.

5.12.1.12. NO-ACTION ALTERNATIVE

The No-Action Alternative will not directly impact streams or protected riparian buffers as no construction or other activities are involved in the No-Action Alternative.

5.12.2. Surface Water Quantity and Quality – Yadkin River Basin

5.12.2.1. INTRODUCTION

As part of the technical evaluations being conducted for Union County's YRWSP, the County and Duke Energy contracted with HDR Engineering, Inc. of the Carolinas (HDR) to update an existing operations model of the Yadkin River Basin in North Carolina. The existing water quantity / hydro operations model was originally developed to support the Yadkin–Pee Dee Hydroelectric Project (No. 2206) Federal Energy Regulatory Commission (FERC) relicensing using the CHEOPS™ (Computerized Hydro Electric Operations Planning Software) platform and included the six hydroelectric developments on the Yadkin–Pee Dee River from High Rock reservoir through Blewett Falls reservoir, all in North Carolina (HDR, 2014b).

CHEOPS™ is designed to evaluate the effects of operational changes and physical modifications at multi-development hydroelectric projects. The model, as developed for relicensing, included the Duke Energy Progress-owned Yadkin-Pee Dee Hydroelectric Project, FERC No. 2206, which includes the Tillery and Blewett Falls Developments, and the upstream

Alcoa Power Generating, Inc. (APGI)-owned Yadkin Hydroelectric Project, FERC No. 2197, which includes the High Rock, Tuckertown, Narrows, and Falls Developments. The relicensing operations model has been updated as part of this EIS to include the most-upstream reservoir, W. Kerr Scott, owned by the U.S. Army Corps of Engineers (USACE) (HDR, 2014a).

The seven aforementioned Duke Energy Progress, APGI, and USACE facilities are collectively referred to herein as "the system." This expanded model is intended to be used as a tool to assist in evaluating water quantity distribution between the seven reservoirs due to changes in model inputs including various operational modifications and possible interbasin transfers (IBT) (HDR, 2014b). Such evaluations have been performed by reviewing relative changes between proposed operational modifications (YRWSP alternatives) within the system. The Yadkin-Pee Dee Basin CHEOPS™ model was specifically used as part of this EIS to evaluate the direct effects of the proposed water withdrawals for Alternatives 1, 2A, 2B, 3, 4, 5 and 11 on water quantity.

While Duke Energy Progress relied on the CHEOPS™ model platform during their FERC relicensing for the Yadkin-Pee Dee River Hydroelectric Project, APGI relied on the OASIS™ model platform for water supply evaluations associated with FERC relicensing of their Yadkin Hydroelectric Project. The OASIS™ platform is similar to that of CHEOPS™. However, the CHEOPS™ model is being used for purposes of these evaluations due to recent hydrology updates made to the model through 2013 to include the most recent drought during 2006-2009, and incorporation of both the APGI and Duke Energy Progress system operating rules defined in their FERC relicensing applications and Settlement Agreements. In short, the CHEOPS™ model for the Yadkin River Basin is a more current and up-to-date model than the existing OASIS™ model for the Basin. A detailed Yadkin-Pee Dee Basin CHEOPS™ Operations Model Study Model Logic and Verification Report may be found in Appendix E, CD-4.

5.12.2.2. MODEL FEATURES

The CHEOPS™ model was initially constructed for Duke Energy Progress' (Formerly Progress Energy) FERC relicensing process and includes the following updated features as completed for this EIS and used by Union County for evaluation of alternatives in this EIS:

- A 59-year hydrological record from 1955 through 2013.
- Inflow adjustments based on historical reservoir operations, modified to eliminate negative inflow values from the data set.
- Inclusion of net daily evaporation from reservoirs.
- Basin-wide water withdrawals and return flows for all users through 2060 were developed specifically for the Union County YRWSP EIS evaluations. The evaluations for this EIS are based on current (Year 2012) and future (Year 2050) water demands, as 2050 is the projection period used for Union County's YRWSP. However, basin-wide water demand projections were also extended an additional ten years to 2060 for updating the CHEOPS™ model to provide an approximate 5-decade projection period to allow flexibility for potential future uses of the model.
- Inclusion of the Low Inflow Protocol (LIP) for the Yadkin and Yadkin-Pee Dee River Hydroelectric Projects for procedures on how the Yadkin-Pee Dee River reservoir

system, as a whole, will be operated when inflow into the reservoirs is not enough to meet normal water demands while also maintaining lake levels within their normal ranges. A copy of the LIP is included in Appendix E, CD-1.

5.12.2.3. SCENARIO NAME AND DETAILS - UNION COUNTY YRWSP IBT

The following list describes the modeling scenario runs and associated naming nomenclature for the runs.

- **BLY-2012 (Yadkin Baseline-2012)**
    - Existing 5 mgd (net) Union County grandfathered Catawba IBT from Catawba River, withdrawn at CRWTP between Lake Wylie and Fishing Creek Reservoir
    - No additional IBT for Union County's YRWSP
    - Current (Year 2012) basin-wide water demands (withdrawals/returns)
- **BLY-2050 (Yadkin Baseline-2050)**
    - Existing 5 mgd (net) Union County grandfathered Catawba IBT from Catawba River, withdrawn at CRWTP between Lake Wylie and Fishing Creek Reservoir
    - No additional IBT for Union County's YRWSP
    - Future (Year 2050) basin-wide water demands (withdrawals/returns)
    - Includes future impact of climate change in future years resulting in an increased temperature of 2.3 deg F (0.6 deg F increase per decade) and lake surface evaporation increases of 7.8% (equivalent to an increase of 2% per decade), as compared to the 2012 baseline. This impact is consistent with the climate change impact considered by the Catawba-Wateree Water Management Group in preparation of the Catawba-Wateree Water Supply Master Plan baseline planning scenario, and is consistent with modeled climate change scenarios for this region of the United States.
- **A1-2012 (Alternative 1-2012)**
    - 23 mgd (maximum month daily average demand (MMDD)) IBT (net) from Pee Dee River, withdrawn at Lake Tillery
    - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
    - Used to compare effects of Alternative 1 to BLY-2012 (Yadkin Baseline-2012) scenario under current basin-wide water demand.
- **A1-2050 (Alternative 1-2050)**
    - 23 mgd (MMDD) IBT (net) from Pee Dee River, withdrawn at Lake Tillery
    - Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
    - Used to compare effects of Alternative 1 to BLY-2050 (Yadkin Baseline-2050) scenario under future projected basin-wide water demand.
    - Includes future impact of climate change identified in scenario BLY-2050.
- **A2A-2012 (Alternative 2A-2012)**
    - 23 mgd (MMDD) IBT (net) from Yadkin River, withdrawn at Narrows Reservoir
    - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT

  - Used to compare effects of Alternative 2A to BLY-2012 (Yadkin Baseline-2012) scenario under current basin-wide water demand.
- **A2A-2050 (Alternative 2A-2050)**
  - 23 mgd (MMDD) IBT (net) from Yadkin River, withdrawn at Narrows Reservoir
  - Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 2A to BLY-2050 (Yadkin Baseline-2050) scenario under future projected basin-wide water demand.
  - Includes future impact of climate change identified in scenario BLY-2050.
- **A2B-2012 (Alternative 2B-2012)**
  - 23 mgd (MMDD) IBT (net) from Yadkin River, withdrawn at Tuckertown Reservoir
  - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 2B to BLY-2012 (Yadkin Baseline-2012) scenario under current basin-wide water demand.
- **A2B-2050 (Alternative 2B-2050)**
  - 23 mgd (MMDD) IBT (net) from Yadkin River, withdrawn at Tuckertown Reservoir
  - Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 2B to BLY-2050 (Yadkin Baseline-2050) scenario under future projected basin-wide water demand.
  - Includes future impact of climate change identified in scenario BLY-2050.
- **A3-2012 (Alternative 3-2012)**
  - 14.2 mgd (MMDD) IBT (net) from Pee Dee River, withdrawn at Blewett Falls Lake
  - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 3 to BLY-2012 (Yadkin Baseline-2012) scenario under current basin-wide water demand.
- **A3-2050 (Alternative 3-2050)**
  - 14.2 mgd (MMDD) IBT (net) from Pee Dee River, withdrawn at Blewett Falls Lake
  - Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 3 to BLY-2050 (Yadkin Baseline-2050) scenario under future projected basin-wide water demand.
  - Includes future impact of climate change identified in scenario BLY-2050.
- **A4-2012 (Alternative 4-2012)**
  - 14.2 mgd (MMDD) IBT (net) from Pee Dee River, withdrawn between Lake Tillery and Blewett Falls Lake
  - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 4 to BLY-2012 (Yadkin Baseline-2012) scenario under current basin-wide water demand.

- **A4-2050 (Alternative 4-2050)**
  - 14.2 mgd (MMDD) IBT (net) from Pee Dee River, withdrawn between Lake Tillery and Blewett Falls Lake
  - Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 4 to BLY-2050 (Yadkin Baseline-2050) scenario under future projected basin-wide water demand.
  - Includes future impact of climate change identified in scenario BLY-2050.
- **A5-2012 (Alternative 5-2012)**
  - No IBT; 23 mgd (MMDD) withdrawal from the Rocky River
  - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 5 to BLY-2012 (Yadkin Baseline-2012) scenario under current basin-wide water demand.
- **A5-2050 (Alternative 5-2050)**
  - No IBT; 23 mgd (MMDD) withdrawal from the Rocky River
  - Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 5 to BLY-2050 (Yadkin Baseline-2050) scenario under future projected basin-wide water demand.
  - Includes future impact of climate change identified in scenario BLY-2050.
- **A11-2012 (Alternative 11-2012)**
  - 16.4 mgd (MMDD) IBT (net) from Pee Dee River, withdrawn at Lake Tillery
  - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of combined Alternative 1 and Alternative 11 to BLY-2012 (Yadkin Baseline-2012) scenario under current basin-wide water demand.
- **A11-2050 (Alternative 11-2050)**
  - 16.4 mgd (MMDD) IBT (net) from Pee Dee River, withdrawn at Lake Tillery Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of combined Alternative 1 and Alternative 11 to BLY-2050 (Yadkin Baseline-2050) scenario under future projected basin-wide water demand.
  - Includes future impact of climate change identified in scenario BLY-2050.

5.12.2.4. IBT QUANTITIES AND DISTRIBUTIONS

The impacts of the Alternatives 1, 2A, 2B, 3, 4, 5 and 11 IBT options from the Yadkin River Basin were evaluated for current basin-wide water demands based on Year 2012 values and future basin-wide water demands based on Year 2050 projections. The basin-wide water demands used for this modeling effort are based on the projections developed by HDR as part of the CHEOPS™ update for this EIS. Projections of water demands included municipal water supply, power plant cooling, agricultural/irrigation, and industry. These demands include other IBTs that are certified, grandfathered, or anticipated but not certified. The model requires that withdrawals be supplied as annual average withdrawal values. Since the withdrawal is not the same for every day of the year, the annual average values are adjusted to produce monthly use patterns and thus simulate seasonal water use patterns. In the CHEOPS™ model, each withdrawal's monthly distribution is based on the historical pattern for that water user. The Union County proposed IBT withdrawals were distributed according to the County's monthly demand patterns from 2006 to 2012. Table 5-10 shows the monthly distribution of average demands as a percentage of annual average demand that was used in the CHEOPS™ model for Union County's modeled withdrawals.

Table 5-10 IBT Monthly Distribution Based on 2006 to 2012 Union County Water Use

Month	Percent of Average	Month	Percent of Average
January	79%	July	123%
February	77%	August	117%
March	80%	September	113%
April	96%	October	107%
May	115%	November	91%
June	121%	December	81%

5.12.2.5. USE OF MODEL RESULTS

The model results are used throughout this EIS to analyze impacts of the proposed Yadkin River Basin water supply alternatives for the Union County YRWSP on specific parameters. Model results were analyzed for the following parameters:

- Lake Levels
  - Aesthetics
    - Effect of IBT alternatives on lake aesthetics, based on lake elevation
  - Water Withdrawal
    - Effect of IBT alternatives on water supply/withdrawal by other water users, based on lake elevation and storage.
- Reservoir Outflows (Downstream releases)
  - Effect of IBT alternatives on reservoir outflow for each of the reservoirs in the system
- Water Quantity Management (LIP Occurrence)
  - Effect of IBT alternatives on system-wide occurrence of various LIP levels
- Hydropower Generation
  - Effect of IBT alternatives on Duke Energy Progress and APGI hydropower generation

Three distinct hydrologic periods were analyzed within the model for each scenario, and included the following:

- Full Period of Record (59-year hydrology, 1955-2013)
- Drought 1 (5-year low inflow period (Drought of Record), 1999-2003)
- Drought 2 (4-year low inflow period; most recent significant drought), 2006-2009)

Under these parameters, the results of the modeling are summarized in a set of Performance Measure Sheets (PMS) for comparison purposes to assess the impacts of IBT quantity on the system and its reservoirs, as compared to “baseline” conditions under both current and future water demands throughout the Yadkin River Basin. This assessment and development of performance metrics were based on HDR’s recently enhanced CHEOPS™ model and the operating agreements used as the basis for the FERC license applications for the Yadkin and Yadkin-Pee Dee Hydroelectric Projects filed with FERC in April 2006, and the Comprehensive Settlement Agreements for the relicensing of the Yadkin and Yadkin-Pee Dee Hydroelectric Projects dated February, 2007 and June, 2007, respectively.

The original concept of the PMS was developed during the relicensing process for the Duke Energy Catawba-Wateree Hydroelectric Project. Since the 11 reservoirs and numerous diverse stakeholders to the system all had different metrics of interest and differing opinions on how to rate differences between operating regimes (as computed and measured as output to model scenarios), the PMS concept was developed. In this concept, each reservoir basin is evaluated with general criteria such as reservoir elevations, outflows, powerhouse generation, and time spent in Low Inflow Protocol (LIP) stages. Since recreational boaters and parties who withdraw water for consumptive uses have different criteria, general categories were developed. These different categories allow for the setting of the elevation or flow of interest, and the variance around that value which is considered acceptable, moderately acceptable, or not acceptable. Each stakeholder in the CW relicensing process had an opportunity to participate in the identification of categories and setting of the metric values to best represent their interests.

Additional experience in the PMS development process was gained during the Keowee-Toxaway relicensing for Duke Energy’s Jocassee, and Keowee hydroelectric developments. During this relicensing process, stakeholder inputs were sought and utilized in measuring the impacts from one operating regime to another.

During the Union County IBT model development process, HDR worked with Union County, Duke Energy and NCDWR representatives to identify likely metrics and conditions which may be of concern to other stakeholders. The metrics of this PMS contain the licensed flow requirements, likely areas of concern such as the amount of time spent at or near the maximum pool elevation(s), target elevation(s), and minimum elevation(s). The determination of what was considered a “minor” versus a “moderate” category were based on experience from the previously noted regional hydroelectric relicensing efforts, taking into consideration the possible concerns of stakeholders throughout the Yadkin-Pee Dee River Basin.

5.12.2.6. DIRECT IMPACTS – YADKIN RIVER BASIN WATER QUANTITY

The Yadkin River Basin CHEOPS™ model has been used to evaluate the impacts of the proposed interbasin transfer alternatives for a 23 mgd (MMDD) withdrawal for the Union County YRWSP from various locations between Tuckertown Reservoir and Blewett Falls Lake. Key indicators used are lake levels and water storage in W. Kerr Scott Reservoir, High Rock Lake, Tuckertown Reservoir, and Narrows Reservoir (Badin Lake), Lake Tillery and Blewett Falls Lake, as related to both reservoir aesthetics (including recreation) and water withdrawal for water supply uses. Additional indicators include the impact on downstream releases from these projects and effect on hydropower generation at both APGI and Duke Energy Progress operated hydroelectric facilities. Additionally, a summary of predicted LIP stages over the 59-year hydrological Period of Record has been developed for evaluation purposes. Under each of the IBT alternatives (except Alternative 11), a portion of the proposed water withdrawal would be returned to the Pee Dee River at the downstream reservoir on the system, Blewett Falls Lake, through Union County's discharges into the Rocky River from the Crooked Creek WRF and City of Monroe WWTP.

Two distinct comparisons have been made for evaluating each surface water alternative from the Yadkin River Basin (Alternatives 1, 2A, 2B, 3, 4, 5 and 11). The proposed water transfer under each alternative has been compared to a "baseline" scenario based on system operations and existing/projected basin water demands, without any proposed Union County IBT. Comparisons have been made to the following "baseline" scenarios:

1. BLY_2012
    - Yadkin baseline system operations with current (Year 2012) basin-wide water demand estimates.
    - Used to compare Union County's Year 2050 projected IBT amount under each alternative to current water use within the Basin in the Year 2012.
2. BLY_2050
    - Yadkin baseline system operations with future (Year 2050) basin-wide water demand estimates.
    - Used to compare Union County's Year 2050 projected IBT amount under each alternative to future projected water use within the Basin in the Year 2050.
    - Includes future impact of climate change previously identified.

As previously noted, for each model scenario evaluated, results were analyzed for three distinct hydrology periods, as follows:

1. Period of Record (POR) = 1955 to 2013
2. Drought 1 (Yadkin River Basin Drought of Record (DOR)) = 1999 to 2003
3. Drought 2 (most recent significant drought within the Basin) = 2006 to 2009

Direct impacts on water quantity for each alternative have been evaluated for their impacts to lake levels (for both lake aesthetics and water withdrawals), reservoir discharges, water quantity management (LIP occurrence) and hydropower generation. In general, results for all alternatives reflect negligible impacts to the baseline scenarios due to the proposed Union County IBT. This is especially true for the period of record (POR) evaluations as, over the 59 year period, the proposed IBT would have a negligible effect on system operations and water quantity. Minor to moderate impacts were noted for certain alternatives and in certain scenarios during modeled drought periods. No major impacts were identified from the water quantity modeling. The primary differences in metrics observed are between the 2050 and 2012 evaluations from projected basin-wide water demand increases in the future, not the proposed Union County IBT.

Lake Levels

Aesthetics

Often of important consideration to lakeside property owners and parties with recreational interests for particular lakes is the effect of water withdrawals on lake elevations and, subsequently, lake aesthetics. Given this consideration, the effect of each Union County surface water supply alternative from the Yadkin River Basin was evaluated in CHEOPS™ for their effect on lake elevations, relative to the operating rule/guide curve, full pond elevation, and/or normal minimum elevation for a particular reservoir, as a percentage of time the end of day elevations are within a particular range of the reservoir rule/guide curve or full pond elevation. Results from the applicable Performance Measure Sheets (PMS) for the model analysis are summarized in the following tables, by reservoir, alternative and baseline scenario comparison (BLY-2012 or BLY-2050). Potential negative impacts, as compared to the “baseline” scenarios, are denoted by “-” (Negligible Impact, with no detectable modeled impact, as compared to baseline), “MI” (Minor Impact, typically resulting in negative impact of >0% and <5%, as compared to baseline), “MO” (Moderate Impact, typically resulting in negative impact of 5% to <15%, as compared to baseline), and “MA” (Major Impact, typically resulting in negative impact of 15% or greater. For detailed results of the PMS, see Appendix E, CD-2.

Table 5-11 Period of Record (1955 to 2013) Lake Aesthetics (Elevation) Impacts, Based on % of Time End of Day Elevations within Particular Range of Rule/Guide Curve or Full Pond Elevation

Reservoir	Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT							Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuckertown	-	-	MI	-	-	-	-	-	-	MI	-	-	-	-
Narrows (Badin)	-	MO	MI	-	-	-	-	-	MI	MI	-	-	-	-
Falls	-	MI	-	-	-	-	-	-	MO	MO	-	-	-	-
Tillery	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blewett Falls	MI	-	-	MI	MI	MI	-	MI	-	-	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-12 Drought 1 (1999 to 2003) Lake Aesthetics (Elevation) Impacts, Based on % of Time End of Day Elevations within Particular Range of Rule/Guide Curve or Full Pond Elevation

Reservoir	Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT							Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High Rock	-	-	-	-	-	-	-	-	MI	MI	-	-	-	-
Tuckertown	-	-	MO	-	-	-	-	-	MI	MO	-	-	-	-
Narrows (Badin)	-	MO	MI	-	-	-	-	-	MO	MO	-	-	-	-
Falls	-	MI	-	-	-	-	-	-	MI	MI	-	-	-	-
Tillery	-	-	-	-	-	-	-	MI	MI	MI	MI	MI	MI	MI
Blewett Falls	MI	-	-	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-13 Drought 2 (2006 to 2009) Lake Aesthetics (Elevation) Impacts, Based on % of Time End of Day Elevations within Particular Range of Rule/Guide Curve or Full Pond Elevation

Reservoir	Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT							Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High Rock	-	-	-	-	-	-	-	-	MI	MI	-	-	-	-
Tuckertown	-	-	MO	-	-	-	-	-	MI	MI	-	-	-	-
Narrows (Badin)	-	MO	MI	-	-	-	-	-	MO	MI	-	-	-	-
Falls	-	MI	MI	-	-	-	-	-	-	-	-	-	-	-
Tillery	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blewett Falls	-	-	-	-	-	-	-	MI	-	-	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-14 Period of Record (1955-2013) Average Modeled Lake Elevation Differences for YRWSP Alternatives (Union County 2050 IBT) as Compared to Baseline Current (2012) Conditions

Reservoir	Avg. Elev. (feet)	Difference (inches) from BASE (UC2050_2012)							Avg. Elev. (feet)	Difference (inches) from BASE (2050)						
	Base 2012	Alternative							Base 2050	Alternative						
		1	2A	2B	3	4	5	11		1	2A	2B	3	4	5	11
W. Kerr Scott	1030.2	-	-	-	-	-	-	-	1030.1	-	-	-	-	-	-	-
High Rock	623.2	-	-	-	-	-	-	-	623.2	-	-	-	-	-	-	-
Tuckertown	564.2	-	-	-	-	-	-	-	564.2	-	-	-	-	-	-	-
Narrows (Badin)	509.0	-	-	-	-	-	-	-	509.0	-	-1	-	-	-	-	-
Falls	330.9	-	-	-	-	-	-	-	330.9	-	-	-	-	-	-	-
Tillery	278.0	-	-	-	-	-	-	-	278.0	-	-	-	-	-	-	-
Blewett Falls	176.5	-	-	-	-	-	-	-	176.5	-	-	-	-	-	-	-

"-" = No modeled change in lake elevation for alternative as compared to baseline condition

Table 5-15 Drought 1 (1999-2003) Average Modeled Lake Elevation Differences for YRWSP Alternatives (Union County 2050 IBT) as Compared to Baseline Current (2012) Conditions

Reservoir	Avg. Elev. (feet)	Difference (inches) from BASE (UC2050_2012)							Avg. Elev. (feet)	Difference (inches) from BASE (2050)						
	Base 2012	Alternative							Base 2050	Alternative						
		1	2A	2B	3	4	5	11		1	2A	2B	3	4	5	11
W. Kerr Scott	1030.0	-	-	-	-	-	-	-	1030.0	-	-	-	-	-	-	-
High Rock	622.1	-	-	-	-	-	-	-	622.0	-	-	-1	-	-	-	-
Tuckertown	564.0	-	-	-5	-	-	-	-	563.9	-	-	-5	-	-	-	-
Narrows (Badin)	508.8	-	-4	-1	-	-	-	-	508.6	-	-4	-1	-	-	-	-
Falls	330.2	-	-	-	-	-	-	-	330.2	-	-	-	-	-	-	-
Tillery	278.0	-	-	-	-	-	-	-	278.0	-	-	-	-	-	-	-
Blewett Falls	176.6	-	-	-	-	-	-	-	176.4	-1	-	-	-1	-1	-1	-1

"-" = No modeled change in lake elevation for alternative as compared to baseline condition

Table 5-16 Drought 2 (2006-2009) Average Modeled Lake Elevation Differences for YRWSP Alternatives (Union County 2050 IBT) as Compared to Baseline Current (2012) Conditions

Reservoir	Avg. Elev. (feet)	Difference (inches) from BASE (UC2050_2012)							Avg. Elev. (feet)	Difference (inches) from BASE (2050)						
	Base 2012	Alternative							Base 2050	Alternative						
		1	2A	2B	3	4	5	11		1	2A	2B	3	4	5	11
W. Kerr Scott	1030.1	-	-	-	-	-	-	-	1030.0	-	-	-	-	-	-	-
High Rock	622.9	-	-	-	-	-	-	-	622.9	-	-	-1	-	-	-	-
Tuckertown	564.2	-	-	-2	-	-	-	-	564.1	-	-	-1	-	-	-	-
Narrows (Badin)	508.8	-	-1	-	-	-	-	-	508.8	-	-2	-1	-	-	-	-
Falls	330.4	-	-1	-1	-	-	-	-	330.3	-	-	-	-	-	-	-
Tillery	278.0	-	-	-	-	-	-	-	278.0	-	-	-	-	-	-	-
Blewett Falls	176.5	-	-	-	-	-	-	-	176.5	-	-	-	-	-	-	-

"-" = No modeled change in lake elevation for alternative as compared to baseline condition

W. Kerr Scott Reservoir

Impacts to lake elevations were observed to be negligible in W. Kerr Scott Reservoir as the result of Union County's proposed IBT under Alternatives 1, 2A, 2B, 3, 4, 5 or 11. This is due largely to the fact that the operational rules of this reservoir are not dependent on the downstream APGI or Duke Energy Progress hydroelectric projects. As all proposed IBT alternative withdrawals are downstream of this reservoir, there are no observed impacts to lake elevations in W. Kerr Scott Reservoir under current or future projected basin-wide water demands.

High Rock Lake

As indicated by Tables 5-11, 5-12 and 5-13, while impacts to lake elevations were observed to be negligible in High Rock Lake as the result of Union County's proposed IBT under Alternatives 1, 2A, 2B, 3, 4, 5 or 11, based on current basin water demands, modeling of future basin water demands indicate minor impacts to lake elevations in High Rock Lake under Alternatives 2A (Narrows Reservoir withdrawals) and 2B (Tuckertown Reservoir withdrawals). During the POR, Drought 1 and Drought 2, impacts to lake elevations are considered minor, resulting in elevation deviations from the baseline scenarios approximately 1% to 2% of the time. For all other alternatives (1, 3, 4, 5 and 11), impacts to lake elevations in High Rock Lake are observed to be negligible under current or future basin-wide water demand projections.

As indicated in Tables 5-14, 5-15 and 5-16, with the 2050 demands including the Union County IBT under each Yadkin River Basin alternative (1, 2A, 2B, 3, 4, 5 and 11), annual average High Rock Lake modeled elevations for the POR, Drought 1 and Drought 2 period are no lower than the baseline operations with current basin-wide water demands.

Tables 5-14, 5-15 and 5-16 additionally indicate that with the 2050 demands of the Union County IBT from Tuckertown Reservoir (Alternative 2B), annual average High Rock Lake elevations for the Drought 1 and 2 periods are approximately 1-inch lower, as compared to baseline operations with future (Year 2050) basin-wide water demands. Impacts on elevations are observed to be negligible, on an average annual average basis, for the POR analysis for Alternative 2B. Additionally, impacts are observed to be negligible to High Rock Lake for any of the other alternatives (1, 2A, 3, 4, 5 and 11) for the POR, Drought 1 and Drought 2 periods.

Tuckertown Reservoir

As indicated by Tables 5-11, 5-12 and 5-13, impacts to lake elevations were observed in Tuckertown Reservoir under Alternative 2B, where a Union County IBT would withdraw water from Tuckertown Reservoir. During the POR, impacts to lake elevations are considered minor, resulting in elevation deviations from the baseline scenarios approximately 1% to 2% of the time. However, during both Drought 1 and Drought 2, these impacts are moderate with deviations from the baseline scenarios approximately 10% to 14% of the time during these shorter drought periods. Additionally, minor impacts during Drought 1 and 2 are observed under Alternative 2A (Narrows Reservoir withdrawals), with future projected basin-wide water demands, with deviations approximately 1% to 2% of the time. For all other alternatives (1, 3, 4, 5 and 11), impacts to lake elevations in Tuckertown Reservoir are observed to be negligible, under current and projected future basin-wide water demands.

As indicated in Tables 5-14, 5-15 and 5-16, with the 2050 demands of the Union County IBT from Tuckertown Reservoir (Alternative 2B), annual average Tuckertown Reservoir elevations for the Drought 1 period would be about 5 inches lower and about 2 inches lower during the Drought 2 period as compared to baseline operations with current basin-wide water demands. No impact to average elevations is modeled during the POR for Alternative 2B. Additionally, no other alternative (1, 2A, 3, 4, 5 and 11) is modeled to have more than a negligible impact to Tuckertown Reservoir elevations during the POR, Drought 1 or Drought 2 periods.

Tables 5-14, 5-15 and 5-16 additionally indicate that with the 2050 demands of the Union County IBT from Tuckertown Reservoir (Alternative 2B), annual average Tuckertown Reservoir elevations for the Drought 1 period would be about 5 inches lower and about 1 inch lower during the Drought 2 period as compared to baseline operations with future (Year 2050) basin-wide water demands. No impact to average elevations is modeled during the POR for Alternative 2B. Additionally, no other alternative (1, 2A, 3, 4, 5 and 11) is modeled to have more than a negligible impact to Tuckertown Reservoir elevations during the POR, Drought 1 or Drought 2 periods.

Narrows Reservoir (Badin Lake)

As indicated by Tables 5-11, 5-12 and 5-13, impacts to lake elevations were observed in Narrows Reservoir under both Alternative 2A and 2B, where a Union County IBT would withdraw water from Narrows Reservoir (Alternative 2A) or Tuckertown Reservoir (Alternative 2B). During the POR, impacts to lake elevations are considered minor under Alternative 2B, resulting in elevation deviations from the baseline scenarios approximately 1% of the time. Under Alternative 2A, the impacts are considered moderate during the POR, with elevation deviations from the baseline scenarios approximately 7% of the time. During both Drought 1 and

Drought 2, these impacts are considered moderate under Alternative 2A, with deviations from the baseline scenarios approximately 9% to 12% of the time during these shorter drought periods. Additionally, impacts under Alternative 2B during the Drought 1 period are noted as being moderate when future basin-wide water demands are applied. For all other alternatives (1, 3, 4, 5 and 11), impacts to lake elevations in Narrows Reservoir are observed to be negligible, under current and projected future basin-wide water demands.

As indicated in Tables 5-14, 5-15 and 5-16, with the 2050 demands of the Union County IBT from Narrows Reservoir (Alternative 2A), annual average Narrows Reservoir elevations for the Drought 1 period would be about 4-inches lower and about 1-inch lower for the Drought 2 period, as compared to baseline operations with current basin-wide water demands. Additionally, the proposed withdrawal from Tuckertown Reservoir (Alternative 2B) would lower annual average Narrows Reservoir elevations for the Drought 1 period by about 1-inch. No impact to average elevations is modeled during the POR for any alternative. Additionally, no other alternative (1, 3, 4, 5 and 11) is modeled to have more than a negligible impact to Narrows Reservoir elevations during the Drought 1 or Drought 2 periods.

Tables 5-14, 5-15 and 5-16 additionally indicate that with the 2050 demands of the Union County IBT from Narrows Reservoir (Alternative 2A), annual average Narrows Reservoir elevations would be approximately 1-inch lower over the POR, 4-inches lower during the Drought 1 period and about 1-inch lower for the Drought 2 period, as compared to baseline operations with future (Year 2050) basin-wide water demands. Additionally, the proposed withdrawal from Tuckertown Reservoir (Alternative 2B) would lower annual average Narrows Reservoir elevations for both the Drought 1 and Drought 2 periods by about 1-inch, but no modeled change to average elevations over POR. No other alternative (1, 3, 4, 5 and 11) is modeled to have more than a negligible impact to Narrows Reservoir elevations during the POR, Drought 1 or Drought 2 periods.

Falls Reservoir

As indicated by Tables 5-11, 5-12 and 5-13, impacts to lake elevations were observed in Falls Reservoir under Alternative 2A and 2B, where a Union County IBT would withdraw water from Narrows Reservoir and Tuckertown Reservoir, respectively. During the POR, Drought 1 and Drought 2, impacts to lake elevations are considered minor, resulting in elevation deviations from the baseline scenarios approximately 1% to 2% of the time. For all other alternatives (1, 3, 4, 5 and 11), impacts to lake elevations in Falls Reservoir are observed to be negligible under current and projected future basin-wide water demands.

As indicated in Tables 5-14, 5-15 and 5-16, with the 2050 demands including the Union County IBT under each Yadkin River Basin alternative (1, 2A, 2B, 3, 4, 5 and 11), annual average Falls Reservoir modeled elevations for the POR and Drought 1 periods are no lower than the baseline operations with current basin-wide water demands. However, during the Drought 2 period, withdrawals from Narrows Reservoir (Alternative 2A) and Tuckertown Reservoir (Alternative 2B) result in annual average Falls Reservoir elevations approximately 1-inch lower than the baseline condition. For all other alternatives (1, 3, 4, 5 and 11), impacts are observed to be negligible during the Drought 2 period.

Tables 5-14, 5-15 and 5-16 additionally indicate that with the 2050 demands of the Union County IBT under each Yadkin River Basin alternative (1, 2A, 2B, 3, 4, 5 and 11), annual average Falls Reservoir elevations for the POR, Drought 1 and Drought 2 periods are not modeled as being any lower than the baseline operations with future (Year 2050) basin-wide water demands.

Lake Tillery

As indicated by Tables 5-11, 5-12 and 5-13, impacts to lake elevations were observed to be negligible to Lake Tillery as the result of Union County's proposed IBT under Alternatives 1, 2A, 2B, 3, 4, 5 or 11, based on current basin-wide water demands. Even direct withdrawals from Lake Tillery as proposed under Alternative 1 are not observed to change elevations within the lake. However, under future projected basin-wide water demands during the Drought 1 period only, Union County's proposed IBT under Alternatives 1, 3, 4, 5 and 11 are observed to have minor impacts on elevations within Lake Tillery, with deviations approximately 1% to 2% of the time. Although, elevation impacts are considered negligible for these alternatives during the POR or Drought 2 period, even with the increased projected future basin-wide water demands.

As indicated in Tables 5-14, 5-15 and 5-16, with the 2050 demands of the Union County IBT under Alternatives 1, 2A, 2B, 3, 4, 5 and 11, model results do not indicate a notable difference in annual average Lake Tillery elevations for the POR, Drought 1 and Drought 2 periods as compared to the baseline operations with current basin-wide water demands.

Tables 5-14, 5-15 and 5-16 additionally indicate that with the 2050 demands of the Union County IBT under Alternatives 1, 2A, 2B, 3, 4, 5 and 11, model results do not indicate a notable difference in annual average Lake Tillery elevations for the POR, Drought 1 and Drought 2 periods when compared to the baseline operations with future (Year 2050) basin-wide water demands.

Blewett Falls Lake

As indicated by Tables 5-11, 5-12 and 5-13, minor impacts to lake elevations were observed in Blewett Falls Lake under Alternative 1, 3, 4, 5 and 11, where a Union County IBT would withdraw water from either Lake Tillery (Alternatives 1 and 11), Blewett Falls Lake (Alternative 3), the Pee Dee River (Alternative 4), or the Rocky River (Alternative 5). During the POR, Drought 1 and Drought 2, impacts to lake elevations are considered minor, resulting in elevation deviations from the baseline scenarios approximately 1% to 2% of the time. It is noted that any of the proposed withdrawals (including the non-IBT Alternative 5 Rocky River withdrawal) from Duke Energy Progress' Yadkin-Pee Dee Hydroelectric Project or tributaries flowing to Blewett Falls Lake could have a minor impact on the elevation of Blewett Falls Lake. For alternatives with withdrawals outside of the Yadkin-Pee Dee Hydroelectric Project (2A and 2B), impacts to lake elevations in Blewett Falls Lake are observed to be negligible.

As indicated in Tables 5-14, 5-15 and 5-16, with the 2050 demands of the Union County IBT under Alternatives 1, 2A, 2B, 3, 4, 5 and 11, model results do not indicate a notable difference in annual average Blewett Falls Lake elevations for the POR, Drought 1 and Drought 2 periods when compared to the baseline operations with current basin-wide water demands.

Tables 5-14, 5-15 and 5-16 additionally indicate that with the 2050 demands of the Union County IBT under Alternatives 1, 3, 4, 5 and 11, annual average Blewett Falls Lake elevations for the Drought 1 period would be about 1-inch lower, as compared to baseline operations with future (Year 2050) basin-wide water demands. However, during both the POR and Drought 2 periods, there are no modeled differences in average lake elevations for the alternatives as compared to the baseline condition. Withdrawals under Alternatives 2A and 2B are not modeled to affect Blewett Falls Lake average elevations under the POR, Drought 1 or Drought 2 periods.

Summary

Generally, the CHEOPS^{TM} modeling results for Alternatives 1, 3, 4, 5 and 11, with water withdrawals from Duke Energy Progress operated lakes (Lake Tillery or Blewett Falls Lake) or tributaries flowing thereto, show impacts on lake elevations to be negligible to minor, when compared to the respective baseline scenario. Only slight reductions in elevations were noted in these reservoirs for small percentages of time under the aforementioned alternatives, typically resulting in annual average elevation differences less than ¼ -inch, even with the higher Year-2050 basin-wide water use projections and during extreme drought periods.

However, under Alternatives 2A and 2B, for withdrawals from APGI operated lakes, moderate impacts on reservoir elevations are apparent in Tuckertown Reservoir and Narrows Reservoir due to elevated percentages of the time below defined full pond and/or target operating curve levels, when compared to the baseline scenarios. While average annual lake elevations under these alternatives are typically less than 1-inch below the baseline scenario, the alternatives do appear to increase the percentage of time the reservoirs spend below their full pond and/or target elevations. Based on the modeling results, it appears that withdrawals from APGI operated lakes as proposed in Alternatives 2A and 2B have a greater negative effect on overall basin lake levels than do the proposed withdrawals of Alternatives 1, 3, 4, 5 and 11.

In addition to the PMS metric evaluation, the elevation and storage exceedance curves and comparisons for each reservoir under the various IBT alternatives, as depicted in Appendix E, CD-2, generally reflect only negligible to minor differences between any of the alternatives when compared to baseline conditions over the POR or during the Drought 1 and Drought 2 periods. The greatest differences reflected by these charts confirm the conclusion that Alternatives 2A and 2B have a greater negative (moderate) impact on lake elevations and system-wide water storage, than the other proposed IBT alternatives from the Yadkin River Basin.

Water Withdrawal

Of important consideration to owners of water supply intakes in the Yadkin River Basin lake system is the effect of water withdrawals on lake elevations related to operability of these intakes. In times of reduced system inflow (i.e. droughts), water supply intakes may be vulnerable to inoperability (not being able to take in water from the source) or reduced operability because of falling lake levels. Additional water withdrawals within the lake system increase outflows from the system and can subsequently exacerbate the effect of low lake levels on intake operability.

Given this consideration, the effect of each Union County surface water supply alternative from the Yadkin River Basin was evaluated in CHEOPS^{TM} for their effect on lake elevations, relative to the critical intake elevations in each reservoir. The critical intake is defined as the highest intake in each reservoir, which represents the first intake that could be exposed due to falling lake levels during times of low inflow. This evaluation was completed to determine if any of the IBT alternatives negatively affected lake levels such that other water supply intakes were jeopardized.

Results from the applicable PMS for the model analysis are summarized in the following tables, by reservoir, alternative and baseline scenario comparison (BLY-2012 or BLY-2050). Potential negative impacts, as compared to the "baseline" scenarios, are denoted by "-" (Negligible Impact, with no detectable modeled impact, as compared to baseline), "MI" (Minor Impact, typically resulting in negative impact of >0% and <5%, as compared to baseline), "MO" (Moderate Impact, typically resulting in negative impact of 5% to <15%, as compared to baseline), and "MA" (Major Impact, typically resulting in negative impact of 15% or greater. For detailed results of the PMS, see Appendix E, CD-2.

As shown in the summary tables, there impacts to water supply intakes due to restricted intake operation are observed to be negligible for any of the proposed Yadkin River Basin IBT alternatives (1, 2A, 2B, 3, 4, 5 or 11), as compared to the baseline scenarios for both current and future projected basin-wide water use. Furthermore, under no scenario were there any days in which modeled lake elevations were low enough to restrict water supply intake operation on any reservoir. Additionally, minimum modeled lake elevations remain well above all existing lake intakes. As such, impacts were determined to be negligible ("-"), based on this metric.

Table 5-17 Period of Record (1955 to 2013) Water Withdrawal (Intake) Impacts, Based on Number of Days of Restricted Operation at Lake Located Intakes

Reservoir	Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT							Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuckertown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Narrows (Badin)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tillery	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blewett Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-18 Drought 1 (1999 to 2003) Water Withdrawal (Intake) Impacts, Based on Number of Days of Restricted Operation at Lake Located Intakes

Reservoir	Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT							Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuckertown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Narrows (Badin)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tillery	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blewett Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-19 Drought 2 (2006 to 2009) Water Withdrawal (Intake) Impacts, Based on Number of Days of Restricted Operation at Lake Located Intakes

Reservoir	Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT							Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuckertown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Narrows (Badin)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tillery	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blewett Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Reservoir Discharge

For ecological considerations and certain recreational interests in the Yadkin River Basin the effect of water withdrawals on reservoir discharges (downstream releases) from these lakes is of importance. In times of reduced system inflow (i.e. droughts), the ecological health or recreational uses (e.g. kayaking or canoeing) of the waterway can be negatively affected. During normal periods (i.e. normal inflow), both the APGI and Duke Energy Progress hydroelectric projects are required to make certain downstream releases from the reservoirs under the operating agreements between the two entities and as required under their respective FERC licenses. During periods of reduced inflow to the system, the LIP specifies reductions to these release requirements, based on particular drought stages, while seeking to provide discharges at a level sufficient to maintain the ecological health of the waterway. However, additional water withdrawals within the lake system increase outflows from the system and may subsequently result in reservoir discharges lower than those required under the FERC licenses for the operation of the lake system.

Given this consideration, the effect of each Union County surface water supply alternative from the Yadkin River Basin was evaluated in CHEOPS™ for their effect on discharges, relative to the required downstream releases from these reservoirs. This evaluation was completed to determine if any of the IBT alternatives negatively affected downstream releases such that the waterway's ecological health and certain recreational interests would be jeopardized, as compared to the baseline conditions within the Yadkin River Basin without the proposed IBT.

Results from the applicable PMS for the model analysis are summarized in the following tables, by reservoir, alternative and baseline scenario comparison (BLY-2012 or BLY-2050). Potential negative impacts, as compared to the "baseline" scenarios, are denoted by "-" (Negligible Impact, with no detectable modeled impact, as compared to baseline), "MI" (Minor Impact, typically resulting in negative impact of >0% and <5%, as compared to baseline), "MO" (Moderate Impact, typically resulting in negative impact of 5% to <15%, as compared to baseline), and "MA" (Major Impact, typically resulting in negative impact of 15% or greater. For detailed results of the PMS, see Appendix E, CD-2.

It is noted that for W. Kerr Scott, Tuckertown and Narrows Reservoirs, there are no specified release values considered in the PMS sheets. Only High Rock Lake, Falls Reservoir, Lake Tillery and Blewett Falls Lake have downstream release metrics outlined in the operating agreements and FERC license documents. Typically, the impacts noted in the following tables result from the CHEOPS™ model spending several more days (as compared to the baseline scenario) in a more severe drought stage under a particular alternative. This subsequently results in several more days below the "normal" or highest specified minimum discharge requirement while the model adheres to the reduced discharge requirements during LIP stages.

Table 5-20 Period of Record (1955 to 2013) Reservoir Discharge (Downstream Release) Impacts, Based on Number of Days Below Specified Release Values

Reservoir	Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT							Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	NA							NA						
High Rock	-	-	-	-	-	-	-	-	MI	MI	-	-	-	-
Tuckertown	NA							NA						
Narrows (Badin)	NA							NA						
Falls	-	MI	MI	-	-	-	-	-	MO	MI	-	-	-	-
Tillery	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI
Blewett Falls	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-21 Drought 1 (1999 to 2003) Reservoir Discharge (Downstream Release) Impacts, Based on Number of Days Below Specified Release Values

Reservoir	**Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT**							**Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT**						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	NA							NA						
High Rock	-	-	-	-	-	-	-	-	MI	MI	-	-	-	-
Tuckertown	NA							NA						
Narrows (Badin)	NA							NA						
Falls	-	MI	MI	-	-	-	-	-	MI	MI	-	-	-	-
Tillery	MI	MI	MI	-	-	-	MI	MI	MI	MI	-	-	-	MI
Blewett Falls	-	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-22 Drought 2 (2006 to 2009) Reservoir Discharge (Downstream Release) Impacts, Based on Number of Days Below Specified Release Values

Reservoir	**Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT**							**Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT**						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	NA							NA						
High Rock	-	MI	MI	-	-	-	-	-	-	-	-	-	-	-
Tuckertown	NA							NA						
Narrows (Badin)	NA							NA						
Falls	-	MO	MO	-	-	-	-	-	MO	MO	-	-	-	-
Tillery	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI
Blewett Falls	-	MI	MI	MI	MI	MI	MI	MI	-	MI	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

High Rock Lake

Impacts to downstream releases were observed to be negligible in High Rock Lake as the result of Union County's proposed IBT under Alternatives 1, 2A, 2B, 3, 4, 5 or 11, based on current basin water demands for the POR and Drought 1. However, under current basin water demands for the Drought 2 period, there was a minor impact on downstream releases as more days were spent below the normal February to Mid-May 2,000 cfs daily average release under Alternatives 2A and 2B, resulting in a 1% impact as compared to the baseline. Impacts under any of the other alternatives are observed to be negligible.

With basin-wide future projected 2050 water demands including the 2050 demands of the Union County IBT, minor impacts to downstream releases were noted under Alternatives 2A and 2B for the POR and Drought 1 analysis. These impacts on downstream releases occurred as several more days were spent below the normal February to Mid-May 2,000 cfs daily average release metric, resulting in less than a 1% impact as compared to the baseline. Impacts are negligible for these two alternatives during the Drought 2 period. Additionally, under Year 2050 basin-wide water demand projections there were impacts to High Rock Lake discharges were observed to be negligible for any of the other alternatives (1, 3, 4, 5 and 11) during the POR, Drought 1 or Drought 2 analysis periods.

In general, there are minor reservoir discharge impacts to High Rock Lake under Alternatives 2A and 2B with a proposed Union County IBT withdrawal from Narrows Reservoir and Tuckertown Reservoir, respectively. Impacts to High Rock Lake under other proposed alternatives are considered to be negligible.

Falls Reservoir

Under current basin water demands minor impacts on downstream releases from Falls Reservoir were observed for Alternatives 2A and 2B during the POR and Drought 1 periods, as more days were spent below the normal February through May daily average flow metrics, resulting in a 1 to 3% impact as compared to the baseline. However, during the Drought 2 period, Alternatives 2A and 2B resulted in a moderate impact to the flow release from Falls Reservoir, as more days were spent below the May 16th to May 31st 1,500 cfs normal release metric, as compared to the baseline. This impact is primarily due to the fact that only 23 days are spent below the 1,500 cfs threshold under the baseline conditions, as compared to 26 days for Alternatives 2A and 2B. While representing an impact of only three additional days, it results in a statistical difference of 13%. Under any of the other IBT alternatives (1, 3, 4, 5 and 11) impacts were observed to be negligible with current basin-wide water demands.

With basin-wide future projected 2050 water demands including the 2050 demands of the Union County IBT, minor impacts to downstream releases were noted under Alternatives 2A and 2B are similar to those previously noted for the current basin-wide demands. However, during the Period of Record, the impacts from Alternative 2A are moderate as the time spent below the May 16th to May 31st 1,500 cfs normal release metric is a little more than 5% greater than the baseline condition. Under Year 2050 basin-wide water demand projections impacts to Falls Reservoir discharges were observed to be negligible for any of the other alternatives (1, 3, 4, 5 and 11) during the POR, Drought 1 or Drought 2 analysis periods.

In general, there are only minor impacts to downstream releases from Falls Reservoir under Alternatives 2A and 2B with a proposed Union County IBT withdrawal from Narrows Reservoir and Tuckertown Reservoir, respectively. Impacts to releases from this reservoir under other proposed alternatives are considered to be negligible.

Lake Tillery

Under current basin water demands, minor impacts on downstream releases from Lake Tillery were observed for all Yadkin River Basin IBT Alternatives (1, 2A, 2B, 3, 4, 5 and 11) during the POR and Drought 2 periods, as more days were spent below the spring spawning and continuous minimum flow release targets, resulting in a 1 to 2% impact, compared to the baseline. During the Drought 1 period, Alternatives 1, 2A and 2B and 11 resulted in similar impacts, but Alternatives 3, 4 and 5 resulted negligible impacts. With basin-wide water future projected 2050 water demands and the 2050 demands of the Union County IBT, impacts to downstream releases for all alternatives were similar to those previously noted for the current basin-wide demands.

In general, while all alternatives are shown to impact discharges from Lake Tillery by increasing the times which certain release targets are not met, these impacts are found to be minor (only 1 to 2%) with a proposed Union County IBT withdrawal from the Yadkin River Basin. Even withdrawals from the Rocky River would have a minor impact to Lake Tillery releases due to reduced inflow (from the Rocky River) to the Yadkin-Pee Dee Hydroelectric Project reservoirs.

In the CHEOPS model and in actual operation, any required operating parameter for Blewett Falls will be supported by Tillery since they are the same FERC licensee. An example is when the total Blewett Falls outflows (continuous flow requirement, withdrawals and losses due to evaporation and leakage) cannot be met on any given day from the sum of Blewett Falls usable storage and inflows, Tillery will be scheduled to release sufficient flow to allow Blewett Falls to make the required release without having to violate its minimum elevation rule. Thus, when inflows to Blewett Falls are reduced due to withdrawals from the Rocky River, Tillery may need to release additional flows during low flow periods to ensure Blewett Falls' outflows are met.

Furthermore, impacts to Lake Tillery releases due to upstream water withdrawal alternatives (Alternative 2A and 2B) seem be to slightly greater than any of the other alternatives.

Blewett Falls Lake

Similar to the modeled impacts in discharges from Lake Tillery, minor impacts downstream releases were observed in Blewett Falls Lake for all Yadkin River Basin IBT Alternatives (1, 2A, 2B, 3, 4, 5 and 11) during the Period of Record under both current and future projected basin-wide water demand scenarios, as more days were spent below the normal continuous flow targets throughout the year. These alternatives typically result in an impact of less than 1%, compared to the baseline scenarios. Additionally, during the Drought 1 and Drought 2 periods, impacts from Alternative 1 (proposed withdrawals from Lake Tillery to Blewett Falls discharges were observed to be negligible, while all other alternatives result in a minor impact of typically less than 1%.

In general, while all alternatives are shown to impact discharges from Blewett Falls Lake, by increasing the times which certain release targets are not met, these impacts are found to be minor (<1%) with a proposed Union County IBT withdrawal from the Yadkin River Basin. Even withdrawals from the Rocky River would result in a minor impact to Blewett Falls releases due to reduced inflow (from the Rocky River) to the Yadkin-Pee Dee Hydroelectric Project reservoirs. Furthermore, impacts to Blewett Falls releases under Alternative 1, with a proposed IBT withdrawal from Lake Tillery, seem be to slightly less during times of drought than any of the other alternatives.

Flow Regime below Blewett Falls Lake

While the CHEOPS™ modeling includes each reservoir in the Basin from W. Kerr Scott downstream to Blewett Falls Lake, it does not directly model water quantity below the Blewett Falls dam. However, it is important to evaluate the potential impacts of IBT alternatives on the flow regime below Blewett Falls Lake, for purposes of this EIS evaluation. Therefore, as part of the modeling effort, CHEOPS™ model developers also developed an Excel-based post-processing routine for the riverine section of the Pee Dee River downstream of Blewett Falls Lake to the North Carolina – South Carolina State Line. This post-processing routine evaluates the impacts of each alternative to flow in the river at the State Line, taking into consideration flow discharge from Blewett Falls Lake, flow accretion in the riverine section, as well as water withdrawals and discharges from other water users along this extent of the river.

From the results of this evaluation, the following flow duration (exceedance) curves were developed to compare the IBT alternatives to the baseline conditions for both current (Year 2012) and future (Year 2050) baseline conditions for the POR under current basin-wide water demands (Illustration 5-1), POR under future basin-wide water demands (Illustration 5-2) and POR for current vs. future basin-wide water demands without Union County IBT Alternatives (Illustration 5-3).

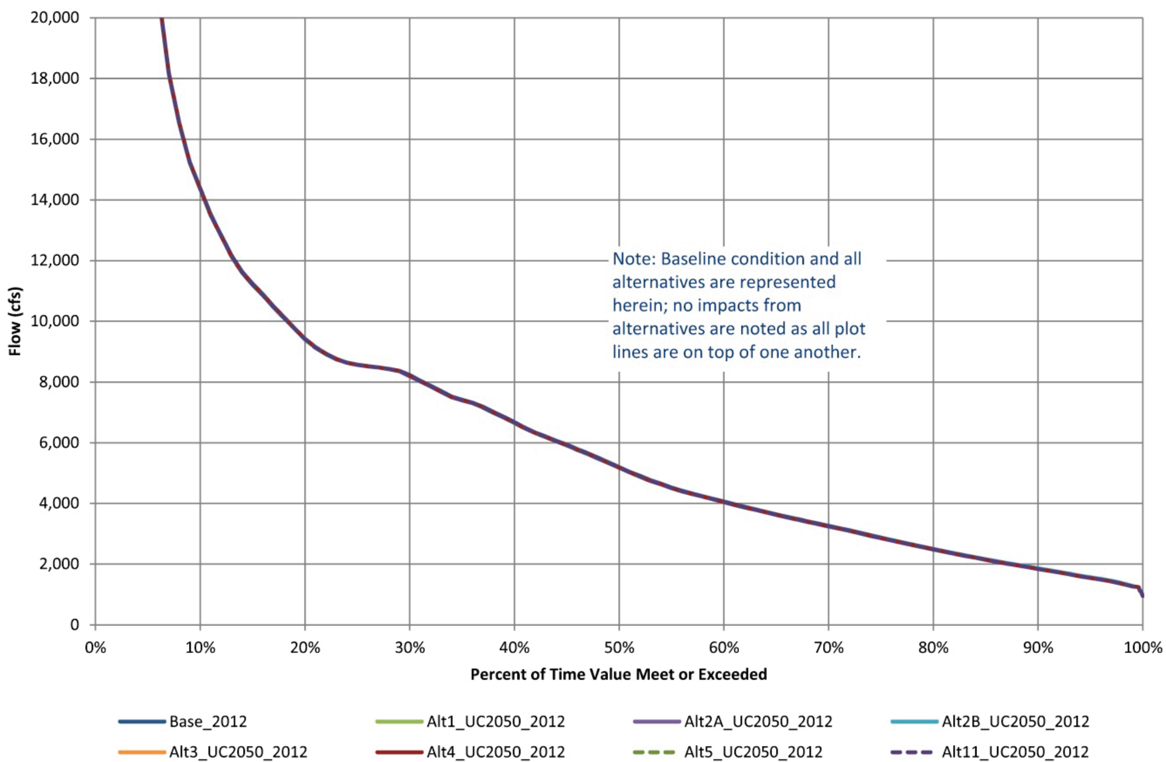

Illustration 5-1 Period of Record Simulated Pee-Dee River Flow for All Months at the NC/SC Line under Current (Year 2012) Basin-Wide Water Demands with Union County IBT Alternatives.

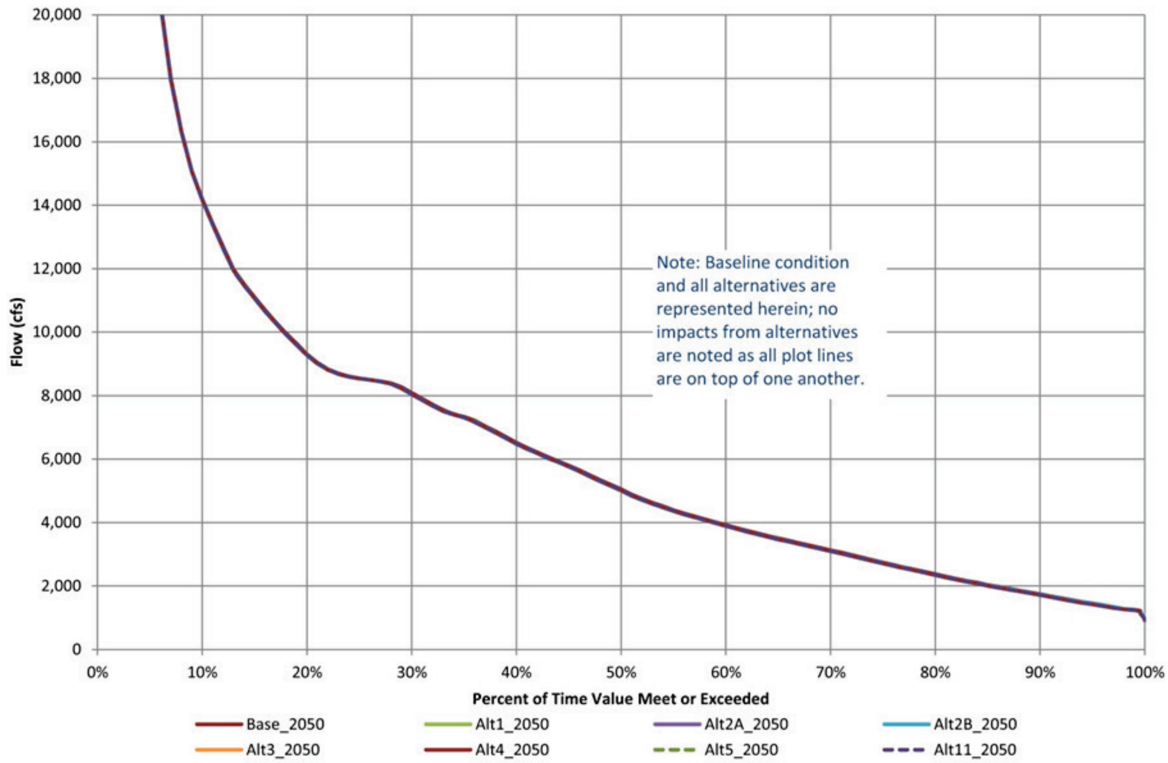

Illustration 5-2 Period of Record Simulated Pee-Dee River Flow for All Months at the NC/SC Line under Future (Year 2050) Basin-Wide Water Demands with Union County IBT Alternatives.

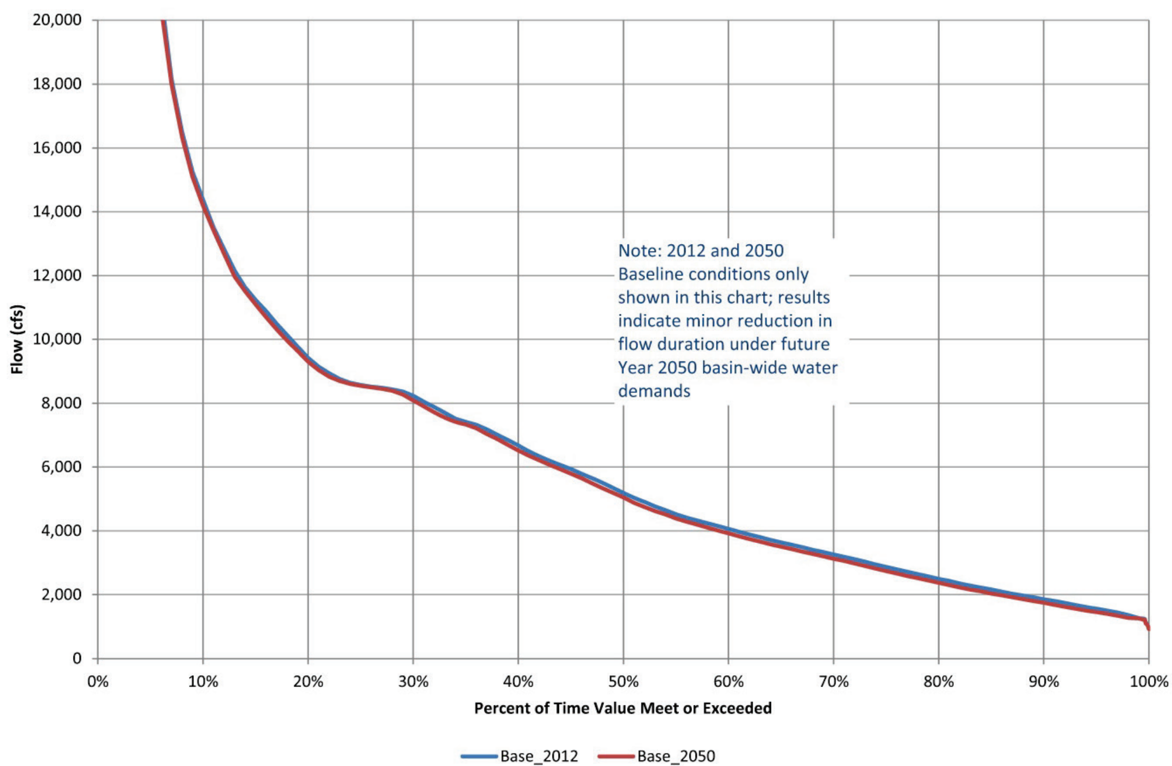

Illustration 5-3 Period of Record Simulated Pee-Dee River Flow for All Months at the NC/SC Line - Current (Year 2012) versus Future (Year 2050) Basin-Wide Water Demands (No Union County IBT Alternatives).

These duration curves can also be found in Appendix E, CD-2 as part of the modeling output for the Yadkin River Basin. Review of these curves indicate that under both current (Year 2012) and future (Year 2050) basin-wide water demands (Illustrations 5-1 and 5-2, respectively), impacts to the flow regime downstream of Blewett Falls Lake which would occur as the result of any of the proposed Union County IBT alternatives are negligible. Of note, however, is a slight flow reduction in this portion of river due to basin-wide water demand projections increasing from the current demand to future (Year 2050) projected demands as indicated in Illustration 5-3. This may be attributed to increased future water demands being projected within the drainage area from below Blewett Falls Lake to the State Line, and is not the result of any proposed Union County IBT alternatives.

Summary

Generally, the CHEOPS™ modeling results show negligible impacts on reservoir discharges, when compared to the respective baseline scenarios. Only minor increases in time spent below respective target release values were observed, typically resulting in minor impacts of 1% to 3% on APGI operated reservoirs (for Alternatives 2A and 2B, only) and less than 1% on Duke Energy Progress operated reservoirs (for all alternatives). However, the noted impacts tend to be greater for Alternatives 2A and 2B within APGI reservoirs during drought periods, while Alternative 1 seems to have the least impact on reservoir discharges, through the overall lake system, when compared to each of the other Yadkin River Basin IBT alternatives.

In addition to the PMS metric evaluation, the outflow exceedance curves for each reservoir under the various IBT alternatives, as depicted in Appendix E, CD-2, generally reflect only negligible to minor differences between any of the alternatives when compared to baseline conditions over the POR or during the Drought 1 and Drought 2 periods. Furthermore, evaluation of impacts to the flow regime below the Blewett Falls development, as analyzed at the North Carolina – South Carolina State Line, indicate the impacts to flow below Blewett Falls Lake are negligible under any of the Yadkin River Basin IBT alternatives.

Water Quantity Management (LIP Occurrence)

In addition to water quantity metrics related to lake elevations, water supply intake operation and reservoir discharges; water quantity management metrics were also evaluated to determine if proposed Union County IBT alternatives would impact the occurrence of the Yadkin-Pee Dee Low Inflow Protocol (LIP). Metrics evaluated included the percent of time in Normal Conditions (non-drought periods with no LIP in effect), number of years attaining particular LIP Stages (0 to 4) and number of years with more than 60 days in particular LIP Stages. The results of this analysis indicate that, based on this metric, impacts to LIP occurrence are negligible for any of the Union County IBT alternatives, as compared to the baseline conditions.

Under current basin-wide water demands, over the POR, the system is in Normal Conditions 99% of the time for the baseline conditions and all alternatives. Additionally, over the POR, there is only a single year in which LIP Stages 0, 1, 2 and 3 are attained, with Stages 0, 1 and 2 being attained for more than 60 days, under all alternatives. Stage 4 is not attained under any of the alternatives or the baseline case. During the Drought 1 Drought of Record period, under the baseline case and each alternative, the system is in Normal Conditions 88% of the five year period and in LIP Stages 0 to 3 12% of the period. During the Drought 2 period, under the baseline case and each alternative, the system is in Normal Conditions 100% of the period with no LIP Stage declared.

Under projected Year 2050 future basin-wide water demands, over the POR, the system is in Normal Conditions 99% of the time for the baseline conditions and all alternatives. Additionally, over the POR, there are two years in which LIP Stage 0 is attained and only a single year in which Stages 1, 2 and 3 are attained. During this year, only Stages 0, 1 and 2 being attained for more than 60 days, under all alternatives. Stage 4 is not attained under any of the alternatives or the baseline case. During the Drought 1 Drought of Record period, under the baseline case and each alternative, the system is in Normal Conditions 87% of the five year period and in LIP Stages 0 to 3 13% of the period (representing a difference of 1% from the current basin-wide water demand baseline case identified in the previous paragraph). During the Drought 2 period, under the baseline case and each alternative, the system is in Normal Conditions 100% of the period with no LIP Stage declared.

Results from the applicable Performance Measure Sheets (PMS) for the model analysis are summarized in the following tables, by reservoir, alternative and baseline scenario comparison (BLY-2012 or BLY-2050). The tables indicate that under current and future projected basin-wide water demands, impacts of the Union County IBT alternatives on LIP occurrence are negligible ("-") when compared to the baseline conditions. For detailed results of the PMS, see Appendix E, CD-2.

Table 5-23 Period of Record (1955 to 2013) Water Quantity Management (LIP Occurrence) Impacts, Based on % of Time in Normal Conditions, Number of Years in LIP Stages and Number of Years with More than 60 Days in LIP Stages

Reservoir	Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT							Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuckertown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Narrows (Badin)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tillery	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blewett Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-24 Drought 1 (1999 to 2003) Water Quantity Management (LIP Occurrence) Impacts, Based on % of Time in Normal Conditions, Number of Years in LIP Stages and Number of Years with More than 60 Days in LIP Stages

Reservoir	**Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT**							**Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT**						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuckertown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Narrows (Badin)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tillery	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blewett Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-

“-” = Negligible Impact“(no detectable impact); MI” = Minor Impact (>0% to <5%); “MO” = Moderate Impact (5% to <15%); “MA” = Major Impact (≥15%)

Table 5-25 Drought 2 (2006 to 2009) Water Quantity Management (LIP Occurrence) Impacts, Based on % of Time in Normal Conditions, Number of Years in LIP Stages and Number of Years with More than 60 Days in LIP Stages

Reservoir	**Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT**							**Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT**						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
W. Kerr Scott	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuckertown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Narrows (Badin)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tillery	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blewett Falls	-	-	-	-	-	-	-	-	-	-	-	-	-	-

“-” = Negligible Impact“(no detectable impact); MI” = Minor Impact (>0% to <5%); “MO” = Moderate Impact (5% to <15%); “MA” = Major Impact (≥15%)

Hydropower Generation

Impacts of each proposed Union County IBT alternative from the Yadkin River Basin on hydropower generation were also evaluated. Impacts to APGI’s Yadkin Hydroelectric Project, consisting of hydroelectric generating stations on High Rock Lake, Tuckertown Reservoir, Narrows Reservoir and Falls Reservoir, and Duke Energy Progress’ Yadkin-Pee Dee Hydroelectric Project, consisting of hydroelectric generating stations on Lake Tillery and Blewett Falls Lake were evaluated through the CHEOPS^{TM} model. Impacts to average hydropower megawatts produced per year and the average equivalent number of homes per year that could be powered by each hydro project were evaluated. Increases in system water withdrawals can reduce the available water storage by which APGI and Duke Energy Progress are able to access from the reservoirs they operate, in order to produce hydropower. Such reductions to hydropower production would result in slight increases in fossil-based power generation to continue meeting energy demands. As such, this is an important metric to evaluate in the comparison of IBT alternatives for Union County.

Results from the applicable Performance Measure Sheets (PMS) for the model analysis are summarized in the following tables, by hydroelectric project, alternative and baseline scenario comparison (BLY-2012 or BLY-2050). Potential negative impacts, as compared to the "baseline" scenarios, are denoted by "-" (Negligible Impact, with no detectable modeled impact, as compared to baseline), "MI" (Minor Impact, typically resulting in negative impact of >0% and <5%, as compared to baseline), "MO" (Moderate Impact, typically resulting in negative impact of 5% to <15%, as compared to baseline), and "MA" (Major Impact, typically resulting in negative impact of 15% or greater. For detailed results of the PMS, see Appendix E, CD-2.

Table 5-26 Period of Record (1955 to 2013) Hydropower Generation Impacts, Based on Average Annual Hydropower Production and Equivalent Number of Homes Powered by the Hydro Projects

Hydroelectric Project	**Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT**							**Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT**						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
Yadkin (APGI)	-	MI	MI	-	-	-	-	-	MI	MI	-	-	-	-
Yadkin-Pee Dee (Duke Energy Progress)	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-27 Drought 1 (1999 to 2003) Hydropower Generation Impacts, Based on Average Annual Hydropower Production and Equivalent Number of Homes Powered by the Hydro Projects

Hydroelectric Project	**Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT**							**Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT**						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
Yadkin (APGI)	-	MI	MI	-	-	-	-	-	MI	MI	-	-	-	-
Yadkin-Pee Dee (Duke Energy Progress)	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Table 5-28 Drought 2 (2006 to 2009) Hydropower Generation Impacts, Based on Average Annual Hydropower Production and Equivalent Number of Homes Powered by the Hydro Projects

Hydroelectric Project	Comparison to BLY-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT							Comparison to BLY-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT						
	Alternative							Alternative						
	1	2A	2B	3	4	5	11	1	2A	2B	3	4	5	11
Yadkin (APGI)	-	MI	MI	-	-	-	-	-	MI	MI	-	-	-	-
Yadkin-Pee Dee (Duke Energy Progress)	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

APGI Yadkin Hydroelectric Project

Under both current and projected future basin-wide water demands, minor impacts on hydropower generation in APGI's Yadkin Hydroelectric Project were noted in the model analysis, under Alternatives 2A and 2B for a proposed Union County IBT withdrawal from Narrows Reservoir and Tuckertown Reservoir, respectively. These alternatives typically resulted in decreased hydropower generation, as compared to baseline conditions, by approximately 0.5% under both the current and future basin-wide water demands for the Period of Record and approximately 1% during Drought 1 and Drought 2 periods. For all other alternatives (1, 3, 4, 5 and 11), where proposed Union County IBT withdrawals would be downstream of APGI's Yadkin Hydroelectric Project, impacts were negligible for APGI's hydropower generation, as compared to the baseline conditions.

Duke Energy Progress Yadkin-Pee Dee Hydroelectric Project

Under both current and projected future basin-wide water demands, minor impacts on hydropower generation in Duke Energy Progress's Yadkin-Pee Dee Hydroelectric Project were noted in the model analysis, under each alternative for a proposed Union County IBT withdrawal from the Yadkin River Basin. These alternatives typically resulted in decreased hydropower generation for the Yadkin-Pee Dee Hydroelectric Project, as compared to baseline conditions, by approximately 0.5% under both the current and future basin-wide water demands for the Period of Record and less than 1% during Drought 1 and Drought 2 periods. Both the proposed withdrawal alternatives from the APGI operated reservoirs (Alternatives 2A and 2B) and proposed withdrawal alternatives from Duke Energy Progress operated reservoirs, or tributaries thereto, result in a minor decrease in hydropower generation capacity for the Yadkin-Pee Dee Hydroelectric Project due to decreased inflow from APGI reservoirs (Alternatives 2A and 2B) and tributaries to Lake Tillery and Blewett Falls Lake (Alternatives 4 and 5) or increased outflow from the Duke Energy Progress lakes (Alternatives 1, 3 and 11).

It should be noted that, when comparing the baseline cases for 2050 projected future basin-wide water demands to current basin-wide water demands, the increase in water demands throughout the basin, not considering Union County's proposed IBT is modeled to impact hydropower generation in the AGPI project approximately 1% during the POR and drought periods (i.e. Drought 1 and 2). However, impacts to Duke Energy Progress' Project are slightly higher due to projected future basin-wide water demands with an impact to generation of approximately 2% during the POR and 3% during drought periods. These impacts are independent of, and not resulting from, any proposed Union County IBT alternative. Rather, they are the inherent result of increased water withdrawals projected throughout the Yadkin River Basin in the future, including withdrawals for thermal power generation, public water supply, industrial use and agriculture and irrigation uses.

In addition to the PMS metric evaluation, the generation detail histograms and data comparisons for each hydropower producing reservoir under the various IBT alternatives, as depicted in Appendix E, CD-2, generally reflect only minor differences between any of the alternatives when compared to baseline conditions over the POR or during the Drought 1 and Drought 2 periods.

5.12.2.7. DIRECT IMPACTS - YADKIN RIVER BASIN WATER QUALITY

The North Carolina Division of Water Resources (DWR) classifies surface water bodies, such as streams, rivers, and lakes, to designate uses to be protected within these waters. These designations carry specific water quality standards which are used to manage all stream, rivers, and lakes in North Carolina. There are four classes of waters [C, B, WS-IV (with a CA), and WS-V)] affected by Alternatives 1, 2A, 2B, 3, 4, 5, and 11. Class C waters are protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Class B waters are designated with the same Class C protections in addition to primary recreation. The designation of WS-IV is classified as waters used as sources of water supply for drinking, culinary, or food processing purposes where a WS-I, II or III classification is not feasible. WS-IV waters are generally in moderately to highly developed watersheds. WS-V watersheds are protected as water supplies which are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or waters formerly used for public water supply. Table 5-29 depicts water classification for reservoir and rivers that would be utilized in Alternatives 1, 2A, 2B, 3, 4, 5, and 11.

Table 5-29 North Carolina Surface Water Classifications

Waterbody	Surface Water Classification	Alternative
Lake Tillery	WS-IV, B, CA	Alternative 1 and 11
Narrows Reservoir	WS-IV, B, CA	Alternative 2A
Narrows Reservoir	WS-IV, B, CA	Alternative 2B
Blewett Falls Lake	WS-IV, B, CA	Alternative 3
Yadkin-Pee Dee River	WS-V, B	Alternative 4 [1]
Rocky River	C	Alternative 5 [1]

[1] Alternative will require reclassification of the waterbody to allow for public water supply use.

The water quality regulations for each WS-IV classified waterbody include either a Critical Area or Protected Area. A Critical Area (CA) is an area adjacent to a water supply intake or reservoir where risk associated with pollution is greater than from the remaining portions of the watershed. A Protected Area is the area adjoining and upstream of the Critical Area in WS-IV water supply in which protection measures are required. Table 5-30 summarizes selected water quality criteria that are applicable to Class C, B, and WS waters in North Carolina.

Table 5-30 Selected North Carolina Water Quality Criteria (NCDENR, Division of Water Resources, 2007)

Parameter	Class C, B, and WS
Temperature	not to exceed 2.8 degrees C (5.04 degrees F) above the natural water temperature, and in no case to exceed 32 degrees C (89.6 degrees F)in lower piedmont waters
Turbidity	receiving water, not designated as trout waters, shall not exceed 50 Nephelometric Turbidity Units (NTU) for lakes, and reservoirs not designated as trout waters, the turbidity shall not exceed 25 NTU
Dissolved Oxygen	not less than a daily average of 5.0 mg/l with a minimum instantaneous value of not less than 4.0 mg/l is applicable in non-trout waters
pH	shall be normal for the waters in the area, which generally shall range between 6.0 and 9.0

No-Action Alternative

Under the no action alternative, Union County would not be able to meet the water supply needs of its current and future residents, and on behalf of the wholesale communities served by the County. This alternative is deficient because Union County's current grandfathered IBT from the Catawba River Basin and the Anson County water supply are not capable of meeting the projected future demand within the Rocky River IBT Basin.

As discussed in Section 2, water needs in Union County's Yadkin River Basin Service Area are projected to continue increasing from their current levels through the Year 2050. The no-action alternative is not a viable option to meet Union County's water needs. Therefore, Union County must secure a reliable water supply from other sources to meet its future demand in this service area.

Direct Impacts – Yadkin River Basin Alternatives

The direct impacts of Alternatives 1, 2A, 2B, 3, 4, 5, and 11 have been evaluated for their impacts to reservoir and river spatial withdrawals in the water column and water quality (DO and temperature). Generally, the results for all alternatives represent negligible impacts to current and future water quality of the Yadkin River Basin due to the proposed Union County IBT.

Water Intake Withdrawal Depth

Withdrawing water from a reservoir differs than directly withdrawing water from a river. Water accumulated in reservoirs has physical and chemical qualities which are significantly different from water flowing in the river. Lakes can have an important impact on water quality. The development of a reservoir causes the stagnation of water which leads to a natural settling of suspended materials which determinate a good transparency of the water and less sensitivity to weather conditions. However, this stagnation of water leads to thermal and chemical stratification which excludes the circulation throughout the water column.

Reservoirs, more so than rivers, become thermally stratified and develop different layers. Illustration 5-4 shows a cross-section of a typical thermal stratified reservoir. The epilimnion has typically warmer water temperatures than the hypolimnion. The epilimnion is generally mixed as a result of surface winds and this layer receives the most sunlight and contains the most phytoplankton. As phytoplankton grow and reproduce, they absorb nutrients from the water and when the phytoplankton die, they sink into the hypolimnion thereby depleting the epilimnion of nutrients. The hypolimnion becomes oxygen depleted before the rest of the water column as a result of dead algal cells sinking and consuming available oxygen as they decompose.

Intake location ultimately affects the spatial and temporal distribution of water which is withdrawn from the waterbody source. The choice of epilimnetic versus hypolimnetic withdrawal can strongly affect reservoir water quality throughout the year. For example, an epilimnetic withdrawal tends to increase the stability of stratification, resulting in less transfer of DO from the epilimnion to the hypolimnion. Whereas, hypolimnetic withdrawal tends to warm the hypolimnion and transport DO into the hypolimnion. However, the warmer hypolimnetic water has lower DO saturation levels and increases respiration rates that deplete oxygen (Dortch, 1998). To ensure minor to no impacts on water quality from intake siting, it is recommended that water be withdrawn from multiple sections of the water column to ensure water quality is not negatively impacted.

Union County proposes to site intake structures at three levels in the water column to withdraw water from the reservoir or river. Actual intake arrangements often vary by water utility, taking into consideration water quality and availability, site characteristics and constraints, as well as redundancy and contingency measures. Illustration 5-5 depicts a conceptual fixed intake layout, including three passive intake screens and two raw water intake lines. The intention of having multiple intakes at different elevations is to provide operational flexibility to respond to lake water quality issues that can vary throughout the year due to lake turnover, algae blooms, and naturally occurring weather events. Thermal stratification varies substantially, and it is strong in the two deepest reservoirs (Narrows and Tillery), generally weak in three reservoirs (High Rock, Tuckertown, and Blewett Falls), and negligible in Falls Reservoir.

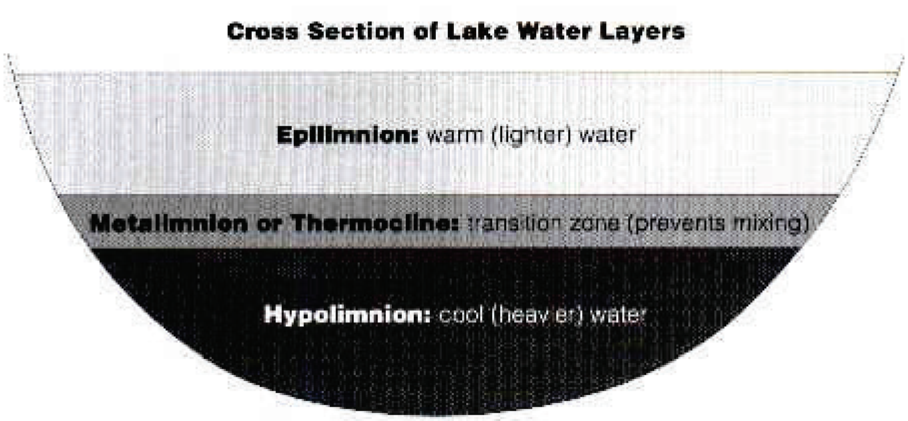

Illustration 5-4 Cross-section of a Thermal Stratified Reservoir (Ecology, 2012).

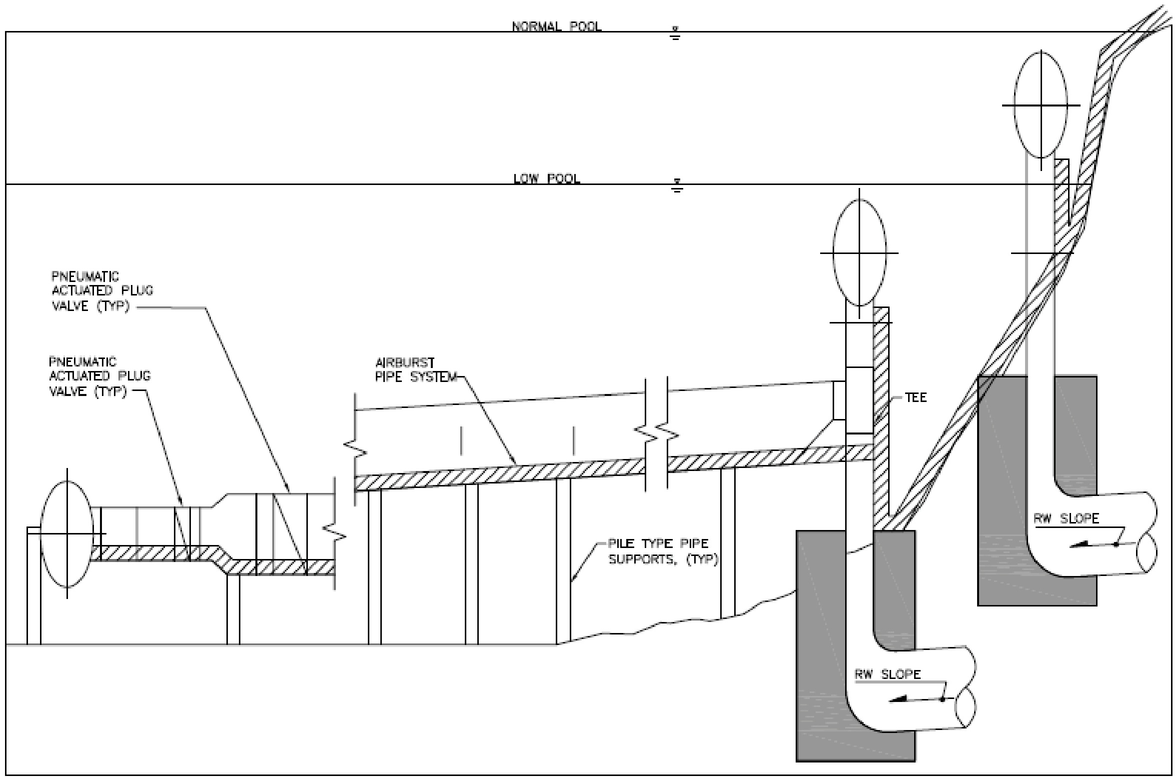

Illustration 5-5 Conceptual Fixed Intakes

Tuckertown Reservoir

According to the Yadkin River Basin Basinwide Assessment Report, symptoms of eutrophication, or high productivity (i.e., elevated pH values; chlorophyll *a,* an indicator of algal growth; nutrient concentrations; and algal blooms, which can result in depleted DO levels), have been documented in Tuckertown Reservoir since 1981 (NCDENR Division of Water Quality, 2002). Generally, Tuckertown Reservoir exhibits consistent surface water temperatures. Tuckertown Reservoir experiences weak thermal stratification which occurs from July to September.

Because of the relatively shallow depths, short retention time, and weak thermal stratification, Tuckertown Reservoir is mixed thermally throughout much of its length. This, in turn, leads Tuckertown Reservoir to exhibit similar water temperatures and DO concentrations throughout the water column. Union County proposes three levels from which to withdraw from the lake, with the upper two levels most frequently used. The lower intake would serve as an emergency intake during extreme drought or lake surface contamination (i.e. algal bloom, petroleum spill, etc.). The lowest level would be below the hydropower operational limit in the reservoir and the upper intakes would be at a sufficient depth to avoid being uncovered during drought. Therefore, water quality impacts from Alternative 2B would be negligible in Tuckertown Reservoir due to the fact water would be withdrawn from multiple intake levels and this reservoir experiences fairly similar water quality parameters throughout the entire water column.

Narrows Reservoir (Badin Lake)

Narrows Reservoir differs from Tuckertown Reservoir due to its deeper waters and defined water processes (i.e. stratification). Narrows Reservoir displays a strong and persistent thermocline near the dam. Thermal stratification begins to develop in May. Typically, by mid-summer, a well-developed epilimnion exists. Reservoir turnover occurs in late summer or early fall.

This defined pattern of stratification can cause impacts to water quality. Siting water intake structures in a lake that experiences stratification is even more important. To withdraw water from one section of the water column (epilimnion or hypolimnion) could cause an adverse impact to water quality. For instance, if water is withdrawn only from the epilimnion, reservoir waters could experience an increase in stratification causing less transfer of DO from the epilimnion to the hypolimnion. In addition, waters downstream of the reservoir could be adversely impacted due to water withdrawn from only one section of the water column, causing changes in water temperature and/or DO concentrations of discharged waters.

Union County proposes three levels from which to withdraw from the lake, with the upper two levels most frequently used. The lower intake would serve as an emergency intake during extreme drought or lake surface contamination (i.e. algal bloom, petroleum spill, etc.). The lowest level would be below the hydropower operational limit in the reservoir and the upper intakes would be at a sufficient depth to avoid being uncovered during drought. However, with a stratified lake, there is a greater probability of withdrawing waters that display certain water quality parameters which have different concentrations than other sections of the water column. Therefore, Alternative 2A would have the potential to create minor impacts on water quality in Narrows Reservoir due to the fact that the majority of water withdrawals would be in the upper two-thirds of the water column of a thermally stratified lake. However, such impacts would not be readily noticeable to other water users in Narrows Reservoir.

Lake Tillery

At the normal maximum operating elevation of 277.3 feet msl, Lake Tillery has an average depth of 23.6 feet and a maximum depth of approximately 71 feet at the dam. The average retention time for the reservoir is approximately 8.3 days. Lake Tillery is a warm-water, moderately productive reservoir, with moderate amounts of nutrients and ions. Generally, seasonal lake thermal stratification and DO deficits in the hypolimnion occur from May through October, depending upon annual climatic factors, river basin inflow, and power generation levels. As summer progresses, the thermocline shifts from 2-3 meters from the surface in May to 5-6 meters from the surface in June and July and then shifted upwards again in August to 2-3 meters from the surface.

This defined pattern of stratification can cause impacts to water quality. Siting water intake structures in a lake that experiences stratification is even more important. Withdrawing water from one section of the water column (epilimnion or hypolimnion) could cause an adverse impact to water quality. For instance, if water is withdrawn only from the epilimnion, reservoir waters could experience an increase in stratification causing less transfer of DO from the epilimnion to the hypolimnion. In addition, waters downstream of the reservoir could be adversely impacted due to water withdrawn from only one section of the water column, causing changes in water temperature and/or DO concentrations of discharged waters. There is potential for a single withdrawal point (single level intake) to result in violations of state water quality standards. However, withdrawing water from multiple sections (multi-level intake) of the water column based on seasonal adjustments to thermocline conditions reduces this potential for violations of state water quality standards.

Union County proposes three levels from which to withdraw from the lake, with the upper two levels most frequently used. The lower intake would serve as an emergency intake during extreme drought or lake surface contamination (i.e. algal bloom, petroleum spill, etc.). The lowest level would be below the hydropower operational limit in the reservoir and the upper intakes would be at a sufficient depth to avoid being uncovered during drought. However, with a stratified lake, there is a greater probability of withdrawing waters that display certain water quality parameters which have different concentrations than other sections of the water column. Therefore, Alternatives 1 and 11 would have the potential to create minor impacts on water quality in Lake Tillery due to the fact that the majority of proposed water withdrawals would be in the upper two-thirds of the water column of a thermally stratified lake. However, such impacts would not be readily noticeable to other water users in Lake Tillery.

Blewett Falls Lake

The average depth of Blewett Falls Lake is 10.8 feet with a maximum depth of approximately 35 feet. Blewett Falls Lake is a shallow, eutrophic lake (high biological productivity with turbid water). Generally, Blewett Falls Lake is uniform in water quality parameters and stratification is weak throughout the year.

Because of the relatively shallow depths, short retention time, and weak thermal stratification, Blewett Fall Lake is mixed thermally throughout much of its length. This, in turn, leads Blewett Falls Lake to exhibit similar water temperatures and DO concentrations throughout the water column. Union County proposes three levels from which to withdraw from the lake, with the upper two levels most frequently used. The lower intake would serve as an emergency intake during extreme drought or lake surface contamination (i.e. algal bloom, petroleum spill, etc.). The lowest level would be below the hydropower operational limit in the reservoir and the upper intakes would be at a sufficient depth to avoid being uncovered during drought. Therefore, water quality impacts from Alternative 3 would be negligible in Blewett Falls Lake due to the fact water would be withdrawn from multiple intake levels and this reservoir experiences fairly similar water quality parameters throughout the entire water column.

Pee-Dee River

Natural mixing of riverine water sources is typically sufficient to eliminate the need for intake structures at multiple elevations. However, Union County proposes to use multiple intakes for intake redundancy and sufficient water yield. Alternative 4 water demands would necessitate only a small proportion of the total water within the Pee Dee River be withdrawn at this location. Therefore, water quality impacts from Alternative 4 would be negligible in the Pee Dee River due to the fact that water would be withdrawn through multiple intakes ensuring water quality remains at its current levels.

Rocky River

Natural mixing of riverine water sources is typically sufficient to eliminate the need for intake structures at multiple elevations. However, when a river is shallow or does not have significant flow, withdrawals in any section of the water column could potentially cause adverse effects to water quality. In order to ensure adequate depth in the river at the proposed location, a low profile dam may need to be installed to achieve sufficient water yield for Union County's proposed YRWSP. The impounding of water brings changes in water quality. This low profile dam could cause this section of the river to exhibit reservoir characteristics instead of the current riverine characteristics, resulting in changes to current water quality and quantity. In addition, Alternative 5 water demands would necessitate a large portion of the total water within the Rocky River be withdrawn at this location. Therefore, Alternative 5 has the potential to cause adverse (moderate to potentially major) impacts to water quality and quantity based on the topography and flows of Rocky River and the potential need for a low profile dam to operate a raw water intake.

Summary

No impacts to water quality due to intake depth in the water column are anticipated under Alternatives 2b, 3, and 4. Under these alternatives, water quality impacts from the proposed water withdrawal options would be negligible because Tuckertown Reservoir, Blewett Falls Lake, the Yadkin-Pee Dee River, generally experience fairly similar water quality parameters throughout the entire water column. However, the reservoirs (Narrows Reservoir and Lake Tillery) that exhibit stratification are more likely to be impacted by water withdrawals from certain depths in the water column. Alternatives 1, 2A, and 11 would have the potential to have minor impacts on water quality in Lake Tillery and Narrows Reservoir due to the fact that the majority of water withdrawals would be in the upper two-thirds of the water column of a thermally stratified lake. However, such impacts would not be readily noticeable to other water users in Lake Tillery. The Rocky River could experience the greatest adverse (moderate to potentially major) impacts on water quality as a result of insufficient depth and flows at the proposed intake location. Alternative 5 would potentially require a low profile dam to achieve sufficient water yield for Union County's proposed YRWSP, and this alternative would use a large portion of the total water within the Rocky River. Therefore, Alternative 5 has the potential to have major impacts on water quality in the Rocky River which could result in violations of state water quality standards.

Dissolved Oxygen and Temperature

Dissolved Oxygen (DO) is a measure of the amount of gaseous oxygen dissolved in an aqueous solution. Oxygen enters into water by diffusion from the surrounding air, by aeration or rapid movement, and as a waste product of photosynthesis. There are many factors which reduce water's ability to hold oxygen. The amount of oxygen held depends greatly on the temperature of the water. As water temperature increases, DO concentrations in the water decreases. Other factors which influence DO concentrations are the levels of other solid, chemical, or gas compounds present in the water. Most deep reservoirs are typically thermally stratified as a result of surface heating and wind mixing. Water temperature regulates biotic growth rates and life stages and defines fishery habitat (warm-, cool-, or cold-water).

A monthly water quality survey program was conducted in accordance with the Yadkin-Pee Dee River Hydroelectric Project (FERC No. 2206) at the Tillery and Blewett Falls reservoirs during 2004 to characterize the existing water quality conditions. In addition, a water quality monitoring study was conducted in accordance with the Yadkin Hydroelectric Project (FERC No. 2197) in High Rock, Tuckertown, Narrows, and Falls Reservoirs and associated tailwaters from 1999-2003. Reservoir water quality is determined by several factors including the water quality of inflows, hydraulic retention time, reservoir depth, and the level that water is withdrawn from it.

High Rock Lake

River flow in the Yadkin River is regulated by seven developments, five of which are located downstream of High Rock Lake (Tuckertown Reservoir, Narrows Reservoir, Falls Reservoir, Lake Tillery, and Blewett Falls Lake). W.S. Kerr Reservoir is the only major development upstream of High Rock Lake. Water released from High Rock Lake provides the majority of the inflow to the downstream developments. High Rock Lake is a relatively shallow reservoir that, at full pool, extends about 19 river miles upstream to near the confluence of the South Yadkin and Yadkin rivers. The lake has an average depth of 17 feet and a maximum depth of 62 feet. Upstream land management practices and urbanization have historically added to an already heavy sediment load in High Rock Lake. This heavy sediment load reduces the overall storage capacity of High Rock Lake. The upper portion of the lake is listed as impaired due to standards violations for chlorophyll a, low DO, and turbidity. While the Abbotts Creek Arm is listed as impaired due to standards violations for DO and turbidity, the lower portion of the lake is listed as impaired for turbidity. Multiple studies were conducted in the 1970s on water quality in High Rock Lake, and generally High Rock Lake is classified as highly eutrophic, but because of the short residence time, the lake more closely resembles a slow-moving river than a typical lake.

As discussed in the water quantity evaluation section for *Lake Levels - Aesthetics,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within High Rock Lake. As a result, Alternatives 1, 3, 4, 5 or 11 would not cause reservoir fluctuations. Alternatives 2A and 2B would cause minor impacts during drought conditions only. These minor impacts to reservoir elevations would occur only 1-2 percent of the time. Given the relatively small amount of time reservoir elevations would fluctuate, DO concentration and water temperature should remain at current levels a vast majority of the time. Therefore, only Alternatives 2A and 2B would have minor impacts to DO concentration or water temperature in High Rock Lake during drought conditions.

Tuckertown Reservoir

Tuckertown Reservoir has two small tributary arms and receives almost all of its flow from High Rock Reservoir. With water quality similar to that found in the lower portion of High Rock Reservoir, Tuckertown Reservoir is turbid with a shallow photic zone (NAI, 2005). Generally, weak thermal stratification of the water column occurs during the summer months with a few degrees difference between surface and bottom temperatures. Past monitoring has shown DO depletion in deeper waters at Tuckertown Reservoir which typically extends from May through October or November, but anoxic conditions are usually limited to the summer months.

As discussed in water quantity evaluation section for *Lake Levels - Aesthetics,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Tuckertown Reservoir. As a result, only Alternative 2B would cause minor impacts to reservoir elevations under normal conditions. These minor impacts to reservoir elevations would occur only 1-2 percent of the time. However, during drought conditions Alternative 2A would cause minor impacts whereas Alternative 2B would cause moderate impacts to reservoir elevations. Moderate impacts would result in reservoir elevation fluctuations at least 5 percent of the time. Therefore, Alternative 2B would have minor impacts on DO concentration or water temperature in Tuckertown Reservoir under normal conditions. However, during drought conditions Alternative 2A and 2B would cause minor to moderate impacts to water quality due to the fact that fluctuations in reservoir elevations would occur.

Narrows Reservoir (Badin Lake)

Although Narrows Reservoir receives most of its flow from Tuckertown Reservoir, the Gladys Fork Arm is a major tributary to the reservoir. Past monitoring studies found that Narrows Reservoir had greater water clarity and lower concentrations of suspended solids, nutrients and algal biomass than the two upstream reservoirs, High Rock and Tuckertown Reservoirs, and better surface DO concentrations than Falls Reservoir which is downstream (NAI, 2005). Although surface waters are less turbid than the upstream reservoirs (High Rock and Tuckertown), the photic zone is still relatively shallow. Narrows Reservoir differs from Tuckertown Reservoir because of its deeper waters and exhibits stratification with a well developed thermocline near the Narrows Reservoir dam.

As discussed in the water quantity evaluation section for *Lake Levels - Aesthetics,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Narrows Reservoir. As a result, only Alternatives 2A and 2B would cause minor to moderate impacts on reservoir elevations. In addition, Alternatives 2A and 2B would cause moderate impacts to reservoir elevations during Drought 1 conditions. These moderate impacts to reservoir elevations would occur at least 5 percent of the time. However during Drought 2 conditions, Alternative 2A would cause moderate impacts whereas Alternative 2B would cause minor impacts. Due to decreases in reservoir elevation under Alternative 2A and 2B during normal and drought conditions, water temperatures could increase causing DO concentrations to decrease. Therefore, Alternative 2A would have moderate impacts on DO concentration and water temperature in Narrows Reservoir, whereas 2B would have moderate impacts only during Drought 1 conditions and minor impacts during normal and Drought 2 conditions. Given these impacts on reservoir elevations, DO concentrations and water temperatures in Narrows Reservoir could be adversely impacted.

Falls Reservoir

Falls Reservoir is a small (203-acre) run-of-river impoundment. Generally water flows through the reservoir relatively quickly which results in the lake experiencing no eutrophication problems. There is no seasonal drawdown in the reservoir because of its limited storage capacity. Lower nutrient loadings in Falls Reservoir result in mesotrophic, intermediate productivity conditions. Due to the short retention time in Falls Reservoir, operations and DO conditions at Narrows Reservoir strongly influence DO concentrations in the Falls Reservoir tailrace. However, low DO concentrations occur much less frequently, less than 5 percent of the time, in the Falls Reservoir tailrace than in the other three upstream impoundment tailraces (High Rock Lake, Tuckertown Reservoir, and Narrows Reservoir).

As discussed in the water quantity evaluation section for *Lake Levels - Aesthetics,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Falls Reservoir. As a result, only Alternative 2A would cause minor impacts to reservoir elevations under normal conditions. These minor impacts to reservoir elevations would occur only 1-2 percent of the time. Under 2050 demands, Alternatives 2A and 2B would have moderate impacts to DO concentrations and water temperatures as a result of reservoir elevation fluctuations. However, during drought conditions only Alternatives 2A and 2B would have minor impacts. Given the relatively small amount of time reservoir elevations would fluctuate, DO concentration and water temperature should remain at current levels a majority of the time. Therefore, only Alternatives 2A and 2B would have minor to moderate impacts on DO concentration or water temperature in Falls Reservoir due to the fact that fluctuations in reservoir elevations would occur only a small percentage of the time.

Lake Tillery

Lake Tillery exhibited a defined seasonal pattern of temperature stratification and DO depletion during water quality studies conducted in 2004[1]. The 2004 study revealed the reservoir was isothermal with DO concentrations above 5 mg/l during winter, early spring, and fall months (January through April and September through December). DO concentrations were stratified in the lake during June, July, and August and DO concentrations were less than 5.0 mg/L below 8 meters. Lake Tillery destratified in September, when DO concentrations ranged from 7.0 to 5.8 mg/L throughout the water column. The lake remained destratified during October and November. Generally, the differential in temperature between surface and bottom waters increases in May through August. Lake Tillery experienced very strong top to bottom differences in DO during the temperature stratification period with low to anoxic DO concentrations (<1 to 4 mg/l).

Lake Tillery has a short hydraulic retention time (average of 8.3 days), coupled with the “filtering effect” of the four upstream reservoirs (i.e., High Rock, Lake Tuckertown Reservoir, Narrows Reservoir, and Falls Lake), influence the water quality of the reservoir. The filtering effect of the upstream reservoirs causes lower turbidity levels in Lake Tillery due to decreased amounts of

[1] See License Application for Yadkin-Pee Dee Hydroelectric Project (FERC No. 2206) filed on April 26, 2006.

sediment traveling downstream. In addition, the upstream reservoirs will also impact the trophic status and nutrient and solids concentrations in Lake Tillery. A North Carolina Department of Environment and Natural Resources, Division of Water Quality (DWQ) assessment of the lake in 1999 rated the reservoir as mesotrophic, owing to its relatively short hydraulic retention time, water clarity exceeding one meter in depth, and low algal productivity relative to moderate amounts of nutrients. Long-term data collected by the DWQ and Progress Energy indicated the water quality conditions in the lake have not appreciably changed since the 1980s (NCDENR Division of Water Quality, 1998).

As discussed in the water quantity evaluation section *for Lake Levels* - *Aesthetics,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Lake Tillery. As a result, Alternatives 1, 2A, 2B, 3, 4, 5 or 11 would not cause apparent reservoir fluctuations on average during the Period of Record. Ensuring reservoir elevations don't fluctuate throughout the year would maintain current water quality in Lake Tillery. In addition, no discharge flows would be introduced under Alternatives 1, 2A, 2B, 3, 4, and 5. Generally, the reservoir's water quality is influenced by river inflow, power plant operations, reservoir depth, precipitation, and any additional water introductions. Therefore, impacts from Alternatives 1, 2A, 2B, 3, 4, and 5 on DO concentration or temperature in Lake Tillery would be negligible due to the fact that water withdrawals would to not cause significant fluctuations in reservoir elevations and no return flows would be introduced into the reservoir. However, Alternative 11 could cause minor impacts to water temperature and DO concentrations based on the discharge of treated wastewater.

During Drought 1 conditions, however, Alternatives 1, 2A, 2B, 3, 4, 5, and 11 would cause minor impacts to reservoir elevations. These minor impacts to reservoir elevations would occur only 1-2 percent of the time.

Blewett Falls Lake

Blewett Falls Lake does not exhibit the same water column formation as Lake Tillery. Blewett Falls Lake has no well-defined epilimnion, thermocline, and hypolimnion layers during stratification. The shallow nature of the lake, coupled with river inflows and power plant operations, influences the temperature stratification and DO concentrations within the reservoir. The lake experiences weak to moderate temperature stratification during the summer months which is in contrast Lake Tillery. In addition, Blewett Falls Lake did not have as large a volume of anoxic water like Lake Tillery. This seasonal DO depletion is typically confined to the bottom 2-3 meters of the reservoir.

For Blewett Falls Lake the 2004 study[2] indicated that DO concentrations were uniform vertically during April, then stratified and decreased with depth from May through August and became destratified and uniform from September through November. Water temperatures in the reservoir follow an annual seasonal cycle with minimum temperature ranging from 6º to 8ºC and maximum temperatures ranging from 28º to 32ºC.

[2] See License Application for Yadkin-Pee Dee Hydroelectric Project (FERC No. 2206) filed on April 26, 2006.

As discussed in the water quantity evaluation section for *Lake Levels*, *Aesthetics,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Blewett Falls Lake. As a result, Alternatives 1, 3, 4, 5, and 11 would cause minor impacts to reservoir elevations. These minor impacts to reservoir elevations would occur only 1-2 percent of the time. Given the relatively small amount of time reservoir elevations would fluctuate, DO concentration and water temperature should remain at current levels a majority of the time. During Drought 1 conditions, all alternatives (1, 2A, 2B, 3, 4, 5, and 11) would cause minor impacts to reservoir elevations. However, during Drought 2 conditions only Alternatives 1, 3, 4, 5, and 11 would have minor impacts, whereas Alternatives 2A and 2B would have negligible impacts. Therefore, Alternatives 1, 3, 4, 5, and 11 would have minor impacts on DO concentration or water temperature in Blewett Falls Lake due to the fact that fluctuations in reservoir elevations would occur only a small percentage of the time. In addition, under certain drought conditions all alternatives would also have a minor impact on DO concentrations and water temperatures.

Pee Dee and Rocky Rivers

In the Pee Dee River, approximately 4 miles downstream of Lake Tillery, water temperatures can reach approximately 36°C in a shallow open run area and then decrease to less than 32°C downstream of the Rocky River confluence. DO concentrations between Lake Tillery and Blewett Falls Lake are influenced by discharges from the Tillery powerhouse, spills at Tillery dam, and inflows from several tributaries. DO concentrations increase with increased distance from the powerhouse. These improved DO conditions are largely due to re-aeration, as water flows through a series of shoals, and inflow from the Rocky River. Re-aeration continues to increase DO concentrations downstream of the Rocky River. However, inflows from several of the tributaries to this reach (i.e., Turkey Top, Brown, Cedar, and Savannah creeks) sometimes have low DO concentrations, which limit improvement in DO concentrations, particularly during low flow periods.

The Rocky River, which is the main source of accretion flows within the Lake Tillery tailwaters is unregulated and has a flashy flow regime partly due to runoff from the urban areas near Charlotte. The Rocky River has higher total nitrogen concentrations than the Lake Tillery tailrace, which results in higher total nitrogen concentrations downstream of its junction with the Pee Dee River, including the Blewett Falls tailrace (FERC, 2008). The Rocky River or its tributaries is listed in the North Carolina 303(d) list for copper, turbidity and impaired biological integrity (NCDENR, Division of Water Quality, 2004).

Run-of-river intakes differ from reservoir intakes because they are designed to operate within a wide range of river levels. The intakes need to be designed with additional considerations for protection of facility from debris and sediment, fish entrainment, operation during flooding or drought conditions, etc. Generally, these intakes do not alter river elevation levels unless the river is shallow. Water withdrawals from the Pee Dee River (Alternative 4) should not affect river levels based on the river's current topography (i.e. wide width and deep maximum depth). The major influence on DO concentrations and water temperature in the Pee Dee River come from upstream impoundments and water releases. Under past hydropower operations, the tailwaters of Lake Tillery has DO concentrations that did not meet applicable state water quality criteria during late spring to early fall. However, during the licensing process of the Yadkin Hydroelectric Project (FERC No. 2197) and Yadkin-Pee Dee Hydroelectric Project (FERC No. 2206) a settlement was agreed upon to increase the rate of water moving through the system and lower the effects of biochemical oxygen demand on DO to increase DO concentrations in the tailwaters through the operation of turbine aeration facilities. This approach is intended to enhance DO concentrations in the tailwaters of Lake Tillery to ensure the waters downstream of Lake Tillery meet state water quality standards. Therefore, water quality impacts from Alternative 4 would be negligible within the Pee Dee River. The only impacts from Alternative 4 were indirect and minor in Blewett Falls Lake due to slight reservoir elevation fluctuations.

However, Alternative 5 has the potential to cause moderate to major impacts to water quality and other resources within the Rocky River. The Rocky River in the vicinity of Alternative 5 is several hundred feet wide but is shallow with a flat slope. In order to ensure adequate depth in the river at the proposed location, a low profile dam may need to be installed to achieve sufficient water yield for Union County's proposed YRWSP. This dam could have potential adverse effects to not only water quality, but other resources, such as fisheries. The impounding of water brings changes in water quality. This low profile dam could alter temperature and sediment content. Also, the dam could cause the re-suspension of some chemicals when low oxygen conditions trigger certain chemical reactions in the bottom sediments where those chemicals have settled. This low profile dam could cause this section of the river to exhibit reservoir characteristics instead of the current riverine characteristics, resulting in DO concentrations and water temperatures behind the low profile dam to differ from other sections of the Rocky River upstream and downstream of the proposed water intake. In addition to the potential water quality changes, aquatic habitat could be disturbed or permanently eliminated as a result of construction of a low profile dam. While Alternative 5 has the same indirect impacts to Blewett Falls Lake as Alternative 4, adverse water quality impacts on the source water body (Rocky River) are more likely with Alternative 5 than Alternative 4. Therefore, Alternative 5 has the greater potential to cause adverse impacts to water quality and other aquatic resources based on the topography of the Rocky River and the potential need for a low profile dam to operate a raw water intake.

Summary

Generally, there are only negligible to minor water quality impacts projected under Alternatives 1, 3, 4, and 11. However, the minor impacts as a result of Alternative 11 are primarily the result of introducing treated wastewater back into Lake Tillery and not due to causing reservoir elevation fluctuations like the other alternatives. Minor to moderate impacts were observed under Alternatives 2A and 2B due to elevated percentages of time below defined full pond when compared to the baseline scenarios. In addition, during drought conditions, Alternatives 2A and 2b would cause moderate impacts to DO concentrations and water temperatures due to the fact that fluctuations in reservoir elevations occur at least 5 percent of the time. Alternatives 2A and 2B would have a greater adverse effect on water quality than the proposed withdrawal of Alternatives 1, 3, 4, and 11. The Rocky River could experience the greatest adverse impacts on water quality as a result of insufficient depth and flows at the proposed intake location.

Alternative 5 would potentially require a low profile dam to achieve sufficient water yield for Union County's proposed YRWSP, and this alternative would use a large portion of the total water within the Rocky River. Therefore, Alternative 5 has the potential to have major impacts on water quality in the Rocky River. Tables 5-31 and 5-32 provide summaries indicating impacts during normal and drought conditions, respectively, for Alternatives 1, 2A, 2B, 3, 4, 5, and 11.

Table 5-31 Summary of Impacts to Water Quality During Normal Conditions for Alternatives 1, 2A, 2B, 3, 4, 5, and 11 (Source: Staff, November 2014).

Waterbody	Alternative						
	1	2A	2B	3	4	5	11
High Rock Lake	-	-	-	-	-	-	-
Tuckertown Reservoir	-	-	MI	-	-	-	-
Narrows Reservoir	-	MI to MO	MI to MO	-	-	-	-
Falls Reservoir	-	MI to MO	MO	-	-	-	-
Lake Tillery	-	-	-	-	-	-	MI
Blewett Falls Lake	MI	-	-	MI	MI	MI	MI
Pee Dee River	-	-	-	-	-	-	-
Rocky River	-	-	-	-	-	MO to MA	-

"-" = Negligible Impact"; MI" = Minor Impact; "MO" = Moderate Impact; "MA" = Major Impact

Table 5-32 Summary of Impacts to Water Quality During Drought Conditions for Alternatives 1, 2A, 2B, 3, 4, 5, and 11 (Source: Staff, November 2014).

Waterbody	Alternative						
	1	2A	2B	3	4	5	11
High Rock Lake	-	MI*	MI	-	-	-	-
Tuckertown Reservoir	-	MI	MO**	-	-	-	-
Narrows Reservoir	-	MO	MI to MO	-	-	-	-
Falls Reservoir	-	-	-	-	-	-	-
Lake Tillery	MI	MI	MI	MI	MI	MI	MI
Blewett Falls Lake	MI	none to MI	none to MI	MI	MI	MI	MI
Pee Dee River	-	-	-	-	-	-	-
Rocky River	-	-	-	-	-	MOI to MA***	-

"-" = Negligible Impact"; MI" = Minor Impact; "MO" = Moderate Impact; "MA" = Major Impact

5.12.3. Surface Water Quantity and Quality - Catawba River Basin

5.12.3.1. INTRODUCTION

As part of the Duke Energy's Federal Energy Regulatory Commission (FERC) relicensing for the Catawba-Wateree Hydroelectric Project (Project No. 2232), a CHEOPS^{TM} water quantity/hydro operations model was developed to support the Catawba-Wateree Hydroelectric Project Federal Energy Regulatory Commission (FERC) relicensing using the proprietary CHEOPS™ (Computerized Hydro Electric Operations Planning Software) platform and included the eleven hydroelectric developments on the Catawba River from Bridgewater (Lake James) through Wateree (Lake Wateree) (HDR, 2014a).

Recent enhancements to this model have been made by the Catawba-Wateree Water Management Group (CWWMG) as part of their Catawba-Wateree Water Supply Master Plan for the Basin, including updated water demand projections for the basin. The CWWMG, with funding provided by the North Carolina Division of Water Resources (NCDWR), contracted with HDR Engineering, Inc. of the Carolinas (HDR) to update an existing operations model of the Catawba-Wateree Hydroelectric Project (HDR, 2014a). This updated model is currently being vetted through the State of North Carolina for acceptance as the state-approved water quantity model for the Catawba River Basin, in accordance with SL143-2010.

The Catawba River Basin CHEOPS™ model was specifically used as part of the Union County YRWSP EIS to evaluate the direct effects of the proposed water withdrawals for Alternatives 6 and 7 on water quantity.

5.12.3.2. MODEL FEATURES

The model was initially constructed for Duke Energy's FERC relicensing process and includes the following features as used by the CWWMG for the basin's Water Supply Master Plan:

- An 82-year hydrological record from 1929 through 2010.
- Inflow adjustments based on historical reservoir operations, modified to eliminate negative inflow values from the data set.
- Inclusion of net daily evaporation from reservoirs.
- Updated water withdrawals and return flows for all users through 2065 developed for the Water Supply Master Plan and coordinated by the CWWMG.
- Inclusion of the Catawba-Wateree Low Inflow Protocol (LIP) for procedures on how the Catawba River Basin reservoir system, as a whole, will be operated when inflow into the reservoirs is not enough to meet normal water demands while also maintaining lake levels within their normal ranges. A copy of the LIP is included in Appendix E, CD-1.

5.12.3.3. SCENARIO NAME AND DETAILS - UNION COUNTY YRWSP IBT

The model results are used throughout this EIS to analyze impacts of the proposed Catawba River Basin water supply alternatives for the Union County YRWSP on specific parameters. Model results were analyzed for the following parameters:

- **LC-2012 (Baseline-2012)**
  - Existing 5 mgd (net) Union County grandfathered Catawba IBT from Catawba River, withdrawn at CRWTP between Lake Wylie and Fishing Creek Reservoir
  - No additional IBT for Union County's YRWSP
  - Current (Year 2012) basin-wide water demands (withdrawals/returns)
- **BLC-2050 (Baseline-2050)**
  - Existing 5 mgd (net) Union County grandfathered Catawba IBT from Catawba River, withdrawn at CRWTP between Lake Wylie and Fishing Creek Reservoir
  - No additional IBT for Union County's YRWSP
  - Future (Year 2050) basin-wide water demands (withdrawals/returns)

  - Includes future impact of climate change in future years resulting in an increased temperature of 2.3 deg F (0.6 deg F increase per decade) and lake surface evaporation increases of 7.8% (equivalent to an increase of 2% per decade), as compared to the 2012 baseline. This impact is consistent with the climate change impact considered by the Catawba-Wateree Water Management Group in preparation of the Catawba-Wateree Water Supply Master Plan (CWWMG, 2014) baseline planning scenario, and is consistent with modeled climate change scenarios for this region of the United States.
- **Alt 6-2012**
  - 21.6 mgd IBT (net) from Catawba River, withdrawn at Union County's CRWTP between Lake Wylie and Fishing Creek Reservoir
  - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 6 to Baseline-2012 scenario under current basin-wide water demand.
- **Alt 6-2050**
  - 21.6 mgd IBT (net) from Catawba River, withdrawn at Union County's CRWTP between Lake Wylie and Fishing Creek Reservoir
  - Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 6 to Baseline-2050 scenario under future projected basin-wide water demand.
  - Includes future impact of climate change identified in scenario BLC-2050.
- **Alt 7-2012**
  - Existing 5 mgd (net) grandfathered Catawba IBT from Catawba River, withdrawn at CRWTP between Lake Wylie and Fishing Creek Reservoir
  - 16.6 mgd IBT wholesale water purchase from Charlotte Water withdrawn from Mountain Island Lake
  - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 7 to Baseline-2012 scenario under current basin-wide water demand.
- **Alt 7-2050**
  - Existing 5 mgd (net) grandfathered Catawba IBT from Catawba River, withdrawn at CRWTP between Lake Wylie and Fishing Creek Reservoir
  - 16.6 mgd IBT wholesale water purchase from Charlotte Water withdrawn from Mountain Island Lake
  - Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 7 to Baseline-2050 scenario under future projected basin-wide water demand.
  - Includes future impact of climate change identified in scenario BLC-2050.

5.12.3.4. IBT QUANTITIES AND DISTRIBUTIONS

The impacts of the Alternative 6 and 7 IBT options from the Catawba River Basin were evaluated for current basin-wide water demands based on Year 2012 values and future basin-wide water demands based on Year 2050 projections. The basin-wide water demands used for this modeling effort are based on the projections from the CWWMG's Water Supply Master Plan (CWWMG, 2014), interpolated for the Years 2012 and 2050, respectively, including municipal water supply, power plant cooling, agricultural/irrigation, and industrial demands. These demands include other IBTs that are certified, grandfathered, or anticipated but not certified. The model requires that withdrawals be supplied as annual average withdrawal values. Since the withdrawal is not the same for every day of the year, the annual average values are adjusted to produce monthly use patterns and thus simulate seasonal water use patterns. In the CHEOPS™ model, each withdrawal's monthly distribution is based on the historical pattern for that water user. The Union County proposed IBT withdrawals were distributed according to the County's monthly demand patterns from 2006 to 2012. Table 5-33 shows the monthly distribution of average demands as a percentage of annual average demand that was used in the CHEOPS™ model for Union County's modeled withdrawals.

Table 5-33 IBT Monthly Distribution Based on 2006 to 2012 Union County Water Use

Month	Percent of Average	Month	Percent of Average
January	79%	July	123%
February	77%	August	117%
March	80%	September	113%
April	96%	October	107%
May	115%	November	91%
June	121%	December	81%

5.12.3.5. USE OF MODEL RESULTS

The model results are used throughout this EIS to analyze impacts of the proposed Catawba River Basin water supply alternatives for the Union County YRWSP on specific parameters. Model results were analyzed for the following parameters:

- Lake Levels
  - Aesthetics
    - Effect of IBT alternatives on lake aesthetics, based on lake elevation
  - Water Withdrawal
    - Effect of IBT alternatives on water supply/withdrawal by other water users, based on lake elevation and storage.
- Reservoir Outflows
  - Effect of IBT alternatives on reservoir outflow for each of the reservoirs in the system
- Water Quantity Management (LIP Occurrence)
  - Effect of IBT alternatives on system-wide occurrence of various LIP levels

- Hydropower Generation
  - Effect of IBT alternatives on Duke Energy hydropower generation

Three distinct periods were analyzed within the model for each scenario, and included the following:

- Full Period of Record (82-year hydrology, 1929-2010)
- Drought 1 (5-year low inflow period (previous Drought of Record), 1999-2003)
- Drought 2 (4-year Drought of Record low inflow period), 2006-2009)

Under these parameters, the results of the modeling are summarized in a set of Performance Measure Sheets for comparison purposes to assess the impacts of IBT quantity on the system and its reservoirs, as compared to “baseline” conditions under both current and future water demands throughout the Catawba River Basin. This assessment and development of PMS were based on the CWWMG’s recently enhanced CHEOPS^{TM} model and the operating agreements used as the basis for the FERC license application and the Final Comprehensive Relicensing Agreement for the Catawba-Wateree Hydroelectric Project filed with FERC in August 2006.

The criteria used for the PMS for evaluation of the impacts to the Catawba-Wateree River Basin were previously developed during the relicensing process for the Duke Energy Catawba-Wateree Hydroelectric Project in the mid-2000s. Since the 11 reservoirs and numerous diverse stakeholders to the system all had different metrics of interest and differing opinions on how to rate differences between operating regimes (as computed and measured as output to model scenarios), the PMS concept was developed. In this concept, each reservoir basin is evaluated with general criteria such as reservoir elevations, outflows, powerhouse generation, and time spent in Low Inflow Protocol (LIP) stages. Since recreational boaters and parties who withdraw water for consumptive uses have different criteria, general categories were developed. These different categories allow for the setting of the elevation or flow of interest, and the variance around that value which is considered acceptable, moderately acceptable, or not acceptable. Each stakeholder in the CW relicensing process had an opportunity to participate in the identification of categories and setting of the metric values to best represent their interests.

In April, 2015, the DWR Classifications and Standards Rule Review Branch received a request from McDowell County, North Carolina, to reclassify Lake James to WS-IV, for purposes of constructing a new water intake in Lake James for public water supply. Although the request does not mention an amount that McDowell County wishes to withdraw from Lake James, a “Draft Environmental Assessment for Water Supply Infrastructure at Lake James McDowell County, North Carolina,” dated September 2013 by McGill Associates, lists the lead agency contact as Division of Water Infrastructure, and states that the proposed project includes a 3.8 mgd surface water intake. It is noted the surface water evaluations, basin-wide water use projections and model results reflected in this Union County YRWSP EIS do not specifically account for this proposed new McDowell County withdrawal in Lake James.

5.12.3.6. DIRECT IMPACTS – CATAWBA RIVER BASIN WATER QUANTITY

The Catawba River Basin CHEOPS^{TM} model has been used to evaluate the impacts of the proposed interbasin transfer alternatives for a withdrawal for the Union County YRWSP from either the Catawba River downstream of Fishing Creek Reservoir at the site of Union County's existing joint venture Catawba River Water Supply Project (CRWSP) (Alternative 6, 28.9 mgd (MMDD) withdrawal) or from Mountain Island Lake through a finished water interconnection with Charlotte Water (Alternative 7, 16.6 mgd (MMDD) supply from Charlotte Water plus 12.3 mgd (MMDD) withdrawal from the CRWSP). Key indicators used are lake levels and water storage in each of the eleven reservoirs in this river basin, as related to both reservoir aesthetics (including recreation) and water withdrawal for water supply uses. Additional indicators include the impact on downstream releases from these projects and effect on hydropower generation at Duke Energy's hydroelectric facilities on each reservoir. Additionally, a summary of predicted LIP stages over the 82-year simulation period has been developed for evaluation purposes.

Two distinct comparisons have been made for evaluating each surface water alternative from the Catawba River Basin (Alternatives 6 and 7). The proposed water transfer under each alternative has been compared to a "baseline" scenario based on system operations and existing/projected basin water demands, without any proposed Union County IBT. Comparisons have been made to the following "baseline" scenarios:

1. BLC_2012
    - Catawba baseline system operations with current (Year 2012) basin-wide water demand estimates
    - Used to compare Union County's Year 2050 projected IBT amount under each alternative to current water use within the Basin in the Year 2012.
2. BLC_2050
    - Catawba baseline system operations with future (Year 2050) basin-wide water demand estimates;
    - Used to compare Union County's Year 2050 projected IBT amount under each alternative to future projected water use within the Basin in the Year 2050.
    - Includes future impact of climate change previously identified.

As previously noted, for each model scenario evaluated, results were analyzed for three distinct hydrology periods, as follows:

1. Period of Record (POR) = 1929 to 2010
2. Drought 1 (previous Drought of Record in the Basin prior to 2006-2009) = 1999 to 2003
3. Drought 2 (Catawba River Basin Drought of Record (DOR)) = 2006 to 2009

Direct impacts on water quantity for each alternative have been evaluated for their impacts to lake levels (for both lake aesthetics and water withdrawals), reservoir discharges, water quantity management (LIP occurrence) and hydropower generation. In general, results for the two alternatives reflect minor impacts to the baseline scenarios due to the proposed Union County IBT. This is especially true for the POR evaluations as, over the 82 year period, the proposed IBT would have a negligible to minor effect on system operations and water quantity. Minor to moderate impacts were noted for certain alternatives and in certain scenarios during modeled drought periods. No major impacts were identified from the water quantity modeling. The primary differences in metrics observed are between the 2050 and 2012 evaluations from projected basin-wide water demand increases in the future, not the proposed Union County IBT.

Lake Levels

Aesthetics

Often of important consideration to lakeside property owners and parties with recreational interests for particular lakes is the effect of water withdrawals on lake elevations and, subsequently, lake aesthetics. Given this consideration, the effect of each Union County surface water supply alternative from the Catawba River Basin was evaluated in CHEOPS™ for their effect on lake elevations, relative to the reservoir target operating curve, as a percentage of time the end of day elevations are within a particular range of the reservoir rule/guide curve or full pond elevation. Results from the applicable Performance Measure Sheets (PMS) for the model analysis are summarized in the following tables, by reservoir, alternative and baseline scenario comparison (BLC-2012 or BLC-2050). Potential negative impacts, as compared to the "baseline" scenarios, are denoted by "-" (Negligible Impact, with no detectable modeled impact, as compared to baseline), "MI" (Minor Impact, typically resulting in negative impact of >0% and <5%, as compared to baseline), "MO" (Moderate Impact, typically resulting in negative impact of 5% to <15%, as compared to baseline), and "MA" (Major Impact, typically resulting in negative impact of 15% or greater. For detailed results of the PMS, see Appendix E, CD-3.

Table 5-34 Lake Aesthetics (Elevation) Impacts, Based on % of Time End of Day Elevations within Particular Range of Reservoir Target Operating Curve

Reservoir	Comparison to BLC-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT						Comparison to BLC-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT					
	POR (1929-2010)		Drought 1 (1999-2003)		Drought 2 (2006-2009)		POR (1929-2010)		Drought 1 (1999-2003)		Drought 2 (2006-2009)	
	Alternative						Alternative					
	6	7	6	7	6	7	6	7	6	7	6	7
James (Bridgewater)	-	-	-	MI	-	-	-	-	-	-	-	MO
Rhodhiss	MI	-	-	-	MI	-	-	MI	-	-	-	-
Hickory (Oxford)	MI	-	-	-	-	-	-	MI	-	MI	-	-
Lookout Shoals	MI	-	MI	-	MI	-	MI	MI	-	MI	-	-
Norman (Cowans Ford)	-	-	MI	MI	-	MI	-	-	-	-	MI	MI
Mountain Island	MI	-	-	-	-	-	-	-	-	-	-	-
Wylie	-	-	-	MI	-	-	-	MI	-	-	-	-
Fishing Creek	-	-	-	-	-	-	-	-	-	-	-	-
Great Falls	MI	-	-	-	-	-	-	MI	-	MI	-	-
Rocky Creek	MI	-	-	-	-	-	-	MI	-	MI	-	-
Wateree	-	-	-	-	-	-	-	-	-	MI	MI	-

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)
Note: Lake elevations in some lakes were modeled to be less impacted under future basin-wide water use, as compared to the baseline conditions, as an effect of the Catawba-Wateree LIP being in effect for longer period of time due to increased withdrawals, thereby reducing system discharges to preserve reservoir water storage.

Table 5-35 Period of Record (1929-2010) Average Modeled Lake Elevation Differences for YRWSP Alternatives (Union County 2050 IBT) as Compared to Baseline Current (2012) Conditions

Reservoir	Avg. Elev. (feet)	Difference (inches) from BASE (UC2050_2012)		Avg. Elev. (feet)	Difference (inches) from BASE (2050)	
	Base 2012	Alternative		Base 2050	Alternative	
		6	7		6	7
James (Bridgewater)	1196.7	+1	-	1196.5	-	-
Rhodhiss	993.4	-	-	993.3	-	-
Hickory (Oxford)	933.2	+1	-	933.1	-	-
Lookout Shoals	836.7	-	-	836.6	-	-
Norman (Cowans Ford)	757.9	-	-	757.7	-	-
Mountain Island	645.1	-	-	644.7	-	-
Wylie	567.1	-	-	566.9	-	-1
Fishing Creek	416.2	-	-	416.2	-	-
Great Falls	355.1	-	-	355.0	-	+1
Rocky Creek	283.4	+1	-	283.4	-	-
Wateree	224.9	-	-1	224.8	-	-

"-" = No modeled change in lake elevation for alternative as compared to baseline condition
Note: Lake elevations in some lakes were modeled to be several inches higher, as compared to the baseline conditions, as an effect of the Catawba-Wateree LIP being in effect for longer period of time due to increased withdrawals, thereby reducing system discharges to preserve reservoir water storage.

Table 5-36 Drought 1 (1999-2003) Average Modeled Lake Elevation Differences for YRWSP Alternatives (Union County 2050 IBT) as Compared to Baseline Current (2012) Conditions

Reservoir	Avg. Elev. (feet)	Difference (inches) from BASE (UC2050_2012)		Avg. Elev. (feet)	Difference (inches) from BASE (2050)	
	Base 2012	Alternative		Base 2050	Alternative	
		6	7		6	7
James (Bridgewater)	1195.8	-	-1	1195.2	-1	+2
Rhodhiss	993.4	-	-1	992.9	-	+2
Hickory (Oxford)	933.3	-1	-2	932.8	-1	+1
Lookout Shoals	836.9	-	-2	836.3	-2	-1
Norman (Cowans Ford)	758.4	-1	-1	757.0	-	+6
Mountain Island	644.6	+1	-2	643.3	-	-
Wylie	566.0	-	-1	565.7	-	-1
Fishing Creek	417.0	-	-	417.0	-	-
Great Falls	355.4	-	-	355.5	-	-
Rocky Creek	284.2	-	-	284.2	-	-
Wateree	224.8	-	-	224.5	-	+5

"-" = No modeled change in lake elevation for alternative as compared to baseline condition
Note: Lake elevations in some lakes were modeled to be several inches higher, as compared to the baseline conditions, as an effect of the Catawba-Wateree LIP being in effect for longer period of time due to increased withdrawals, thereby reducing system discharges to preserve reservoir water storage.

Table 5-37 Drought 2 (2006-2009) Average Modeled Lake Elevation Differences for YRWSP Alternatives (Union County 2050 IBT) as Compared to Baseline Current (2012) Conditions

Reservoir	Avg. Elev. (feet)	Difference (inches) from BASE (UC2050_2012)		Avg. Elev. (feet)	Difference (inches) from BASE (2050)	
	Base 2012	Alternative		Base 2050	Alternative	
		6	7		6	7
James (Bridgewater)	1196.9	-	-	1195.6	-1	-5
Rhodhiss	993.6	-	-	993.7	-1	-1
Hickory (Oxford)	933.5	-	-	933.6	-1	-1
Lookout Shoals	836.8	-	-	836.8	-1	-1
Norman (Cowans Ford)	757.6	-	-	756.9	-2	-4
Mountain Island	645.8	-	-	645.7	-1	-1
Wylie	567.3	-	-	567.2	-1	-2
Fishing Creek	416.9	-	-	416.9	-	-
Great Falls	355.5	-	-	355.5	-	-
Rocky Creek	284.1	-	-	284.1	-	-
Wateree	224.6	-	-	224.0	-1	-

"-" = No modeled change in lake elevation for alternative as compared to baseline condition

Alternative 6

Under Alternative 6, minor impacts were noted in several reservoirs under various conditions, based on the percent of time in which lake levels were at their specified target elevations as follows:

- Current (2012) Basin-Wide Water Demands with Union County 2050 IBT Demand
  - Period of Record – Minor impacts were noted in Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake, Mountain Island Lake, Great Falls Reservoir, and Rocky Creek Reservoir.
  - Drought 1 (1999-2003) – Minor impacts were noted in Lookout Shoals Lake and Lake Norman.
  - Drought 2 (2006-2009) – Minor impacts were noted in Lake Rhodhiss and Lookout Shoals Lake.
- 2050 Basin-Wide Water Demands with Union County 2050 IBT Demand
  - Period of Record – Minor impacts were noted in Lookout Shoals Lake.
  - Drought 1 (1999-2003) – Impacts considered negligible.
  - Drought 2 (2006-2009) – Minor impacts were noted in Lake Norman.

Typically, these impacts were identified as having a negative impact on the percent of time within a range of +/-2 feet of the target elevation of 1-2% less than the applicable baseline condition. The +/-2 feet elevation range is the evaluation range identified by stakeholders for evaluation as a Performance Measure during Duke Energy's relicensing of the Catawba-Wateree Hydroelectric Project, and is representative of the operational range by which Duke Energy attempts to maintain lake levels relative to their target levels. Based on the results indicated in the PMS, such impacts represent a minor impact to reservoir elevations under Alternative 6, as indicated in Table 5-34.

Additionally, Tables 5-35, 5-36 and 5-37 indicate that during the POR, Alternative 6 does not reduce the average annual lake elevations under both current and future basin-wide water use demands. During the Drought 1 period, however, under current (Year 2012) basin-wide water demands, average annual lake elevations are reduced by approximately 1 inch in Lake Hickory and Lake Norman due to Alternative 6. Under future (Year 2050) basin-wide water demands, Alternative 6 results in approximately 1 inch reductions in annual average lake elevations in Lake James and Lake Hickory and approximately a 2 inch reduction in Lookout Shoals Lake. During the Drought 2 period under current (Year 2012) basin-wide water demands, average annual lake elevation impacts are negligible due to Alternative 6. Under future (Year 2050) basin-wide water demands, Alternative 6 results in approximately 1 inch reductions in annual average lake elevations in Lake James, Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake, Mountain Island Lake, Lake Wylie and Lake Wateree and approximately a 2 inch reduction in Lake Norman.

Alternative 7

Under Alternative 7, minor impacts were noted in several reservoirs under various conditions, based on the percent of time in which lake levels were at their specified target elevations as follows:

- Current (2012) Basin-Wide Water Demands with Union County 2050 IBT Demand
  - Period of Record – Impacts considered negligible.
  - Drought 1 (1999-2003) – Minor impacts were noted in Lake James, Lake Norman and Lake Wylie.
  - Drought 2 (2006-2009) – Minor impacts were noted in Lake Norman.
- 2050 Basin-Wide Water Demands with Union County 2050 IBT Demand
  - Period of Record – Minor impacts were noted in Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake, Lake Wylie, Great Falls Reservoir, and Rocky Creek Reservoir.
  - Drought 1 (1999-2003) – Minor impacts were noted in Lake Hickory, Lookout Shoals Lake, Great Falls Reservoir, Rocky Creek Reservoir and Lake Wateree.
  - Drought 2 (2006-2009) – Moderate impacts were noted in Lake James and Minor impacts were noted in Lake Norman.

Typically, these impacts were identified as having a negative impact on the percent of time within a range of +/-2 feet of the target elevation of 1-2% less than the applicable baseline condition. Therefore, such impacts represent only a minor impact to reservoir elevations under Alternative 7, as indicated in Table 5-34. However, Alternative 7 does result in slightly larger negative impacts in Lake James under the Drought 2 period with future (Year 2050) basin-wide water demands, such that the percent of time the Lake James elevation is within +/- 2 feet of its target elevation is reduced by 9%, as compared to the baseline conditions during the Drought of Record. As such, this is identified as a moderate impact.

Tables 5-35, 5-35 and 5-37 indicate that during the POR, Alternative 7 results in an approximate 1 inch reduction in average annual lake elevations in Lake Wateree under current (Year 2012) basin-wide water use demands, except for an approximate 1 inch reduction in Lake Wateree under current basin-wide water demands. Under future (Year 2050) basin-wide water demands, Alternative 7 results in an approximate 1 inch reduction in Lake Wylie during the POR.

During the Drought 1 period under current basin-wide water demands, average annual lake elevations are reduced by approximately 1 inch in Lake James, Lake Rhodhiss, Lake Norman and Lake Wylie and by approximately 2 inches in Lake Hickory, Lookout Shoals Lake and Mountain Island Lake, due to Alternative 7. Under future (Year 2050) basin-wide water demands, Alternative 7 results in approximately 1 inch reductions in annual average lake elevations in Lookout Shoals Lake and Lake Wylie. However, lake elevations in other lakes were modeled to be several inches higher, as compared to the baseline conditions, as an effect of the Catawba-Wateree LIP being in effect for longer period of time and thereby reducing system discharges to preserve reservoir water storage.

During the Drought 2 period under current (Year 2012) basin-wide water demands, average annual lake elevations are not impacted due to Alternative 7. Under future (Year 2050) basin-wide water demands, Alternative 7 results in approximately 1 inch reductions in annual average lake elevations, as compared to the baseline conditions, in Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake and Mountain Island Lake. Larger reductions were observed in Lake James (5 inches lower), Lake Norman (4 inches lower) and Lake Wylie (2 inches lower). Such reductions in the larger system reservoirs (James, Norman and Wylie) indicate that Alternative 7 stresses the system such that water storage during Drought-of-Record conditions is utilized to support the proposed Alternative 7 withdrawal while attempting to minimize lake elevation impacts to other smaller reservoirs in the system.

Summary

Generally, the CHEOPS^{TM} modeling results for Alternatives 6 and 7 show only negligible to minor impacts on lake elevations, when compared to the respective baseline scenario. Only minor reductions in elevations were noted in these reservoirs for small percentages of time under the aforementioned alternatives, typically resulting in annual average elevation differences of approximately 1-inch, even with the higher Year-2050 basin-wide water use projections. However, based on the model results, it does appear that during Drought-of-Record conditions (Drought 2 period), both Alternative 6 and 7 would have a greater effect on average lake elevations, by reducing the elevations in the majority of the system reservoirs under the future basin-wide water demands. Alternative 7, in particular, represents a noticeable impact to lake elevations under these conditions, with the largest system reservoir elevations being reduced by up to 5 inches, as compared to the baseline condition.

In addition to the PMS metric evaluation, the elevation and storage exceedance curves and comparisons for each reservoir under the two IBT alternatives, as depicted in Appendix E, CD-3,generally reflect some minor differences between the alternatives when compared to baseline conditions over the POR or during the Drought 1 and Drought 2 periods. The greatest differences reflected by these charts confirm the conclusion that Alternatives 6 and 7 have a greater negative impact on lake elevations and system-wide water storage under future (Year 2050) basin-wide water demands during Drought-of-Record conditions.

It should be noted that, when comparing the baseline cases for 2050 projected future basin-wide water demands to current basin-wide water demands, the increase in water demands throughout the basin, not considering Union County's proposed IBT is modeled to have the largest negative effect on lake elevations. These impacts are independent of, and not resulting from, any proposed Union County IBT alternative. Rather, they are the inherent result of increased water withdrawals projected throughout the Catawba River Basin in the future, including withdrawals for public water supply, thermal power generation, industrial use and agriculture and irrigation uses.

Water Withdrawal

Of important consideration to owners of water supply intakes in the Catawba River Basin lake system is the effect of water withdrawals on lake elevations related to operability of these intakes. In times of reduced system inflow (i.e. droughts), water supply intakes may be vulnerable to inoperability (not being able to take in water from the source) or reduced operability because of falling lake levels. Additional water withdrawals within the lake system increase outflows from the system and can subsequently exacerbate the effect of low lake levels on intake operability.

Given this consideration, the effect of each Union County surface water supply alternative from the Catawba River Basin was evaluated in CHEOPS™ for their effect on lake elevations, relative to the critical intake elevations in each reservoir. The critical intake is defined as the highest intake in each reservoir, which represents the first intake that could be exposed due to falling lake levels during times of low inflow. This evaluation was completed to determine if any of the IBT alternatives negatively affected lake levels such that other water supply intakes were jeopardized.

Results from the applicable PMS for the model analysis are summarized in the following table, by reservoir, alternative and baseline scenario comparison (BLC-2012 or BLC-2050). Potential negative impacts, as compared to the "baseline" scenarios, are denoted by "-" (Negligible Impact, with no detectable modeled impact, as compared to baseline), "MI" (Minor Impact, typically resulting in negative impact of >0% and <5%, as compared to baseline), "MO" (Moderate Impact, typically resulting in negative impact of 5% to <15%, as compared to baseline), and "MA" (Major Impact, typically resulting in negative impact of 15% or greater. For detailed results of the PMS, see Appendix E, CD-3.

Table 5-38 Water Withdrawal (Intake) Impacts, Based on Number of Days of Restricted Operation at Lake Located Intakes

Reservoir	Comparison to BLC-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT						Comparison to BLC-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT					
	POR (1929-2010)		Drought 1 (1999-2003)		Drought 2 (2006-2009)		POR (1929-2010)		Drought 1 (1999-2003)		Drought 2 (2006-2009)	
	Alternative						Alternative					
	6	7	6	7	6	7	6	7	6	7	6	7
James (Bridgewater)	-	-	-	-	-	-	-	-	-	-	-	-
Rhodhiss	-	-	-	-	-	-	-	-	-	-	-	-
Hickory (Oxford)	-	-	-	-	-	-	-	-	-	-	-	-
Lookout Shoals	-	-	-	-	-	-	-	-	-	-	-	-
Norman (Cowans Ford)	-	-	-	-	-	-	-	-	-	-	-	-
Mountain Island	MI	-	-	-	-	-	-	MI	-	-	-	-
Wylie	-	-	-	-	-	-	-	MI	-	-	-	-
Fishing Creek	MI	MI	-	-	-	-	-	-	-	-	-	-
Great Falls	-	-	-	-	-	-	-	-	-	-	-	-
Rocky Creek	-	-	-	-	-	-	-	-	-	-	-	-
Wateree	-	-	-	-	-	-	-	-	-	-	-	-

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)
Mountain Island Lake intake is associated with the Riverbend Steam Station. This facility is being decommissioned and, as such, its intake will no longer be in use by the time Union County's proposed withdrawal would occur.

As shown in the summary table, minor negative impacts to water supply intakes due to restricted intake operation are noted in Mountain Island Lake, Lake Wylie and Fishing Creek Reservoir. Under current (2012) basin-wide water demand conditions, Mountain Island Lake was observed to have minor impacts to water supply intakes for Alternative 6 during the POR by rendering the highest thermal power facility intake inoperable for an additional day beyond the baseline condition. However, this intake is associated with the Riverbend Steam Station. This facility is being decommissioned and, as such, its intake will no longer be in use by the time Union County's proposed withdrawal would occur. Additionally, Mountain Island Lake was observed to have minor impacts under future (2050) basin-wide water demand conditions for Alternative 7 during the POR by rendering the highest public water supply intake inoperable for an additional 3 days beyond the baseline condition.

Under future (2050) basin-wide water demand conditions, Lake Wylie was observed to have minor impacts to water supply intakes for Alternative 7 during the POR by rendering the highest public water supply intake inoperable for an additional 5 days beyond the baseline condition. Under current (2012) basin-wide water demand conditions, Fishing Creek Reservoir was observed to have minor impacts to water supply intakes for Alternatives 6 and 7 by rendering the highest public water supply intake inoperable for an additional 1 an 2 days, respectively, beyond the baseline condition.

No other reservoirs were modeled to have impacts considered to be more than negligible to water supply intakes due to restricted intake operation under Alternative 6 or 7. Furthermore, modeled impacts to water supply intakes in all reservoirs were negligible during Drought 1 or Drought 2 period, indicating the effectiveness of the LIP in attempting to prevent lake levels during extreme drought from dropping to a level that would expose intakes.

Reservoir Discharge

For ecological considerations and certain recreational interests in the Catawba River Basin the effect of water withdrawals on reservoir discharges (downstream releases) from these lakes is of importance. In times of reduced system inflow (i.e. droughts), the ecological health or recreational uses (e.g. kayaking or canoeing) of the waterway can be negatively affected. During normal periods (i.e. normal inflow), both the Duke Energy hydroelectric project is required to make certain downstream releases from various reservoirs under its Comprehensive Relicensing Agreement (CRA) for its pending FERC license renewal. During periods of reduced inflow to the system, the LIP specifies reductions to these release requirements, based on particular drought stages, while seeking to provide discharges at a level sufficient to maintain the ecological health of the waterway. However, additional water withdrawals within the lake system increase outflows from the system and may subsequently result in reservoir discharges lower than those required under the CRA for the operation of the lake system.

Given this consideration, the effect of each Union County surface water supply alternative from the Catawba River Basin was evaluated in CHEOPS™ for their effect on discharges, relative to the required downstream releases from these reservoirs. This evaluation was completed to determine if any of the IBT alternatives negatively affected downstream releases such that the waterway's ecological health and certain recreational interests would be jeopardized, as compared to the baseline conditions within the Catawba River Basin without the proposed IBT.

Results from the applicable PMS for the model analysis are summarized in the following tables, by reservoir, alternative and baseline scenario comparison (BLC-2012 or BLC-2050). Potential negative impacts, as compared to the "baseline" scenarios, are denoted by "-" (Negligible Impact, with no detectable modeled impact, as compared to baseline), "MI" (Minor Impact, typically resulting in negative impact of >0% and <5%, as compared to baseline), "MO" (Moderate Impact, typically resulting in negative impact of 5% to <15%, as compared to baseline), and "MA" (Major Impact, typically resulting in negative impact of 15% or greater. For detailed results of the PMS, see Appendix E, CD-3.

Typically, the impacts noted in the following table result from the CHEOPS™ model spending several more days (as compared to the baseline scenario) in a more severe drought stage under a particular alternative. This subsequently results in several more days below the "normal" or highest specified minimum discharge requirement while the model adheres to the reduced discharge requirements during LIP stages.

Table 5-39 Reservoir Discharge (Downstream Release) Impacts, Based on Number of Days Below Specified Release Values

Reservoir	Comparison to BLC-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT						Comparison to BLC-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT					
	POR (1929-2010)		Drought 1 (1999-2003)		Drought 2 (2006-2009)		POR (1929-2010)		Drought 1 (1999-2003)		Drought 2 (2006-2009)	
	Alternative						Alternative					
	6	7	6	7	6	7	6	7	6	7	6	7
James (Bridgewater)	-	-	-	-	-	-	-	-	-	-	-	-
Rhodhiss	NA						NA					
Hickory (Oxford)	-	-	-	-	-	-	-	-	MI	-	-	-
Lookout Shoals	NA						NA					
Norman (Cowans Ford)	NA						NA					
Mountain Island	NA						NA					
Wylie	-	-	-	-	-	-	-	-	-	-	-	-
Fishing Creek	NA						NA					
Great Falls	NA						NA					
Rocky Creek	NA						NA					
Wateree	-	-	-	-	-	-	-	-	-	-	-	-

“-” = Negligible Impact“(no detectable impact); MI” = Minor Impact (>0% to <5%); “MO” = Moderate Impact (5% to <15%); “MA” = Major Impact (≥15%)

Generally, the CHEOPS™ modeling results show little appreciable impact on reservoir discharges, when compared to the respective baseline scenarios. The only minor impact was observed in Lake Hickory for Alternative 6 (proposed withdrawal for the YRWSP at Union County's existing CRWSP), as the 7-day average flowrate released from the hydropower development reflected an average reduction of 4 cfs below the baseline condition, during the Drought 1 period with 2050 basin-wide water demands. For all other time periods and reservoirs for both Alternative 6 and 7, modeled impacts to reservoir discharges are considered negligible, as presented in the PMS.

In addition to the PMS metric evaluation, the outflow exceedance curves for each reservoir under the various IBT alternatives, as depicted in Appendix E, CD-3, generally reflect negligible differences between Alternatives 6 or 7 when compared to respective baseline conditions over the POR, or during the Drought 1 and Drought 2 periods. However, some differences are noted, typically occurring only at certain exceedance intervals, when comparing the 2012 to 2050 future basin-wide water demand conditions. These impacts are independent of, and not resulting from, any proposed Union County IBT alternative. Rather, they are the inherent result of increased water withdrawals projected throughout the Catawba River Basin in the future, including withdrawals for public water supply, thermal power generation, industrial use and agriculture and irrigation uses.

Water Quantity Management (LIP Occurrence)
In addition to water quantity metrics related to lake elevations, water supply intake operation and reservoir discharges, water quantity management metrics were evaluated to determine if proposed Union County IBT alternatives would impact the occurrence of the Catawba-Wateree Low Inflow Protocol (LIP). Metrics evaluated included the percent of time in Normal Conditions (non-drought periods with no LIP in effect), number of months attaining particular LIP Stages (0 to 4) and percentage of time for the applicable period (POR, Drought 1 and Drought 2) spent in particular LIP Stages. The results of this analysis indicate that, based on this metric, there would generally be minor impacts to LIP occurrence for both Alternatives 6 and 7 of the Union County IBT alternatives, as compared to the baseline conditions.

Results from the applicable LIP occurrence evaluation for the model analysis are summarized in the following tables, by reservoir, alternative and baseline scenario comparison (BLC-2012 or BLC-2050). Potential negative impacts, as compared to the "baseline" scenarios, are denoted by "-" (Negligible Impact, with no detectable modeled impact, as compared to baseline), "MI" (Minor Impact, typically resulting in negative impact of >0% and <5%, as compared to baseline), "MO" (Moderate Impact, typically resulting in negative impact of 5% to <15%, as compared to baseline), and "MA" (Major Impact, typically resulting in negative impact of 15% or greater. For detailed results of the LIP evaluation, see Appendix E, CD-3.

Table 5-40 Water Quantity Management (LIP Occurrence) Impacts, Based on % of Time in Normal Conditions, Number of Months in LIP Stages and % of Time in LIP Stages

Evaluation Period	Comparison to BLC-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT		Comparison to BLC-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT	
	Alternative		Alternative	
	6	7	6	7
Period of Record (1929-2010)	MI	MI	MI	MI
Drought 1 (1999-2003)	-	-	-	MO
Drought 2 (2006-2009)	-	-	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Under current basin-wide water demands, over the POR, the system is in Normal Conditions 50% of the time for the baseline conditions and Alternative 7. Under Alternative 6, the system is in Normal Conditions 48% of the time, and in the more severe drought Stage 1 46% of the time, representing a 2% increase in time (18 additional months over the POR) spent in a more severe drought stage, when compared to the baseline conditions. Additionally, under Alternative 6, the system is in Stage 2 drought conditions for an additional 3 months over the POR, when compared to the baseline conditions. These differences, for both Alternative 6 and 7, generally represent minor impacts from the alternatives when compared to the baseline.

During the Drought 1 period, under the baseline case with current basin-wide water demands and each alternative, the system is in Normal Conditions 17% of the five year period and in LIP Stage 0 and 1 for 62% and 22% of the period, respectively. There were no observed differences between Alternatives 6 or 7 when compared to the baseline conditions. During the Drought 2 Drought of Record period, under the baseline case and each alternative, the system is in Normal Conditions 21% of the four year period and in LIP Stage 0, 1 and 2 for 19%, 19% and 42% of the period, respectively. There were no observed differences between Alternatives 6 or 7 when compared to the baseline conditions.

Under projected Year 2050 future basin-wide water demands, over the POR, the system is in Normal Conditions 51% of the time for the baseline conditions and Alternative 6. Under Alternative 7, the system is in Normal Conditions 50% of the time, and in the more severe drought Stage 1 for 41% of the time and Stage 2 for 7 % of the POR, representing a 1% increase in time (1 additional month in Stage 1 and 12 months additional month in Stage 2) over the POR spent in a more severe drought stage, when compared to the baseline conditions. Additionally, under Alternative 6, the system is in Stage 1 drought conditions for an additional 5 months over the POR but in Stage 2 conditions 4 fewer months, when compared to the baseline conditions. These differences, for both Alternative 6 and 7, generally represent minor impacts from the alternatives when compared to the baseline.

During the Drought 1 period, under the baseline case with future Year 2050 basin-wide water demands and each alternative, the system is in Normal Conditions 15% of the five year period and in LIP Stages 0, 1 and 2 for 57%, 18% and 10% of the period, respectively, under baseline conditions and Alternative 6. However, during this period under Alternative 7, differences in LIP stage are noted as having a moderate impact on the system, as the LIP would be in Stage 1 conditions an additional 12 months (20% more time) and 6 fewer months in both Stages 0 and 2 (10% less time in each stage). During the Drought 2 Drought of Record period, under the baseline case and each alternative, the system is in Normal Conditions. Differences were observed for both Alternative 6 and 7, where LIP Stage 0 would have been declared an additional 2% of the time (one month) and LIP Stage 1 would have been declared one fewer month, as compared to the baseline conditions. While a less severe drought stage, under these alternatives intuitively seems to be a benefit to the system, in reality, it can delay water conservation measures and reductions to downstream releases required by the LIP, thus having the potential to negatively affect the available water quantity within the system. As such, these are identified as minor impacts.

Hydropower Generation

Impacts of each proposed Union County IBT alternative from the Catawba River Basin on hydropower generation were also evaluated. Impacts to Duke Energy's Catawba-Wateree Hydroelectric Project, consisting of hydroelectric generating stations on each of the eleven system reservoirs were evaluated through the CHEOPS^{TM} model. Collective impacts to average hydropower megawatts produced per year, average equivalent number of homes per year that could be powered by each hydro project and hydropower generation revenue were evaluated. Increases in system water withdrawals can reduce the available water storage by which Duke Energy is able to access from the reservoirs they operate, in order to produce hydropower. As such, this is an important metric to evaluate in the comparison of IBT alternatives for Union County.

Results from the applicable PMS for the model analysis are summarized in the following tables, by hydroelectric project, alternative and baseline scenario comparison (BLC-2012 or BLC-2050). Potential negative impacts, as compared to the "baseline" scenarios, are denoted by "-" (Negligible Impact, with no detectable modeled impact, as compared to baseline), "MI" (Minor Impact, typically resulting in negative impact of >0% and <5%, as compared to baseline), "MO" (Moderate Impact, typically resulting in negative impact of 5% to <15%, as compared to baseline), and "MA" (Major Impact, typically resulting in negative impact of 15% or greater. For detailed results of the PMS, see Appendix E, CD-3.

Table 5-41 Hydropower Generation Impacts, Based on Average Annual Hydropower Production and Equivalent Number of Homes Powered by the Hydro Projects

Evaluation Period	Comparison to BLC-2012 Current (2012) Basin-Wide Water Use With Union County 2050 IBT		Comparison to BLC-2050 Future (2050) Basin-Wide Water Use With Union County 2050 IBT	
	Alternative		Alternative	
	6	7	6	7
Period of Record (1929-2010)	MI	MI	MI	MI
Drought 1 (1999-2003)	MI	MI	MI	MI
Drought 2 (2006-2009)	MI	MI	MI	MI

"-" = Negligible Impact"(no detectable impact); MI" = Minor Impact (>0% to <5%); "MO" = Moderate Impact (5% to <15%); "MA" = Major Impact (≥15%)

Duke Energy Catawba-Wateree Hydroelectric Project Impacts

Under both current and projected future basin-wide water demands, minor impacts on hydropower generation for Duke Energy's Catawba-Wateree Hydroelectric Project were noted in the model analysis, under both Alternatives 6 and 7 for a proposed Union County IBT withdrawal from the Catawba River Basin. These alternatives typically resulted in decreased hydropower generation and revenue, as compared to baseline conditions, by approximately ½% under both the current and future basin-wide water demands for the Period of Record and up to approximately 1% during Drought 1 and Drought 2 periods.

It should be noted that, when comparing the baseline cases for 2050 projected future basin-wide water demands to current basin-wide water demands, the increase in water demands throughout the basin, not considering Union County's proposed IBT is modeled to negatively impact hydropower generation approximately 5% during the POR, 6% during the Drought 1 period, and up to 9% during the Drought 2 period. These impacts are independent of, and not resulting from, any proposed Union County IBT alternative. Rather, they are the inherent result of increased water withdrawals projected throughout the Catawba River Basin in the future, including withdrawals for public water supply, thermal power generation, industrial use and agriculture and irrigation uses.

In addition to the PMS metric evaluation, the generation detail histograms and data comparisons for each hydropower producing reservoir under the various IBT alternatives, as depicted in Appendix E, CD-3, generally reflect only minor differences between any of the alternatives when compared to baseline conditions over the POR or during the Drought 1 and Drought 2 periods.

5.12.3.7. DIRECT IMPACTS - CATAWBA RIVER BASIN WATER QUALITY

The NCDWR classifies surface water bodies, such as stream, rivers, and lakes, to designate uses to be protected within these waters. These designations carry specific water quality standards which are used to manage all stream, rivers, and lakes in North Carolina. There are three classes of waters [B, WS-V and WS-IV (with a CA)] affected by Alternative 7, which proposes water withdrawals from Mountain Island Lake. Class B waters are designated with the same Class C protections in addition to primary recreation. WS-V waters are classified as waters protected as water supplies which are generally upstream and draining to Class WS-IV waters or water used by industry to supply their employees with drinking water or as waters formerly used as water supply. The designation of WS-IV is classified as waters used as sources of water supply for drinking, culinary, or food processing purposes where a WS-I, II or III classification is not feasible. WS-IV waters are generally in moderately to highly developed watersheds. Table 5-42 depicts water classifications that would be utilized in Alternatives 6 and 7. Alternative 6 proposes water withdrawal from the Catawba River in South Carolina. The Catawba River, in South Carolina, where Alternative 6 is proposed, is classified as Freshwater (FW). In South Carolina, FW use designations include: (1) suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department; (2) suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora; and (3) suitable also for industrial and agricultural uses.

Table 5-42 North Carolina and South Carolina Water Classifications

Waterbody	Surface Water Classification	Water Source for Alternative
Lake James	WS-V, B	
Lake Rhodhiss	WS-IV, B, CA	
Lake Hickory	WS-IV, B, CA	
Lookout Shoals Lake	WS-IV, B, CA	
Lake Norman	WS-IV, B, CA	
Mountain Island Lake	WS-IV, B, CA	Alternative 7
Lake Wylie	WS-V, B (NC) FW (SC)	
Catawba River	Freshwater (FW)	Alternative 6
Fishing Creek Lake	Freshwater (FW)	
Great Falls Reservoir	Freshwater (FW)	
Cedar Creek Reservoir	Freshwater (FW)	
Lake Wateree	Freshwater (FW)	

The water quality regulations for each WS-IV classified waterbody include either a Critical Area or Protected Area. A Critical Area (CA) is an area adjacent to a water supply intake or reservoir where risk associated with pollution is greater than from the remaining portions of the watershed. A Protected Area is the area adjoining and upstream of the Critical Area in a WS-IV water supply in which protection measures are required. Previously referenced, Table 5-30, summarizes selected water quality criteria that are applicable to Class C, B, and WS waters in

North Carolina. Table 5-43 summarizes selected water quality criteria for freshwater (FW) in South Carolina.

Table 5-43 Selected South Carolina Water Quality Criteria. Source: (SCDHEC, 2012)

Parameter	Freshwater (FW)
Temperature	Free flowing shall not be increased more than 5°F (2.8°C) above natural temperature conditions and shall not exceed a maximum of 90°F (32.2°C)
Turbidity	Not to exceed 50 NTUs provided existing uses are maintained.
Dissolved Oxygen	Daily average not less than 5.0 mg/l with a low of 4.0 mg/1. l
pH	Between 6.0 and 8.5

No-Action Alternative

Under the no action alternative, Union County would not be able to meet the water supply needs of its current and future residents, and the wholesale communities served by the County. This alternative is deficient because Union County's current grandfathered IBT from the Catawba River Basin and the Anson County water supply are not capable of meeting the projected future demand within the Rocky River IBT Basin.

As discussed in Section 2, water needs in Union County's Yadkin River Basin Service Area are projected to continue increasing from their current levels through the Year 2050. The no-action alternative is not a viable option to meet Union County's water needs. Therefore, Union County must secure a reliable water supply from other sources to meet its future demand in this service area.

Direct Impacts

The direct impacts of Alternatives 6 and 7 have been evaluated for their impacts to reservoir and river spatial withdrawals in the water column and water quality (DO and temperature). Generally, the results for all alternatives represent minimal impacts to current and future water quality of the Catawba River Basin due to the proposed Union County IBT.

Water Intake Withdrawal Depth

Union County proposes to site intake structures at three levels in the water column to withdraw water from the reservoir or river. Actual intake arrangements often vary by water utility, taking into consideration water quality and availability, site characteristics and constraints, as well as redundancy and contingency measures. Illustration 5-2, previously referenced, depicts a conceptual fixed intake layout, including three passive intake screens and two raw water intake lines. The intention of having multiple intakes at different elevations is to provide operational flexibility to respond to lake water quality issues that can vary throughout the year due to lake turnover, algae blooms, and naturally occurring weather events.

Mountain Island Lake

Mountain Island Lake is the sixth of eleven lakes that comprise the Catawba-Wateree Hydroelectric Project which stretches approximately 225 miles from the Town of Old Fort in the Blue Ridge Mountains of North Carolina to Lake Wateree, located east of Camden, South

Carolina. Mountain Island Lake is bordered by Lake Norman to the north, Mecklenburg County to the east, Lake Wylie to the south and Gaston and Lincoln Counties to the west. The average retention time of the lake is 11 days. Mountain Island Lake has a maximum depth at the dam of 58.4 feet and an average depth of 17.7 feet.

Because of the relatively shallow depths, short retention time, and weak thermal stratification, Mountain Island Lake is mixed thermally throughout much of its length. This, in turn, leads Mountain Island Lake to exhibit few signs of eutrophication which can cause nutrient enrichment in the lake which leads to DO depletion. Union County proposes to purchase finished water from Charlotte Water through the use of Charlotte Water's Catawba River Pump Station in Mountain Island Lake. This alternative would utilize Charlotte Water's existing facilities in the Catawba River Basin to serve Union County's customers in the Rocky River IBT Basin of the Yadkin River Basin. Charlotte Water's Catawba River Pump Station includes several raw water intakes. The primary intake at this facility includes a submerged channel and wetwell with four bar racks, traveling water screens and vertical suction pumps. There are multiple raw water mains associated with the facility including 54-inch, 60-inch, and 120-inch mains. Charlotte Water withdraws raw water primarily from one section of the water column but has the capability to withdraw from multiple sections of the water column. Therefore, water quality impacts from Alternative 7 would be negligible in Mountain Island Lake due to the fact water withdrawn from the reservoir experiences fairly similar water quality parameters throughout the entire water column.

Catawba River

Natural mixing of riverine water sources is typically sufficient to eliminate the need for intake structures at multiple elevations. However, Union County proposes to use multiple intakes for intake redundancy. Therefore, water quality impacts from Alternative 6 would be negligible in the Catawba River due to the fact that water would be withdrawn through multiple intakes ensuring water quality remains at its current levels.

Summary

No impacts to water quality due to intake depth in the water column are expected to occur under Alternatives 6 and 7. Under these Alternatives, the effects of the proposed water withdrawals on water quality are expected to be negligible because Mountain Island Lake and the Catawba River generally experience fairly similar water quality parameters throughout the entire water column.

Dissolved Oxygen and Temperature

Dissolved Oxygen (DO) is a measure of the amount of gaseous oxygen dissolved in an aqueous solution. Oxygen enters into water by diffusion from the surrounding air, by aeration or rapid movement, and as a waste product of photosynthesis. There are many factors which reduce water's ability to hold oxygen. The amount of oxygen held depends greatly on the temperature of the water. As water temperature increases, DO concentrations in the water decreases. Other factors which influence DO concentrations are the levels of other solid, chemical, or gas compounds present in the water. Most deep reservoirs are typically thermally stratified as a result of surface heating and wind mixing. Water temperature regulates biotic growth rates and life stages and defines fishery habitat (warm-, cool-, or cold-water).

Water quality in the Catawba River Basin is generally good, especially in its forested upper reaches above the Catawba-Wateree Project (FERC No. 2232). Water quality varies from reservoir to reservoir, depending upon factors such as quality of the inflows, reservoir configuration, water retention time, and industrial and power plant withdrawals and discharges.

Bridgewater (Lake James)

The Bridgewater Development is the uppermost development in Duke Energy's Catawba-Wateree Hydroelectric Project at river mile (RM) 279.6 and includes three dams (Linville, Paddy Creek, and Catawba) that form Lake James. The 6,754-acre reservoir has a full pond elevation of 1,200 feet msl and a usable storage capacity of 57,349 acre-feet. Lake James has the best water quality within the Catawba River Basin chain of reservoirs. In 2007, DWQ sampled Lake James and determined surface water temperatures exceeded the state criterion for mountain lakes in the summer when air temperatures are high. Although nutrient concentrations in Lake James were elevated relative to other mountain lakes, and chlorophyll-a concentrations exceeded the state standard for trout waters on occasion, the lake had oligotrophic, low productivity conditions.

Alternatives 6 and 7 do not propose to directly withdraw water from Lake James. However, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Lake James as a result of withdrawing water from Mountain Island Lake (Alternative 7) or the Catawba River below Lake Wylie (Alternative 6), each downstream of Lake James.

Based on the CHEOPS modeling and Elevation Exceedance Curves[3], water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Lake James. As a result, impacts from Alternatives 6 and 7 to reservoir elevations would be negligible under normal conditions. During drought conditions, Alternatives 6 and 7 would cause minor to moderate impacts to reservoir elevations. These impacts to reservoir elevations were generally found to occur only 1-2 percent of the time. However, under Alternative 7 during the Drought of Record, these impacts were modeled as occurring up to 9% of the time. Given the relatively small amount of time reservoir elevations would fluctuate and size of the reservoir, DO concentration and water temperature should remain at current levels a majority of the time. Therefore, Alternatives 6 and 7 would have minor impacts on DO concentration and water temperature in Lake James during drought condition due to reservoir elevation fluctuations only a small percentage of the time.

Rhodhiss (Lake Rhodhiss)

The Rhodhiss Development is located 32 RMs downstream from the Bridgewater Development at RM 248. The 2,724-acre reservoir (Lake Rhodhiss) has a full pond elevation of 995.1 feet msl and a usable storage capacity of 7,097 acre-feet. Lake Rhodhiss has enriched water quality

[3] See Appendix G, CD-3 for Elevation Exceedance Curves

conditions caused by nutrient loading from agricultural activities, urban runoff, and municipal discharges. In 2007, DWQ sampled Lake Rhodhiss and determined the lake showed elevated nutrient concentrations and was eutrophic resulting in high productivity conditions.

Alternatives 6 and 7 do not propose to directly withdraw water from Lake Rhodhiss. However, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Lake Rhodhiss as a result of withdrawing water from Mountain Island Lake (Alternative 7) or the Catawba River below Lake Wylie (Alternative 6), each downstream of Lake Rhodhiss.

Based on the CHEOPS modeling and Elevation Exceedance Curves*,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Lake Rhodhiss. As a result, Alternative 6 would cause minor impacts to reservoir elevations during normal and drought conditions whereas Alternative 7 would cause minor impacts only during drought conditions. Under both alternatives, minor impacts to reservoir elevations were found to occur only 1-2 percent of the time. Given the relatively small amount of time reservoir elevations would fluctuate, DO concentration and water temperature should remain at current levels a majority of the time. Therefore, Alternatives 6 and 7 would have minor impacts on DO concentration and water temperature in Lake Rhodhiss during drought conditions. Only Alternative 6 would have minor impacts during normal conditions. These minor impacts are a result of reservoir elevations fluctuating only a small percentage of the time.

Oxford (Lake Hickory)

The Oxford Development is located at RM 230.0 and includes the dam forming Lake Hickory. The 4,072-acre reservoir (Lake Hickory) has a full pond elevation of 935 feet msl and a usable storage capacity of 9,834 acre-feet. Lake Hickory has enriched water quality conditions caused by nutrient loading from agricultural activities, urban runoff, and municipal discharges. In 2007, DWQ sampled Lake Hickory and determined the lake had elevated nutrient concentrations and was eutrophic resulting in high productivity conditions. Lake Hickory had low to moderate nutrient and chlorophyll-concentrations.

Alternatives 6 and 7 do not proposed to directly withdraw water from Lake Hickory. However, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Lake Hickory as a result of withdrawing water from Mountain Island Lake (Alternative 7) or the Catawba River below Lake Wylie (Alternative 6), each downstream of Lake Hickory.

Based on the CHEOPS modeling and Elevation Exceedance Curves*,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Lake Hickory. As a result, Alternative 6 would cause minor impacts to reservoir elevations during normal and drought conditions whereas Alternative 7 would cause minor impacts to reservoir elevation only during drought conditions. Under both alternatives, minor impacts to reservoir elevations were found to occur only 1-2 percent of the time. Given the relatively small amount of time reservoir elevations would fluctuate, DO concentration and water temperature should remain at current levels a majority of the time. Therefore, Alternatives 6 and 7 would have minor impacts on DO concentration and water temperature in Lake Hickory during drought conditions. Only Alternative 6 would have minor impacts during normal conditions.

These minor impacts are a result of reservoir elevation fluctuations only a small percentage of the time.

Lookout Shoals (Lookout Shoals Lake)

The Lookout Shoals Development is located at RM 220.3. The 1,155-acre reservoir (Lookout Shoals Lake) has a full pond elevation of 838.1 feet msl and a usable storage capacity of 2,138 acre-feet. Lookout Shoals Lake has enriched water quality conditions caused by nutrient loading from agricultural activities, urban runoff, and municipal discharges.

Alternatives 6 and 7 do not directly withdraw water from Lookout Shoals Lake. Under Union County's IBT, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Lookout Shoals Lake as a result of withdrawing water from Mountain Island Lake (Alternative 7) or the Catawba River below Lake Wylie (Alternative 6), each downstream of Lookout Shoals Lake.

Based on the CHEOPS modeling and Elevation Exceedance Curves*,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Lookout Shoals Lake. As a result, impacts from Alternatives 6 and 7 to reservoir elevations under normal conditions would be negligible. During drought conditions, Alternatives 6 and 7 would cause minor impacts to reservoir elevations. These minor impacts to reservoir elevations were found to occur only 1-2 percent of the time. Given the relatively small amount of time reservoir elevations would fluctuate, DO concentration and water temperature should remain at current levels a majority of the time. Therefore, Alternatives 6 and 7 would have minor impacts on DO concentration and water temperature in Lookout Shoals Lake during drought conditions only due to reservoir elevation fluctuations only a small percentage of the time.

Cowans Ford (Lake Norman)

The Cowans Ford Development, the largest development in the Catawba-Wateree Hydroelectric Project, is located at RM 186.9, and forms Lake Norman (FERC, 2009). The 32,339-acre reservoir has a full pond elevation of 760 feet msl and a usable storage capacity of 298,142 acre-feet. Lake Norman has historically experienced good water quality conditions. However, in the summer of 2004, low concentrations of DO resulted in fish kills within the lake, totaling 2,500 striped bass (FERC, 2009). North Carolina DWQ concluded that the fish were trapped in the low DO waters of the hypolimnion during thermal stratification of the lake. In 2007, DWQ sampled Lake Norman and concluded the following: (1) elevated concentrations of nitrate nitrogen; (2) low concentrations of other nutrients; (3) moderate to low concentrations of chlorophyll-a; and (4) oligotrophic, low productivity conditions.

Alternatives 6 and 7 do not propose to directly withdraw water from Lake Norman. However, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Lake Norman as a result of withdrawing water from Mountain Island Lake (Alternative 7) or the Catawba River below Lake Wylie (Alternative 6), each downstream of Lake Norman.

Based on the CHEOPS modeling and Elevation Exceedance Curves*,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Lake Norman. As a result, impacts from Alternatives 6 and 7 to reservoir elevations under normal conditions would be negligible. During drought conditions, Alternatives 6 and 7 would cause minor impacts to reservoir elevations. These minor impacts to reservoir elevations were found to occur only 1-2 percent of the time. Given the relatively small amount of time reservoir elevations would fluctuate, DO concentration and water temperature should remain at current levels a majority of the time. Therefore, Alternatives 6 and 7 would have minor impacts on DO concentration and water temperature in Lake Norman during drought conditions due to reservoir elevation fluctuations only a small percentage of the time.

Mountain Island (Mountain Island Lake)

The Mountain Island Development is located at RM 171.5. The 3,117-acre reservoir (Mountain Island Lake) has a full pond elevation of 647.5 feet msl and a usable storage capacity of 10,146 acre-feet. Mountain Island Lake is one of the most monitored lakes in the southeastern United States. The following groups currently have routine monitoring programs on Mountain Island Lake: (1) Mecklenburg County Water Quality Program; (2) NCDENR; and (3) Duke Energy. The Mecklenburg County Department of Environmental Protection uses the Fusilier Water Quality Index (WQI) to summarize reservoir water-quality conditions (Fusilier, 1982). The WQI ranges from 0 (worst value) to 100 (best value) and is computed from measurements of pH, TP, nitrate (NO3), alkalinity, chlorophyll a, percent saturation of DO, temperature, specific conductance, and Secchi disk depth. Generally, water quality conditions in Mountain Island Lake are ranked as Good to Excellent. However, since January 1993, WQI values in the Poor/Fair range have been reported in McDowell Creek Cove of Mountain Island Lake in Mecklenburg County. In August 2004, WQI values dropped to their lowest at Fair in Nance Cove in Mecklenburg County. Both of these coves have experienced significant development activities in the past 5 to 10 years. The other monitoring sites on Mountain Island Lake maintain Good to Excellent WQI values.

Water quality in Mountain Island Lake is highly influenced by the discharge from the Cowans Ford Development (Lake Norman). Consequently, DO concentrations in the Mountain Island tailrace also are below 4 mg/l only 1 percent of the time from May through November. Mountain Island Lake discharges directly into Lake Wylie and has a short 0.6-mile bypassed reach. Between May and November the daily average DO concentrations typically meet water quality standards approximately 87 percent of the time. There is no supplemental aeration capability at the Mountain Island powerhouse.

Alternative 7 proposes to directly withdraw water from Mountain Island Lake, whereas Alternative 6 would not withdraw water directly from this lake, but rather from the Catawba River below Lake Wylie, which is downstream of Mountain Island Lake. However, Alternative 6 has the potential to indirectly affect water quality, and Alternative 7 has the potential to directly affect water quality at Mountain Island Lake.

Based on the CHEOPS modeling and Elevation Exceedance Curves*,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Mountain Island Lake. As a result, impacts from Alternatives 6 and 7 to reservoir elevations under normal conditions would be negligible. During drought conditions, alternatives

6 and 7 would cause minor impacts to reservoir elevations. These minor impacts to reservoir elevations were found to occur only 1-2 percent of the time. Given the relatively small amount of time reservoir elevations would fluctuate, DO concentration and water temperature should remain at current levels a majority of the time. Therefore, Alternatives 6 and 7 would have minor impacts on DO concentration and water temperature in Mountain Island Lake during drought conditions due to reservoir elevation fluctuations only a small percentage of the time.

Wylie (Lake Wylie)

The Wylie Development is located at RM 143.5. The 12,177-acre reservoir (Lake Wylie) has a full pond elevation of 569.4 feet msl and a usable storage capacity of 40,145 acre-feet. Lake Wylie is experiencing localized sedimentation and nutrient enrichment in the Crowders Creek and Catawba Creek arms of the lake. Lake Wylie is not currently considered impaired for nutrients in South Carolina. South Carolina lists Lake Wylie as impaired for recreation due to fecal coliform levels and copper. In 2007, DWQ sampled Lake Wylie and determined the following: (1) elevated nutrient concentrations; (2) mild to severe algal blooms throughout the summer; and (3) eutrophic, high productivity conditions. In 2008, SCDHEC listed Lake Wylie as impaired as a result of fecal coliform and copper levels.

Alternatives 6 and 7 do not propose to directly withdraw water from Lake Wylie. However, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Lake Wylie as a result of withdrawing water from the upstream Mountain Island Lake (Alternative 7) or the Catawba River (Alternative 6) downstream of Lake Wylie.

Based on the CHEOPS modeling and Elevation Exceedance Curves*,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Lake Wylie. As a result, impacts from Alternatives 6 and 7 to reservoir elevations under normal conditions would be negligible. During drought conditions, Alternatives 6 and 7 would cause minor impacts to reservoir elevations. These minor impacts to reservoir elevations were found to occur only 1-2 percent of the time. Given the relatively small amount of time reservoir elevations would fluctuate, DO concentration and water temperature should remain at current levels a majority of the time. Therefore, Alternatives 6 and 7 would have minor impacts on DO concentration and water temperature in Lake Wylie during drought conditions due to reservoir elevation fluctuations only a small percentage of the time.

Fishing Creek (Fishing Creek Lake)

The Fishing Creek Development is located at RM 104.0. The 3,431-acre reservoir (Fishing Creek Lake) has a full pond elevation of 417.2 feet msl and a usable storage capacity of 11,159 acre-feet. In 2008, SCDHEC listed Fishing Creek Lake as impaired due to total nitrogen, total phosphorus, ammonia, chlorophyll-a, and pH.

Alternatives 6 and 7 do not propose to directly withdraw water from Fishing Creek Lake. However, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Fishing Creek Lake as a result of withdrawing water from the Mountain Island Lake (Alternative 7) or the Catawba River (Alternative 6) upstream of Fishing Creek Lake.

Based on the CHEOPS modeling and Elevation Exceedance Curves, water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Fishing Creek Lake. As a result, impacts from Alternatives 6 and 7 to reservoir elevations under normal or drought conditions would be negligible. Therefore, impacts from Alternatives 6 and 7 on DO concentration and water temperature would be negligible in Fishing Creek Lake because reservoir elevations would not fluctuate.

Great Falls/Dearborn (Great Falls Reservoir)

The Great Falls and Dearborn Developments are located at RM 101.5, only 3 miles downstream from the Fishing Creek dam. The 353-acre reservoir (Great Falls Reservoir) has a full pond elevation of 355.8 feet msl and a usable storage capacity of 1,966 acre-feet. In 2008, SCDHEC listed Great Falls Reservoir as impaired as a result of total nitrogen, total phosphorus, and turbidity.

Alternatives 6 and 7 do not propose to directly withdraw water from Great Falls Reservoir. However, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Great Falls Reservoir as a result of withdrawing water from Mountain Island Lake (Alternative 7) or the Catawba River below Lake Wylie (Alternative 6), each upstream of Great Falls Reservoir.

Based on the CHEOPS modeling and Elevation Exceedance Curves, water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Great Falls Reservoir. As a result, impacts from Alternatives 6 and 7 to reservoir elevations under normal or drought conditions would be negligible. Therefore, Alternatives 6 and 7 would have only negligible impacts on DO concentration and water temperature in Great Falls Reservoir because reservoir elevations would not fluctuate.

Rocky Creek/Cedar Creek (Cedar Creek Reservoir)

The Rocky Creek and Cedar Creek Developments are located at RM 99.3 immediately downstream of the Great Falls and Dearborn Developments. The 748-acre reservoir (Cedar Creek Reservoir) has a full pond elevation of 284.4 feet msl and a usable storage capacity of 2,190 acre-feet. Cedar Creek Reservoir is classified as impaired due to high total phosphorus, total nitrogen, chlorophyll a and turbidity levels, and low DO. In 2008, SCDHEC listed Cedar Creek Reservoir as impaired as a result of DO, total nitrogen, total phosphorus, chlorophyll-a, turbidity, and copper.

Alternatives 6 and 7 do not propose to directly withdraw water from Cedar Creek Reservoir. However, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Cedar Creek Reservoir as a result of withdrawing water from Mountain Island Lake (Alternative 7) or the Catawba River below Lake Wylie (Alternative 6), each upstream of Cedar Creek Reservoir.

Based on the CHEOPS modeling and Elevation Exceedance Curves, water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Cedar Creek Reservoir. As a result, impacts from Alternatives 6 and 7 to reservoir elevations under normal or drought conditions would be negligible. Therefore, Alternatives 6 and

7 would have only negligible impacts on DO concentration and water temperature in Cedar Creek Reservoir because reservoir elevations would not fluctuate.

Wateree (Lake Wateree)

The Wateree Development is located at RM 76.9. The 13,025-acre reservoir (Lake Wateree) has a full pond elevation of 225.5 feet msl and a usable storage capacity of 65,568 acre-feet. Lake Wateree is classified as impaired due to high total phosphorus, chlorophyll a. and pH levels. Lake Wateree receives high concentrations of nutrients and organic matter and low concentrations of DO from the Cedar Creek Reservoir. Fishing Creek Lake, Great Falls Reservoir, and Cedar Creek Reservoir have short retention times with limited internal processing of pollutant loads resulting in the majority of the nutrient loads to Lake Wateree originating upstream of Fishing Creek Lake. Typically higher pollutant loads lead to higher algae concentrations which cause lower DO concentrations. In 2008, SCDHEC listed Lake Wateree as impaired as a result of DO, total phosphorus, chlorophyll-a, turbidity, and pH.

Alternatives 6 and 7 do not propose to directly withdraw water from Lake Wateree. However, Alternatives 6 and 7 would have the potential to indirectly affect water quality at Lake Wateree as a result of withdrawing water from the Mountain Island Lake (Alternative 7) or the Catawba River below Lake Wylie (Alternative 6), each upstream of Lake Wateree.

Based on the CHEOPS modeling and Elevation Exceedance Curves*,* water withdrawals from the proposed alternatives were modeled to determine if reservoir elevation fluctuations would occur within Lake Wateree. As a result, impacts from Alternatives 6 and 7 to reservoir elevations under normal or drought conditions would be negligible. Therefore, impacts from Alternatives 6 and 7 on DO concentration and water temperature in Lake Wateree would be negligible because reservoir elevations would not fluctuate.

Catawba River

The Catawba River between Lake Wylie and Fishing Creek Reservoir is a riverine section approximately 26 miles long. Water releases from Lake Wylie are primarily controlled for the use of power generation. The major influence on DO concentrations and water temperatures in this section of the Catawba River come from upstream impoundments and water releases. The Wylie Development releases water with DO concentrations below 4 mg/l, 29 percent of the time from May through November. DO concentrations may remain below 4 mg/l for up to 6 miles below Lake Wylie, after which it improves because of re-aeration and photosynthesis by aquatic plants. Generally, DO concentrations in this stretch of the Catawba River are frequently out of compliance with South Carolina water quality standards.

As previously noted, run-of-river intakes differ from reservoir intakes because they are designed to operate within a wide range of river levels. The intakes need to be designed with additional considerations for protection of facility from debris and sediment, fish entrainment, operation during flooding or drought conditions, etc. Generally, these intakes do not alter river elevation levels unless the river is shallow. Water withdrawals from the Catawba River at the site of Union County's existing Joint Venture with Lancaster County, SC at the CRWSP (Alternative 6) should not affect river levels based on the river's current topography. Alternative 6 ensures the Catawba River will maintain its natural riverine characteristics (i.e. run-of-river) which allows for current water quality levels to remain relatively constant. Additionally, Alternative 6 water demands would necessitate only a small proportion of the total water within the Catawba River be withdrawn at this location. Therefore, water quality impacts from Alternative 6 within the Catawba River would be negligible. The only impacts to water quality identified from Alternative 6 are indirect and minor in Lake James, Lake Rhodhiss, and Lake Hickory during normal conditions. During drought conditions, Alternative 6 results in minor impacts on the previously mentioned reservoirs and, additionally, Lookout Shoals Lake, Mountain Island Lake, Lake Norman, and Lake Wylie.

Summary

Direct impacts from Alternatives 6 and 7 to source waterbody elevations during normal conditions would be negligible, which would ensure water quality within the source waterbodies (i.e. Mountain Island Lake and the Catawba River below Lake Wylie) are not adversely affected. Only during drought conditions were reservoir elevation impacts identified through the CHEOPS modeling for Mountain Island Lake. However, Alternatives 6 and 7 may have indirect impacts on other reservoir elevations which would result in minor impacts to water quality under normal and drought conditions. The reservoirs that would have minor indirect impacts from Alternatives 6 and 7 include: (1) Lake James; (2) Lake Rhodhiss; (3) Lake Hickory; (4) Lookout Shoals Lake; (5) Lake Norman; and (6) Lake Wylie. Impacts from Alternatives 6 and 7 are negligible on Fishing Creek Lake, Cedar Creek Reservoir, and Lake Wateree during normal and drought conditions. Therefore, Alternatives 6 and 7 would likely result in greater adverse impacts on receiving water bodies than on source water-bodies. As indicated through the water quantity modeling, impacts from Alternatives 6 and 7 to reservoir or river elevations in source water-bodies were negligible, but the water withdrawals of both alternatives caused minor impacts to upstream and downstream reservoirs elevation levels, which could lead to potential water quality affects within those non-source waterbodies. Table 5-44 provides a summary indicating the impacts during normal and drought conditions for Alternatives 6 and 7.

Table 5-44 Summary of Impacts to Water Quality During Drought Conditions for Alternatives 6 and 7. (Source: Staff, November 2014)

Waterbody	Normal Conditions		Drought Conditions	
	Alternative 6	Alternative 7	Alternative 6	Alternative 7
Lake James	-	-	MI	MI
Lake Rhodhiss	MI	-	MI	MI
Lake Hickory	MI	-	MI	MI
Lookout Shoals Lake	-	-	MI	MI
Lake Norman	-	-	MI	MI
Mountain Island Lake	-	-	MI	MI
Lake Wylie	-	-	MI	MI
Fishing Creek Lake	-	-	-	-
Great Falls Reservoir	-	-	-	-
Cedar Creek Reservoir	-	-	-	-
Lake Wateree	-	-	-	-
Catawba River	-	-	-	-

"-" = Negligible Impact"; MI" = Minor Impact; "MO" = Moderate Impact; "MA" = Major Impact

5.12.4. Groundwater

5.12.4.1. COMMON ELEMENTS TO ALTERNATIVES

Temporary direct impacts to groundwater may occur as a result of construction of any of the alternatives. Excavation of the trench and pit for the installation of the proposed transmission line and pump station elements, respectively, may result in groundwater being encountered and therefore impacted during construction. The temporary direct impacts to groundwater are anticipated to be negligible and adverse. With the exception of Alternatives 4, 5, and 8, no permanent direct impacts to groundwater will occur from the alternatives.

5.12.4.2. ALTERNATIVE 4

Alternative 4 includes an optional array of Ranney wells. If the wells are implemented for the alternative, additional direct impacts to groundwater are anticipated to occur. The effects on private or community groundwater wells that may be in the vicinity of the proposed Ranney wells are also unknown at this time. If the Ranney well option is selected for Alternative 4, the groundwater table is anticipated to be lowered. Hydraulic and hydrologic modeling to assess the magnitude of the impacts will be performed if this alternative is selected. The impacts are expected to be permanent, adverse, and moderate.

5.12.4.3. ALTERNATIVE 5

Alternative 5 includes either a low-head dam or a small array of Ranney wells in the Rocky River. Each option for ensuring adequate yield of raw water from the river will have different effects on groundwater in the area. Each option is discussed separately as follows.

If the low-head dam option is selected for Alternative 5, the resulting effect on groundwater will extend upstream from the dam and landward of the river banks. The impacts will result from the rise in surface water in the river, which is expected to result in a rise in the water table adjacent to the river. The landward extent of the alteration of groundwater depths and volume is unknown at this time. If the low-head dam option is selected for Alternative 5, modeling of groundwater and the effects of the dam would be conducted. The impacts are expected to be permanent and adverse. The intensity of the impacts would be determined by the hydraulic and hydrologic modeling if the option is chosen.

If the Ranney well option is selected for Alternative 5, the effect will be a lowering of the groundwater table. The extent of the impact is not known at this time. Hydraulic and hydrologic modeling would be conducted to assess the magnitude of the impacts of the Ranney well option, if selected. The impacts are expected to be permanent, adverse, and moderate.

5.12.4.4. ALTERNATIVE 8

Alternative 8 includes the development of a groundwater extraction well field consisting of up to 1,295 wells and ultimately producing approximately up to 28 mgd of raw water. The well field will cover an area up to 37 square miles in order to yield the required volume of water. The portion of Union County selected for the well field does not currently have water and sewer service. Therefore, the residents and businesses in the proposed well field area rely on private and community groundwater wells, which will be adversely affected by the development and operation of the proposed well field. Additionally, operation of the proposed well field is expected to result in a significant reduction in the availability of groundwater for non-extraction related uses, including groundwater discharge into streams and wetlands. Although the precise calculation of impacts due to the implementation of Alternative 8 would require hydraulic and hydrologic modeling, the impacts of the alternative are anticipated to be permanent, adverse, major, and direct.

5.12.4.5. NO-ACTION ALTERNATIVE

The No-Action Alternative involves no excavation or withdrawal of groundwater. Therefore, existing groundwater resources will not be affected by the implementation of the No-Action Alternative. Growth and development in the service area is expected to occur even with implementation of the No-Action Alternative. Additional use of groundwater will occur and minor indirect and cumulative impacts to groundwater due to growth and development are anticipated to occur.

5.13. Shellfish or Fish and Their Habitats

5.13.1. Common Elements of Alternatives

The transmission line corridors associated with the project alternatives include open cut crossings of several rivers and streams that provide habitat to shellfish and fish, although the number of crossings and the streams crossed will vary by alternative (Tables 5-8 and 4-16, respectively). Woody vegetation is anticipated to be removed from streamside areas to accommodate the proposed project, although the area of riparian disturbance will be reduced to the extent practicable. Construction activities associated with the raw water intakes in Lake Tillery, Tuckertown Reservoir, Narrows Reservoir (Badin Lake), Blewett Falls Lake, Pee Dee River and Rocky River, the low-head dam in Rocky River, and the discharge transmission line into Lake Tillery associated with various alternatives will also require disturbance of stream banks and channel substrates. The proposed effluent discharge into Lake Tillery associated with Alternative 11 and its effect on water quality are discussed in Section 5.12.2.

Proposed construction activities will involve land disturbance in the project footprints. Therefore, the potential for erosion and sedimentation may increase during construction. Erosion and sedimentation may carry soils, toxic compounds, trash, and other materials into the aquatic communities. Erosion control during construction will be important to minimize direct impacts to streams during construction. Quick re-vegetation of disturbed areas will reduce the impacts by supporting the underlying soils. An Erosion and Sediment Control Plan will be developed and implemented during construction associated with the proposed alternative. Implementation of BMPs and further precautionary measures during construction of the proposed project will minimize adverse impacts to fish and shellfish.

Transmission line installation is anticipated to have indirect and direct, minor, temporary impacts to fish species within and downstream of the project areas during construction activities for all alternatives except Alternative 7 and WTP A. No permanent impacts to fish and shellfish within and downstream of the project areas are anticipated to occur relative to pipe installation. No permanent direct impacts to shellfish or their habitats will occur from the pump stations and access roads from the project. Impacts are not included for WTP sites since the location and footprint of the infrastructure is not known; however, the impacts are anticipated to be negligible.

Anadromous fish spawning areas are not located within the project areas. Five species of sunfish have been identified in some of the streams in the project areas. Construction moratoria have been imposed in response to the presences of this species. Instream work may be subject to construction moratoria associated with the sunfish or other fish species.

Permanent impacts to fish and shellfish will occur from the raw water intakes and the Alternative 5 low-head dam. Impingement of ichthyoplankton and entrainment of young-of-the-year fish are anticipated relative to the raw water intakes. However, construction of the raw water intakes for this project will be in compliance with Federal Energy Regulatory Commission (FERC) and Duke Energy design requirements passive intake screens, including opening sizes and maximum intake velocity, to minimize impingement and entrainment of aquatic life. Construction of a low-head dam in the Rocky River will restrict upstream movement of aquatic organisms, modify the substrate and habitat composition adjacent to the dam, and alter the instream habitat of the area inundated by the increase in water level. Direct, indirect, temporary and permanent impacts to fish and shellfish are anticipated to be minor in proximity of the raw water intakes, the low-head dam associated with Alternative 5, and the discharge associated with Alternative 11.

Indirect and cumulative impacts to aquatic habitats may occur from growth in the service area. The anticipated growth and associated development may cause increased erosion, sedimentation, and stormwater runoff. The inputs of sediment and runoff from development may result in loss, fragmentation, or degradation of aquatic and terrestrial species and their habitats. As a result, a decline in water quality, aquatic resources, fisheries, and wetlands in the service area may occur. Indirect or cumulative impacts are anticipated to be minor.

5.13.2. Common Elements of Alternatives 2A, 2B, 3A, 4, 7, and 11

Occurrences of American eel and Carolina darter are known to occur in Lanes Creek, which would be crossed by the transmission line corridors for Alternatives 2A and 2B. Occurrences of Carolina creekshell are known in Big Bear Creek, which is also traversed by the Alternative 2A and 2B transmission line corridors. Carolina darter and Carolina creekshell are known to occur in Richardson Creek, which is crossed by the Alternative 3A, 4, and 11 transmission line corridors. Occurrences of Carolina creekshell are also known to exist in several streams that are crossed by the Alternative 7 transmission line corridor. Seven occurrences of the endangered Carolina heelsplitter are known to occur within several streams that are traversed by the Alternative 7 transmission line corridor.

5.13.3. No-Action Alternative

The No-Action Alternative will not directly impact shellfish or fish and their habitats. Regardless of the alternative selected for the project, growth in the project service area is anticipated and planned. Minor indirect and cumulative impacts are expected to occur from development activities associated with anticipated and planned growth.

5.14. Forest Resources

5.14.1. Common Elements of Alternatives

Impacts to forest resources have the potential to occur as a result of vegetative clearing required during construction of each alternative. The forest resources of the project area are comprised of several community types. Mixed hardwood and pine species of varying age are present throughout the project areas. Tracts of forested areas that contain varying ages of pine species planted and managed for timber production are also present. The temporary and permanent direct impacts to forest resources are summarized in Table 5-45. The acreages provided represent an estimate of forested areas based on aerial review of project areas located in South Carolina and data obtained from DFR’s Important Forest Lands mapping.

Trees will be removed to allow access for construction equipment and activities. The impact to forest resources varies among the project alternatives due to variations in the project corridor locations. The majority of the transmission line corridors associated with the individual alternatives are located along existing maintained roadway easements, which minimizes the clearing required for pipe installation.

Temporary and permanent impacts associated with the WTP sites are not known at this time as the location of required infrastructure associated with the WTPs has not been determined. Portions of the pump station and access road sites contain forested areas. Cleared areas associated with the WTP sites and pump stations will be minimized to the extent feasible such that removal of vegetation is limited to the area necessary to accommodate proposed infrastructure and the construction and installation. The indirect impacts and cumulative effect of direct impacts due to land clearing for construction and access in addition to the impacts due to future development are anticipated to be minor for the project alternatives.

Table 5-45 Important Forest Lands per Alternative

Alternative	Transmission Line Corridor, acres		Pump Station, acres		Access Road, acres [1]		Total per Alternative, acres	
	Temporary Impacts	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	Permanent Impacts
1A	130	11	----	----	----	----	130	11
1B	226	18	----	----	----	----	226	18
2A	129	1	----	----	----	----	129	1
2B	126	9	----	<0.5	1	<1	127	9
3A	325	27	----	<0.5	<1	<0.5	326	27
3B [2]	116	3	----	<0.5	<1	<0.5	117	3
4	121	11	----	<0.5	----	----	121	11
5	4	<0.5	----	----	----	----	4	<0.5
6 [2]	56	7	----	----	----	----	56	7
7	34	3	----	----	----	----	34	3
8 [2]	14	1	----	----	----	----	14	1
11	163	13	----	----	----	----	163	13
WTP A [2]	----	----	----	----	----	----	----	----
WTP B [2]	18	1	----	----	----	----	18	1
WTP C [2]	27	2	----	----	----	----	27	2

[1] Metrics are not included if the access road is located in a transmission line corridor.
[2] Impacts are not included for WTP sites or well sites since the location and footprint of the infrastructure is not known.

5.14.2. No-Action Alternative

The No-Action Alternative will not directly impact forest resources. Regardless of the alternative selected for the project, growth in the project service area is anticipated and planned. Indirect and cumulative impacts are expected to occur from development activities associated with anticipated and planned growth.

5.15. Wildlife and Natural Vegetation

5.15.1. Wildlife Habitat and Resources

5.15.1.1. COMMON ELEMENTS OF ALTERNATIVES

Each of the proposed alternatives includes installation of subsurface pipes. Most of the alternatives include construction of an access road and pump station, and a WTP. Construction of transmission lines will have direct impacts on current terrestrial habitats during the construction period. Construction of access roads, pump stations, and WTPs will have direct, permanent impacts on existing terrestrial habitats. The amount and type of impacted habitat for the alternatives varies based on the land cover community types associated with each project area. The two major land use community types in the project areas are disturbed lands and forested areas. Disturbed lands include roadway easements, existing utility easements, land used for agriculture or pastureland, and lands developed for residential, commercial, institutional, and industrial purposes. Forested communities are areas dominated by mature, undisturbed wooded vegetation.

The land use community type associated with the location of the proposed alternatives may be used to compare each alternative's direct impact on wildlife habitat. Construction activities that take place on disturbed lands are anticipated to have less impact on wildlife habitat than construction in forested areas. The approximate percentage of forested land area affected by construction activities provides a basis to compare the estimated wildlife habitat impacts among the alternatives. Forested land associated with the transmission line corridor, pump station, and access roads for each alternative is summarized in Table 5-10. All of the WTP sites associated with the project alternatives contain areas that are forested.

Temporary, minor, direct impacts to wildlife and vegetation have the potential to occur as a result of all alternatives. Impacts to terrestrial habitats and resources will occur during construction activities associated with all of the proposed project alternatives. Temporary fluctuations of terrestrial species are anticipated during construction activities. Slow moving, burrowing, and/or subterranean organisms will be directly impacted by construction activities, while mobile organisms will be displaced to adjacent communities. Negligible, direct, permanent impacts to terrestrial habitat or resources will occur from implementation of any of the alternatives from loss or change in habitat. Permanent impacts to protected species may also occur if present within the footprint of proposed structures and paved areas. The indirect impacts and cumulative effect of direct impacts to wildlife habitat and resources from construction and access in addition to the impacts due to future development are anticipated to be minor for the project alternatives.

5.15.1.2. NO-ACTION ALTERNATIVE

Direct adverse impacts to wildlife habitat and resources will not occur from implementation of the No-Action Alternative. Indirect and cumulative impacts associated with the No-Action Alternative are anticipated to occur from development activities associated with anticipated and planned growth in the service area. Indirect and cumulative impacts to wildlife habitat and resources due to development in the service area will include temporary impacts during construction activities and permanent impacts from conversion of presently undisturbed, forested land.

5.15.2. Rare and Protected Species or Habitats

Two federally listed species are documented within a two-mile radius of the project areas associated with the alternatives. The potential availability of suitable habitat for the federally listed species and FSCs was assessed based on review of published data, including aerial photography, NRCS soils mapping, USGS topographic quadrangles, NWI maps, and FEMA FIRMs. Based on the review of the published data relative to the project areas associated with the alternatives, habitat for numerous federally listed species and FSCs was determined to likely be available within the footprint of the various elements of the proposed alternatives. A discussion of which alternatives are within a two-mile radius of a documented population and which alternative elements potentially contain habitat for listed species are summarized in Table 5-11. A discussion of the potential effects on documented species populations are discussed in the following subsections.

If a population of a federally protected species is found to be present in a project area associated with the selected alternative, USFWS and NCWRC will be contacted to confirm the species identification and extent of the population. Union County will coordinate with the agencies to identify measures to avoid impacting the species. If impacts to the species cannot be entirely avoided, then efforts to minimize the remaining impacts will be identified.

Additionally, USFWS is currently implementing a moratorium on tree cutting from May 15 through August 15 to protect the northern long-eared bat when the young are born and preparing to fledge. As the northern long-eared bat is listed in Mecklenburg and Stanly counties, the moratorium applies to only the portions of the proposed project alternatives that are located in the two counties. No roost trees or hibernacula are currently known to occur in Mecklenburg or Stanly County; however, the moratorium applies due to the listing of the species as potential/probable in the two counties.

Impacts to species habitat are likely to occur during construction of the proposed project and are anticipated to be minor. Impacts to habitat may be adverse or beneficial due to clearing wooded areas and the creation of new forest edges and new herbaceous or scrub-shrub areas in the proposed utility easement. The changes may eliminate habitat for some species while creating or expanding habitat for other species. During construction activities, temporary fluctuations of protected species are possible. Slow moving, burrowing, and/or subterranean organisms may be directly impacted by construction while mobile organisms will be displaced to adjacent communities during construction. Future growth and development in the service area may result in indirect and cumulative impacts to federally protected species and their habitat. The indirect impacts and cumulative effect of direct impacts to rare and protected species or habitats for construction and access in addition to the impacts due to future development are anticipated to be minor for the project alternatives.

5.15.2.1. ALTERNATIVE 1A

Habitat appears to be available within the water main corridor of Alternative 1A for twelve Federal Species of Concern (FSC), two candidate species, one endangered species, and one species protected under the Bald and Golden Eagle Protection Act (BGPA). The endangered species is Michaux's sumac, and the BGPA-protected species is the bald eagle. Populations of Septima's clubtail, robust redhorse, and Piedmont aster (FSC species) have been documented within a two-mile radius of the water main corridor. Habitat is likely present within the access road and pump station areas for one candidate species, Georgia aster, and two FSCs. Habitat for six FSCs appears to be available at the proposed raw water intake site. The aforementioned tree-cutting moratorium to protect the northern long-eared bat is expected to apply to the portion of Alternative 1A that is located within Stanly County. Surveys for Michaux's sumac in areas of appropriate habitat within the construction footprint of the Alternative 1A water main corridor will be performed prior to construction if Alternative 1A is selected for implementation.

5.15.2.2. ALTERNATIVE 1B

Habitat appears to be available within the water main corridor of Alternative 1B for thirteen FSCs, two candidate species, one threatened species, one endangered species, and a BGPA-protected species. Michaux's sumac is federally endangered, and the bald eagle is protected under the BGPA. Of the thirteen FSCs for which habitat is likely available in the water main corridor, populations of three FSC species (i.e., Septima's clubtail, robust redhorse, and Piedmont aster) are documented within a two-mile radius of the water main corridor. The access road and pump station areas of Alternative 1B contain potentially suitable habitat for one candidate species, Georgia aster, and two FSC species. Habitat may be available at the intake site for six FSC species. The aforementioned tree-cutting moratorium to protect the northern long-eared bat is expected to apply to the portion of Alternative 1B that is located within Stanly County. Surveys for Michaux's sumac in areas of suitable habitat within the construction footprint of the water main corridor will be performed prior to construction if Alternative 1B is selected for implementation.

5.15.2.3. ALTERNATIVES 2A AND 2B

Habitat is potentially available within the water main corridors for Alternatives 2A and 2B for thirteen FSC, two candidate species, one threatened species, one endangered species, and one species protected under the BGPA. Populations of four FSC species, including Carolina darter, Carolina creekshell, Septima's clubtail, robust redhorse, and Piedmont aster, have been documented within a two-mile radius of the water main corridor. The documented location of the population of Carolina darter is in Long Creek, and the populations of Carolina creekshell in proximity to the water main corridor are in Riles Creek, Curl Tail Creek and a UT thereto, Stony Run, and Big Bear Creek.

Habitat appears to be present within the access road and pump station areas for one candidate species, the bald eagle, and two FSC species. Habitat for six FSC species and the bald eagle is likely available at the proposed raw water intake site. Numerous populations of the bald eagle are documented within Yadkin River and Narrows Reservoir (Badin Lake) within a two-mile radius of the access road, pump station, and intake areas of the Alternatives 2A and 2B project areas. The aforementioned tree-cutting moratorium to protect the northern long-eared bat is expected to apply to the portion of Alternatives 2A and 2B that are located within Stanly County. Surveys for Michaux's sumac and bald eagle in areas of suitable habitat within the construction footprint of Alternatives 2A and 2B water main corridors and intake areas will be performed prior to construction if either is selected as the preferred alternative.

5.15.2.4. ALTERNATIVE 3A

Habitat appears to be available within the water main corridor for thirteen FSC, one candidate species, five federally endangered species (i.e., red-cockaded woodpecker, Carolina heelsplitter, Schweinitz's sunflower, robust redhorse, and Michaux's sumac), and the bald eagle protected under the BGPA. One population of red-cockaded woodpecker and three populations of Schweinitz's sunflower are documented within a two-mile radius of the Alternative 3A water main corridor. Populations of seven FSC species are documented within a two-mile radius of the water main corridor, which include two populations of robust redhorse, six populations of

Piedmont aster, and one population each of Septima's clubtail, Carolina creekshell, Carolina darter, ravine sedge, and bog spicebush.

Habitat for one FSC species and the bald eagle is expected to be available within the access road and pump station project areas. The Alternative 3A intake site contains potentially suitable habitat for five FSC species, the federally endangered robust redhorse, and the bald eagle. Numerous populations of bald eagle are documented in Yadkin River and Blewett Falls Lake within a two-mile radius of the water main corridor, access road, pump station, and intake project areas associated with Alternative 3A. If Alternative 3A is selected for implementation, appropriate surveys for red cockaded woodpecker, Carolina heelsplitter, Schweinitz's sunflower, Michaux's sumac, and bald eagle will be performed in areas that contain suitable habitat for the respective species to determine if any federally protected species are present within construction areas.

5.15.2.5. ALTERNATIVE 3B

Habitat is likely present within the footprint of Alternative 3B for thirteen listed FSC, one candidate species, four endangered species (i.e., robust redhorse, red-cockaded woodpecker, Schweinitz's sunflower and Michaux's sumac), and the bald eagle protected under the BGPA. Populations of four FSC species (i.e., Carolina darter, robust redhorse, Piedmont aster, and bog spicebush) are documented within a two-mile radius of the water main corridor.

Habitat for one FSC species and the bald eagle is expected to be available in the access road and pump station project areas for Alternative 3B. The intake site contains potentially suitable habitat for seven protected species, including the federally endangered robust redhorse, five FSC species, and the bald eagle. Numerous populations of bald eagle are documented in proximity to the project areas located adjacent to Yadkin River and Blewett Falls Lake, which include the access road, pump station, intake site, and portions of the water main corridor. The WTP D site appears to provide habitat for two FSC. If Alternative 3B is selected, appropriate surveys for red-cockaded woodpecker, bald eagle, Schweinitz's sunflower, and Michaux's sumac will be performed within the construction areas to determine the presence or absence of these federally protected species.

5.15.2.6. ALTERNATIVE 4

Habitat for appears to be provided within the water main corridor for Alternative 4 for twelve FSCs, one candidate species, four federally endangered species (i.e., robust redhorse, red-cockaded woodpecker, Carolina heelsplitter, and Michaux's sumac), and the bald eagle is protected under the BGPA. Two populations of red-cockaded woodpecker, four populations of Piedmont aster, and one population each of Septima's clubtail, robust redhorse, Carolina creekshell, Carolina darter, and ravine sedge are documented within a two-mile radius of the Alternative 4 water main corridor.

Habitat for two FSC species is expected to be available in the access road and pump station footprints. Habitat for five FSC species and one federally endangered species (i.e., robust redhorse) is likely present at the intake site. Surveys of the construction areas with suitable habitat will be performed to determine the presence or absence of red-cockaded woodpecker, Carolina heelsplitter, bald eagle, and Michaux's sumac if Alternative 4 is selected for implementation.

5.15.2.7. ALTERNATIVE 5

Habitat appears to be available within the Alternative 5 water main corridor footprint for one candidate species, one federally endangered species (i.e., Michaux's sumac), and four FSCs. Populations of three FSC (i.e., Septima's clubtail, robust redhorse, and Piedmont aster) are documented within a two-mile radius of the Alternative 5 water main corridor. Habitat for one FSC and the candidate species (i.e., Georgia aster) is likely present within the access road and pump station project areas. Habitat for seven FSCs and one endangered species (i.e., Carolina heelsplitter) is expected to be available at the intake site. If Alternative 5 is selected for implementation, plant surveys will be performed throughout portions of the construction areas that contain appropriate habitat for Michaux's sumac. A mussel survey will be performed in proximity to the intake site to identify existing populations of Carolina heelsplitter.

5.15.2.8. ALTERNATIVE 6

Within the water main corridor for Alternative 6, habitat appears to be available for one candidate species, three federally endangered species (i.e., Carolina heelsplitter, Schweinitz's sunflower, and Michaux's sumac), and seven FSCs. Populations of the candidate species Georgia aster, the endangered Schweinitz's sunflower, and two FSC (i.e., Carolina darter and Piedmont aster) are documented within a two-mile radius of the water main corridor. Populations of Carolina darter are documented in Little Twelve Mile Creek and in Rone Branch in proximity to the project areas. As the footprint of the pump station and raw water intake upgrades and/or expansions have not been determined yet, information regarding the presence or absence of federally protected species cannot be evaluated. If Alternative 6 is pursued for the project, surveys of areas with suitable habitat will be performed to determine the presence of Carolina heelsplitter, Schweinitz's sunflower, and Michaux's sumac in the construction areas.

5.15.2.9. ALTERNATIVE 7

Habitat appears to be available within the water main corridor of Alternative 7 for the federally endangered Carolina heelsplitter and Michaux's sumac, the federally threatened northern long-eared bat, one candidate species, and nine FSCs. Two populations of Carolina creekshell, an FSC, are documented within a two-mile radius of the water main corridor. The Carolina creekshell is documented from Duck Creek and a UT thereto, as well as in Goose Creek. The populations documented in Goose Creek and the UT to Duck Creek are in the proposed construction areas of the water main corridor. Additionally, four populations of Schweinitz's sunflower, six populations of Georgia aster, and one population of Piedmont aster are documented within a two-mile radius of the pipe corridor.

It is not known at this time if a pump station and access road will be necessary for the implementation of Alternative 7. If this infrastructure is required for Alternative 7, the availability of suitable habitat in the footprint will be assessed. The aforementioned tree-cutting moratorium to protect the northern long-eared bat is expected to apply to the portion of Alternative 7 that is located within Mecklenburg County. Surveys of the construction areas with suitable habitat will be performed to determine the presence or absence of Carolina heelsplitter and Michaux's sumac if Alternative 7 is selected for implementation.

5.15.2.10. ALTERNATIVE 8

Habitat is likely available in the Alternative 8 water main corridor for one candidate species, two endangered species (i.e., Michaux's sumac and Carolina heelsplitter), and eight FSCs. One population of the FSC Carolina darter is documented in Beaver Dam Creek within a two-mile radius of the Alternative 8 water main corridor. The WTP D site contains potentially suitable habitat for the candidate species Georgia aster, the federally endangered Michaux's sumac, and two FSCs. The well field area contains habitat that may support the candidate species Georgia aster, three federally endangered species (i.e., Carolina heelsplitter, Schweinitz's sunflower, and Michaux's sumac), and ten FSCs. Within a two-mile radius of the well field, two populations of Carolina darter and Carolina creekshell, seven populations of Georgia aster, and one population each of Piedmont aster and savannah lilliput have been documented. Surveys for the presence of the federally protected Michaux's sumac, Carolina heelsplitter, and Schweinitz's sunflower will be performed within project areas of expected appropriate habitat prior to construction activities.

5.15.2.11. ALTERNATIVE 11

The transmission line corridor for Alternative 11 contains potentially suitable habitat for thirteen FSCs, two candidate species, three federally endangered species (i.e., Schweinitz's sunflower, Michaux's sumac, and Carolina heelsplitter) and the bald eagle protected under the BGPA. Populations of the candidate species Georgia aster and of four FSCs (i.e., Septima's clubtail, robust redhorse, Carolina creekshell, and Piedmont aster) are documented within a two-mile radius of the transmission line corridor.

A pump station will be necessary for Alternative 11; however, the pump station has not yet been sited at the City of Monroe WWTP facility. Therefore, a determination relative to the likely presence of suitable habitat for federally protected species cannot be made at this time. An evaluation of habitat will be conducted upon determination of the footprint of construction of the pump station. Surveys of the project area will be performed within areas providing suitable habitat for Carolina heelsplitter, Schweinitz's sunflower, Michaux's sumac, and bald eagle in order to ensure that all occurrences within the construction areas are identified.

5.15.2.12. WTP A ALTERNATIVE

Habitat appears to be available within the WTP A site for the endangered Michaux's sumac, the candidate species Georgia aster, and two FSCs, prairie birdsfoot-trefoil and Virginia quillwort. The layout of the proposed WTP facility has not yet been developed. Therefore, all portions of the area identified for the proposed facility were considered for the habitat assessment. Construction of the proposed facility will not impact all portions of the WTP area. One population each of Septima's clubtail and robust redhorse as well as three populations of Piedmont aster have been documented within a two-mile radius of the proposed WTP A location. If the WTP A Alternative is selected for implementation, plant surveys will be performed prior to commencing construction throughout portions of the construction areas that contain suitable habitat for Michaux's sumac.

5.15.2.13. WTP B ALTERNATIVE

Within the water main corridor associated with Alternative WTP B, habitat is likely available for the endangered Michaux's sumac, the candidate species Georgia aster, and seven FSCs. One population of both Septima's clubtail and Piedmont aster are documented within a two-mile radius of the water main corridor. The WTP B site may provide suitable habitat for five species that include the candidate species Georgia aster, the endangered Michaux's sumac, and three FSCs. One population of Carolina creekshell is documented within a two-mile radius of the proposed WTP B.

As only a portion of the WTP B area will be utilized for construction of the proposed WTP facility and appurtenant infrastructure, avoidance of federally protected plants and their respective habitats may be possible. Surveys for Michaux's sumac within project areas of suitable habitat will be performed prior to construction to ensure that the presence of the protected species is known.

5.15.2.14. WTP C ALTERNATIVE

Habitat appears to be available in the WTP C Alternative water main corridor for one candidate species, two endangered species (Carolina heelsplitter and Michaux's sumac), and 11 FSCs. Populations of Septima's clubtail and Piedmont aster are documented in a two-mile radius of the water main corridor. One population of Carolina darter, located in Beaverdam Creek, is within a two-mile radius of the pipe corridor and the WTP D site. The WTP C facility area appears to provide habitat for the candidate species Georgia aster, the federally endangered Michaux's sumac, and two FSCs. Habitat for Michaux's sumac is available in the WTP C facility area. Surveys for Carolina heelsplitter and Michaux's sumac will be performed prior to commencing construction to ensure that the presence of protected species is known.

5.15.2.15. NO-ACTION ALTERNATIVE

The No-Action Alternative will not disturb any lands and therefore will not result in direct impacts to federally protected species. Indirect and cumulative impacts due to the anticipated growth and development in the service area are expected to affect federally protected species and their habitat.

Table 5-46 Rare and Protected Species and Habitat in Project Area

Scientific Name	Common Name	Alternative 1A				Alternative 1B				Alternative 2A				Alternative 2B				Alternative 3A				Alternative 3B					Alternative 4				Alternative 5				Alt. 6	Alt. 7	Alternative 8			Alt. 11	WTP A	WTP B		WTP C	
		Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	WTP D Site	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Pipe Corridor	Pipe Corridor	WTP D Site	Well Field Area	Pipe Corridor	WTP A Site	Pipe Corridor	WTP B Site	Pipe Corridor	WTP C Site
Vertebrates																																													
Acipenser brevirostrum	Shortnose sturgeon	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	--	--	--	--	--	--	--	*	--	--	--	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Acipenser oxyrinchus oxyrinchus	Atlantic sturgeon	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	--	--	--	--	--	--	--	*	--	--	--	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Anguilla rostrata	American eel	H	--	--	H	H	--	--	H	H	--	--	H	H	--	--	H	H	--	--	H	H	--	--	H	--	H	--	--	H	--	--	--	H	--	H	--	--	H	H	--	--	--	H	--
Etheostoma collis collis	Carolina darter	H	--	--	--	H	--	--	--	P	--	--	--	P	--	--	--	H	--	--	--	H	--	--	--	--	H	--	--	--	--	--	--	H	P	H	P	--	H	H	--	H	--	H	--
Haliaeetus leucocephalus	Bald eagle	H	--	--	--	H	--	--	--	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	--	H	--	--	--	--	--	--	--	--	--	--	--	--	H	--	--	--	--	--
Moxostoma robustum	Robust redhorse	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	H	--	--	--	H	--	--	--	--	H	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moxostoma sp. 2	Carolina redhorse	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	H	--	--	--	H	--	--	--	--	H	*	*	*	*	*	*	*	*	*	--	--	--	--	--	--
Picoides borealis	Red-cockaded woodpecker	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	P	--	--	--	H	--	--	--	*	P	--	--	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Invertebrates																																													
Alasmidonta varicosa	Brook floater	H	--	--	--	H	--	--	--	H	--	--	--	H	--	--	--	P	--	--	--	H	--	--	--	*	H	--	--	H	*	*	*	*	*	*	*	*	*	H	--	H	--	H	--
Fusconaia masoni	Atlantic pigtoe	--	*	*	*	--	*	*	*	--	*	*	*	--	*	*	*	H	*	*	*	H	*	*	*	*	H	*	*	*	--	--	--	H	H	H	H	--	H	H	--	--	--	H	--
Lampsilis cariosa	Yellow lampmussel	H	--	--	H	H	--	--	H	H	--	--	H	H	--	--	H	H	--	--	H	H	--	--	H	--	H	--	--	--	--	--	--	H	--	H	--	--	H	H	--	--	--	H	--
Lasmigona decorata	Carolina heelsplitter	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	H	--	--	--	--	--	--	--	--	H	--	--	--	--	--	--	H	H	P	H	--	H	H	--	--	--	H	--
Toxolasma pullus	Savannah lilliput	H	--	--	H	H	--	--	H	H	--	--	H	H	--	--	H	H	--	--	--	H	--	--	--	--	H	--	--	--	--	--	--	H	P	H	H	--	H	P	--	H	--	H	--
Villosa vaughaniana	Carolina creekshell	H	--	--	H	P	--	--	H	P	--	--	H	P	--	--	H	P	--	--	H	H	--	--	H	--	P	--	--	H	--	--	--	H	P	P	H	--	H	H	--	H	--	H	--
Vascular Plants																																													
Amphianthus pusillus	Little amphianthus	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	*	*	*	*	*	*	*	*	*	*
Delphinium exaltatum	Tall larkspur	--	*	*	*	--	*	*	*	--	*	*	*	--	*	*	*	--	*	*	*	H	*	*	*	--	--	*	*	*	--	--	--	--	--	--	H	--	H	--	--	--	--	--	--
Echinacea laevigata	Smooth coneflower	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	--	*	*	*	*	*	*	*	*	*
Eurybia mirabilis	Dwarf aster	P	--	--	--	P	--	--	--	P	--	--	--	P	--	--	--	P	--	--	--	P	--	--	--	--	P	H	--	--	P	--	--	--	H	H	H	--	P	P	--	--	--	P	--
Helianthus schweinitzii	Schweinitz's sunflower	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	P	--	--	--	P	--	--	--	--	--	--	--	--	--	--	--	--	P	--	--	--	H	P	--	--	--	--	--
Hymenocallis coronaria	Shoals spiderlily	H	--	--	--	H	--	--	--	H	--	--	--	H	--	--	--	H	--	--	--	H	--	--	--	H	H	--	--	--	H	--	--	--	H	H	H	H	H	H	--	H	H	H	H
Isoetes melanospora	Black-spored quillwort	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	*	*	*	*	*	*	*	*	*	*
Isoetes virginica	Virginia quillwort	P	--	--	--	P	--	--	--	P	--	--	--	P	--	--	--	P	--	--	--	--	--	--	--	--	P	--	--	--	P	--	--	--	--	--	--	--	--	P	P	P	H	P	--
Juglans cinerea	Butternut	H	H	H	--	H	H	H	--	H	H	H	--	H	H	H	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	H	*	*	*	*	*
Lindera subcoriacea	Bog spicebush	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	P	--	--	--	P	--	--	--	--	--	--	--	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Lotus unifoliolatus var. helleri	Prairie birdsfoot-trefoil	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	P	H	H	H	H	H	H	H	H	H	H
Panicum lithophilum	Flatrock panic grass	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Rhus michauxii	Michaux's sumac	H	*	*	*	H	*	*	*	H	*	*	*	H	*	*	*	H	*	*	*	H	*	*	*	*	H	*	*	*	H	--	--	--	H	H	H	H	H	H	H	H	H	H	H
Solidago plumosa	Yadkin River goldenrod	H	--	--	--	H	--	--	--	H	--	--	--	H	--	--	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	H	*	*	*	*	*
Symphyotrichum georgianum	Georgia aster	H	H	H	--	H	H	H	--	H	H	H	--	H	H	H	--	H	*	*	*	H	*	*	*	*	H	*	*	*	H	H	H	--	P	H	H	P	H	P	H	H	H	H	H
Verbena riparia	Riparian vervain	H	--	--	H	H	--	--	H	H	--	--	H	H	--	--	H	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	H	*	*	*	*	*

Scientific Name	Common Name	Alternative 1A				Alternative 1B				Alternative 2A				Alternative 2B				Alternative 3A				Alternative 3B					Alternative 4				Alternative 5				Alt. 6	Alt. 7	Alternative 8			Alt. 11	WTP A	WTP B		WTP C	
		Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	WTP D Site	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Access Road	Pump Station	Other Infrastructure	Pipe Corridor	Pipe Corridor	Pipe Corridor	WTP D Site	Well Field Area	Pipe Corridor	WTP A Site	Pipe Corridor	WTP B Site	Pipe Corridor	WTP C Site

Notes:
H = Habitat appears to be available within project footprint based on the described desktop assessment.
P = Population has been documented within two miles of project element.
-- = Neither habitat nor a population are known within the project footprint.
* = Species is not listed in a county in which the proposed project element occurs.

5.16. Environmental Justice

Populations that are covered by the Executive Order regarding environmental justice are discussed relative to two thresholds: minority populations and low-income populations. Minority and low-income populations are identified where the percentage exceeds the state average to document any disparity in the location and provision of water treatment and transmission facilities between the general population and the minority and/or low-income populations. A disproportionate impact to a minority or low-income population may occur where such populations comprise more than 50 percent of the total population.

5.16.1. Minority Populations

5.16.1.1. ALTERNATIVE 1A

The pump station, access roads, and water main corridor associated with Alternative 1A traverse one block group that has a minority population greater than the North Carolina state average of 32 percent. Block group 2 of census tract 931100 has an overall minority population of 34 percent. The water main corridor is the only infrastructure in this alternative that will be located in this block group. The length of the water main corridor through the block group is approximately 3.8 miles. The water main corridor is routed along existing roadways through the block group. Therefore, temporary impacts to residents of the block group, regardless of minority status, are expected to be short-term and minor. No permanent impacts are expected to the residents. As the minority populations of the block groups traversed by the alternative are each below the 50-percent threshold, none of the anticipated impacts of the alternative will represent a disproportionate impact to minorities.

5.16.1.2. ALTERNATIVE 1B

Similar to Alternative 1A, the pump station, access roads, and water main corridor associated with Alternative 1B traverse only one block group with a minority population greater than the North Carolina state average of 32 percent. Block group 2 of census tract 931100 has an overall minority population of 34 percent. The water main corridor is the only infrastructure in this alternative that will be located in this block group. The length of the water main corridor through the block group is approximately 4.1 miles. The water main corridor is routed along existing roadways through the block group. Therefore, temporary impacts to residents of the block group, regardless of minority status, are expected to be short-term and minor. No permanent impacts are expected to the residents. As the minority populations of the block groups traversed by the alternative are each below the 50-percent threshold, none of the anticipated impacts of the alternative will represent a disproportionate impact to minorities.

5.16.1.3. ALTERNATIVE 2A

The block groups in which the pump station, access roads, and water main corridor are proposed to be sited have minority populations that are less than the state average and below the 50-percent threshold. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative 2A. None of the proposed infrastructure will have a disproportionate direct, indirect, or cumulative impact on a minority population.

5.16.1.4. ALTERNATIVE 2B

The block groups in which the pump station, access roads, and water main corridor are proposed to be sited have minority populations that are less than the state average and are below the 50-percent threshold. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative 2B. None of the proposed infrastructure will have a disproportionate direct, indirect, or cumulative impact on a minority population.

5.16.1.5. ALTERNATIVE 3A

The pump station, access roads, and water main corridor associated with Alternative 3A traverses four block groups that have a greater minority population than the state average. The water main corridor is the only infrastructure associated with this alternative that will occur in block groups with minority populations greater than the state average. Block groups 1 and 2 of census tract 920400 and block group 3 of census tract 920100 have minority populations representing 63 percent, 74 percent, and 71 percent, respectively, of the total population, which are each more than double the state average. Block group 1 of census tract 920200 has a minority population of 44 percent. The water main corridor associated with this alternative traverses approximately 2.2, 5.2, 2.0, and 4.4 miles of these block groups respectively. The water main corridor is routed along an existing utility easement through the block groups. Therefore, temporary impacts to residents of the block group, regardless of minority status, are expected to be short-term and minor. No permanent impacts are expected to the residents.

The western portion of the water main corridor is located in a block group with an 8 percent minority population and follows roadways across the block group. With construction of the low-minority block group segment of the water main being along the roadway and affecting access to properties along the road, impacts to the low-minority population will be greater than to the high-minority populations located along the water main corridor in the existing utility easement. Therefore, no disproportionate direct, indirect, or cumulative impact to minority populations will occur under Alternative 3A.

5.16.1.6. ALTERNATIVE 3B

The infrastructure associated with Alternative 3B crosses twelve block groups with minority populations greater than the state average. The water main corridor associated with this alternative is routed through these twelve block groups. Block group 3 of census tract 920100, block groups 1 through 3 of census tract 920400, and block group 2 of census tract 920500 have minority populations greater than double the state average, with percentages ranging from 63 to 83 percent. Block group 4 of census tract 020800, block group 4 of census tract 920300, and block groups 1, 4, and 5 of census tract 920500 all have minority populations greater than the state average but less than double the state average. The percent minority populations in these five block groups range from 44 to 58 percent. The water main corridor is routed along existing roadways through the block groups. Therefore, direct impacts to the residents of these block groups are expected to be short-term and minor.

Ten of the fifteen block groups in which a portion of the proposed alternative is located are comprised of minority populations that represent more than 50 percent of the total population.

The total minority population of all block groups traversed by Alternative 3B represents 51 percent of the total population of the fifteen block groups. The proposed infrastructure will be located either within roadway ROWs or in areas that are not developed for residential use. An impact that is disproportionate to minority populations will result from Alternative 3B. However, the impact will be temporary and minor.

The WTP associated with Alternative 3B is located in block group 4 of census tract 208, which has a minority population percentage of 46 percent. The WTP and associated access roads are not located in a residential area. Impacts to the population due to these elements are anticipated to be short-term and minor due to construction traffic in the area. The minority population in the WTP block group is below the threshold of a disproportionate impact to the population. No disproportionate direct, indirect, or cumulative impact to minority populations will occur under Alternative 3B.

5.16.1.7. ALTERNATIVE 4

The pump station, access roads, and water main corridor associated with Alternative 4 traverse one block group that has a minority population greater than the North Carolina state average of 32 percent. Block group 1 of census tract 920200 has an overall minority population of 44 percent. The pump station, associated access road, and a portion of the water main corridor are located in this block group. The approximate length of the water main corridor in this block group is 8.6 miles. The water main corridor is routed along existing roadways through the block group; therefore, impacts to the residents of the block group are expected to be short-term and minor. The pump station and associated access road are not located in a residential area. Impacts to the population due to these components are anticipated to be minor in the short-term due to construction traffic in the area and negligible in the long-term due to operation and maintenance activities. The block groups for Alternative 4 have minority populations that are below the threshold of a disproportionate impact. No disproportionate direct, indirect, or cumulative impact to minority populations will occur under Alternative 4.

5.16.1.8. ALTERNATIVE 5

The block groups in which the pump station, access road, treatment plant, and water main corridor are proposed to be sited have minority populations that are less than the state average and below the threshold of a disproportionate impact. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative 5. Therefore, none of the proposed infrastructure will have a disproportionate direct, indirect, or cumulative impact on a minority population.

5.16.1.9. ALTERNATIVE 6

The water main corridor associated with Alternative 6 traverses one block group that has a minority population greater than the North Carolina state average of 32 percent and the South Carolina state average of 34 percent. Block group 1 of census tract 020404 has an overall minority population of 37 percent. The water main corridor is the only infrastructure in this alternative located in this block group, and the length of the water main corridor through the block group is approximately 0.75 mile. The water main corridor is routed along existing roadways through the block group. The Catawba River WTP site in which the pump station and raw water intake construction and/or upgrades will occur is located in a block group that has a minority population representing 34 percent of the population, which is equal to the South Carolina state average and below the threshold of a disproportionate impact. Direct impacts to the residents of the block group are expected to be short-term and minor. No disproportionate direct, indirect, or cumulative impact to a minority population is expected to occur for Alternative 6.

5.16.1.10. ALTERNATIVE 7

The block groups in which the water main corridor is proposed to be sited have minority populations that are less than the state average and below the threshold of a disproportionate impact. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative 7. None of the proposed infrastructure will have a disproportionate direct, indirect, or cumulative impact on a minority population.

5.16.1.11. ALTERNATIVE 8

Three block groups within the well field area of Alternative 8 have minority populations in excess of the state average. Block group 3 of census tract 020601, block group 1 of census tract 020602, and block group 1 of census tract 020702 have minority populations that range from 33 to 56 percent. The block groups within the well field that are above the threshold for consideration of possible disproportionate impacts to a minority population are block group 3 of census tract 020601 and block group 1 of census tract 020702. Possible minor direct, indirect, or cumulative impact may occur to minority populations in the well field area.

The placement of permanent groundwater wells in these areas has the potential for moderate permanent impacts to the populations of these block groups, dependent upon the final siting and proximity to homes and residential areas. The potential impacts range from short-term to long-term and may be beneficial or adverse. The property owners may experience a short-term financial benefit from the sale of land to the County to provide a location for a cluster of wells. The short-term benefit may be followed by a long-term, adverse impact due to the financial loss resulting from the lack of income from farming or timbering the sold land. Farmhands who currently work the fields of farms in the well field area may experience a short-term financial loss if the farm(s) they work are sold to the County. As the well field requirement is nearly 25,000 acres, the impacts will affect a large number of property owners, farmhands, and their families. The impact to individual families will vary in intensity, likely ranging from minor to major based on a number of variables.

The water main corridor and WTP associated with Alternative 8 are located in block group 4 of census tract 020800, which has a minority population percentage of 46 percent. The water main corridor is routed along existing roadways through the block group. Therefore, impacts to the residents of the block group are expected to be short-term and minor. The WTP is located away from residential areas. Impacts to the population due to the WTP are anticipated to be negligible. The block group’s minority population percentage is below the threshold of disproportionate impacts. The Alternative 8 transmission line and WTP will not have a disproportionate direct, indirect, or cumulative impact on a minority population.

5.16.1.12. ALTERNATIVE 11

The pump station and associated infrastructure will be located at the City of Monroe WWTP site, which is in a block group with a minority population of 48 percent. The transmission line corridor associated with Alternative 11 traverses six block groups that have a minority population greater than the North Carolina state average of 32 percent. Block groups 1 and 3 of census tract 020601, block groups 1 and 3 of census tract 020701, block group 2 of census tract 020800, and block group 2 of census tract 931100 have minority populations ranging from 34 percent to 56 percent. The transmission line corridor is the only infrastructure in this alternative that will be located in these block groups. The approximate length of the transmission line corridor through these block groups is 0.1, 1.0, 1.7, 1.3, 2.4, and 3.8 miles, respectively. The transmission line corridor is routed along existing roadways through the block group. Therefore, impacts to the residents of the block group are expected to be short-term and minor.

The transmission line corridor is partially located within one block group that has a minority population percentage that is higher than the 50 percent threshold for disproportionate impacts. Block group 3 of census tract 020601 has a minority population representing 56 percent of the total population. The block group is located near the southern terminus of the proposed transmission line and is on one side only of the road that is followed by the transmission line alignment in census tract 020601. If the transmission line is constructed within block group 3, then approximately 22 residences and one commercial property will be impacted due to the transmission line corridor crossing their driveway or neighborhood entrance road. The direct impacts will be temporary, adverse, and minor. No permanent disproportionate direct, indirect, or cumulative impact to a minority population is expected to occur for Alternative 11.

5.16.1.13. ALTERNATIVE WTP A

The two block groups in which the Alternative WTP A facility area is located have minority populations below the state average and the threshold for disproportionate impacts. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative WTP A. Therefore, the proposed infrastructure will not have a disproportionate direct, indirect, or cumulative impact on a minority population.

5.16.1.14. ALTERNATIVE WTP B

The block groups in which the WTP and water main corridor are proposed to be sited have minority populations less than the state average and below the threshold for a disproportionate impact. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative WTP B. Therefore, none of the proposed infrastructure will have a disproportionate direct, indirect, or cumulative impact on a minority population.

5.16.1.15. ALTERNATIVE WTP C

The block groups in which the WTP and water main corridor are proposed to be sited have minority populations less than the state average and below the threshold for a disproportionate impact. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative WTP C. Therefore, none of the proposed infrastructure will have a disproportionate direct, indirect, or cumulative impact on a minority population.

5.16.1.16. NO-ACTION ALTERNATIVE

The No-Action Alternative will not affect the existing minority populations in the project area. The No-Action Alternative will not alter the availability of drinking water available to persons who are currently served by Union County. However, persons in Union County who do not currently have drinking water supplied by the County will likely not be added to the County's service area.

5.16.2. Low-Income Populations

5.16.2.1. ALTERNATIVE 1A

Alternative 1A infrastructure does not traverse any census tract with a low-income population greater than the state average. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative 1A. Therefore, no direct, indirect, or cumulative impact that is disproportionate to low-income populations will occur as a result of the construction of Alternative 1A.

5.16.2.2. ALTERNATIVE 1B

Alternative 1B infrastructure does not traverse any census tract with a low-income population greater than the state average. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative 1B. Therefore, no direct, indirect, or cumulative impact that is disproportionate to low-income populations will occur as a result of the construction of Alternative 1B.

5.16.2.3. ALTERNATIVE 2A

Alternative 2A infrastructure passes through census tract 9301.02, which has a low-income population higher than the state low-income population percentage average. Approximately 19 percent of the population of the census tract is low-income, which is higher than the state average of 16 percent. The pump station and access road associated with this alternative are located in a non-residential area within this census tract. Impacts to the population due to these elements are anticipated to be negligible. The water main corridor is routed along approximately 5.3 miles of existing roadways within the census tract. Impacts to the residents of the census tract are expected to be short-term and minor. As the low-income population of the aforementioned census tract is below the threshold for a disproportionate impact, Alternative 2A is not anticipated to disproportionately directly, indirectly, or cumulatively impact a low-income population.

5.16.2.4. ALTERNATIVE 2B

The Alternative 2B infrastructure passes through census tract 9301.02, which has a low-income population higher than the state low-income population percentage average of 16 percent. Approximately 19 percent of the population of the census tract is low-income. The pump station and access road associated with this alternative are located in a non-residential area within this census tract. Impacts to the population due to these elements are anticipated to be negligible. The water main corridor is routed along approximately 3.8 miles of existing roadways through the census tract. Therefore, impacts to the residents of the census tract are expected to be short-term and minor. As the low-income population of the aforementioned census tract is below the threshold for a disproportionate impact, Alternative 2B is not anticipated to disproportionately directly, indirectly, or cumulatively impact a low-income population.

5.16.2.5. ALTERNATIVE 3A

Alternative 3A infrastructure passes through four census tracts with low-income populations greater than the state average of 16 percent but less than double the state average. The pump station and access road associated with this alternative are located within census tract 920100 with a low-income population of 22 percent. These project elements are located in a nonresidential area. Therefore, impacts to the population due to these elements are anticipated to be negligible.

The water main corridor is routed through census tracts 920100, 920200, 920300, and 920400 for approximate distances of 5.7, 12.2, 5.9, and 7.2 miles, respectively. The percent of the population of the four census tracts that is low-income ranges from 18 to 22. The water main corridors in these areas are routed along existing roadways through the census tract. Therefore, impacts to the residents of the census tract due to the water main are anticipated to be short-term and minor.

The proposed alternative is sited within four census tracts with low-income population percentages that are greater than the state average. However, the proposed alternative does not include any elements located within a census tract that is populated by greater than a 50 percent low-income population. Alternative 3A will not disproportionately directly, indirectly, or cumulatively impact a low-income population.

5.16.2.6. ALTERNATIVE 3B

Alternative 3B infrastructure passes through four census tracts with a low-income population equal to or greater than the state average of 16 percent but less than double the state average. The pump station and access road associated with this alternative are located within census tract 920100, which has a low-income population of 22 percent. These infrastructure elements are located in a non-residential area. Impacts to the population are anticipated to be negligible.

The water main corridor is routed through census tracts 920100, 920300, 920400, and 920500 for approximate distances of 7.7, 8.6, 8.8, and 8.8 miles, respectively. The population of the four census tracts that are low-income ranges from 18 to 26 percent. The water main corridors in these areas are routed along existing roadways through the census tract. Therefore, impacts to the residents of the census tract are expected to be short-term and minor. The proposed alternative is located in four census tracts with a higher than state average percentage of low-income population; however, none of the census tracts traversed by the alternative is represented by a low-income population that exceeds the threshold for a disproportionate impact. Therefore, Alternative 3B is not anticipated to disproportionately directly, indirectly, or cumulatively impact a low-income population.

5.16.2.7. ALTERNATIVE 4

Alternative 4 infrastructure passes through two census tracts with a low-income population equal to or greater than the state average of 16 percent but less than double the state average.

The pump station and access roads associated with this alternative are located within census tract 920200, which has a low-income population of 34 percent. These infrastructure elements are located in a non-residential area. Impacts to the population due to these elements are anticipated to be negligible.

The water main corridor is routed through census tracts 920200 and 920300 for approximate distances of 8.1 and 6.2 miles, respectively. The percentage of low-income population in the two census tracts are 34 percent in census tract 920200 and 20 percent in census tract 920300. The water main corridors in these areas are routed along existing roadways within the census tract. Impacts to the residents of the census tract are expected to be short-term and minor. The proposed alternative does not traverse a census tract with a low-income population that exceeds the disproportionate impact threshold; therefore, Alternative 4 will not disproportionately directly, indirectly, or cumulatively impact a low-income population.

5.16.2.8. ALTERNATIVE 5

Alternative 5 infrastructure does not traverse any census tract with a low-income population greater than the state average or above the threshold of a disproportionate impact. The greatest percentage of low-income population in a census tract in which Alternative 5 is located is 11 percent, which is found in census tract 930900. Therefore, no direct, indirect, or cumulative impact that is disproportionate to low-income populations will occur as a result of the construction of the infrastructure associated with Alternative 5.

5.16.2.9. ALTERNATIVE 6

Alternative 6 infrastructure passes through census tract 020404, which has a low-income population that is higher than the state low-income population percent average of 16 percent. Approximately 33 percent of the population of the census tract is of low-income status. The water main corridor is routed along approximately 0.6 mile of existing roadways within the census tract. Impacts to the residents of the census tract are expected to be short-term and minor. Although the low-income population of census tract 020404 is larger than the state average percentage, the threshold of a disproportionate impact is not exceeded in the census tract. Alternative 6 is not anticipated to disproportionately directly, indirectly, or cumulatively impact a low-income population.

5.16.2.10. ALTERNATIVE 7

Alternative 7 infrastructure does not traverse any census tract with a low-income population greater than the state average. The greatest percentage of low-income population within the tract is 7 percent in census tract 005714. No direct, indirect, or cumulative impact that is disproportionate to low-income populations will occur as a result of the construction of Alternative 7.

5.16.2.11. ALTERNATIVE 8

The well field associated with Alternative 8 includes three census tracts with low-income populations greater than the state average of 16 percent. Census tracts 020601, 020602, and 020702 have low-income populations representing 29 percent, 25 percent, and 19 percent, respectively. No census tract in which the well field is located exceeds the 50 percent threshold for a disproportionate impact.

The placement of permanent groundwater wells in these areas will permanently impact the populations of these census tracts. The extent of the impact is dependent on the final siting and proximity to homes and residential areas. The potential impacts range from short-term to long-term and may be beneficial or adverse. The property owners may experience a short-term financial benefit from the sale of land to the County to provide a location for a cluster of wells. The short-term benefit may be followed by a long-term, adverse impact due to the financial loss resulting from the lack of income from farming or timbering the sold land. Farmhands who currently work the fields of farms in the well field area may experience a short-term financial loss if the farm(s) they work are sold to the County. As the well field requirement is nearly 25,000 acres, the impacts will affect a large number of property owners, farmhands, and their families. The direct, indirect, and cumulative impact to individual families will vary in intensity, likely ranging from minor to major based on a number of variables.

The water main corridor and WTP associated with Alternative 8 are located in census tract 020702. The water main corridor is routed along approximately 2.8 miles of existing roadways within the census tract, and the WTP is located away from residential areas. Impacts to the residents of the census tract due to the water main corridor are expected to be short-term and minor. Impacts due to the WTP will be negligible. The census tract's low-income population is below the threshold of disproportionate impacts. Therefore, no direct, indirect, or cumulative impact that is disproportionate to low-income populations will occur as a result of the construction of the transmission line corridor and transmission line associated with Alternative 8.

5.16.2.12. ALTERNATIVE 11

Alternative 11 infrastructure passes through census tract 020601, which has a low-income population higher than the state low-income population percent average of 16 percent. Approximately 29 percent of the population of the census tract is below the low-income threshold. The transmission line corridor is routed along approximately one mile of existing roadways within the census tract. Impacts to the residents of the census tract are expected to be short-term and minor. The percent of the population that is low-income along the transmission line corridor is below the threshold of a disproportionate impact. Alternative 11 is not anticipated to disproportionately directly, indirectly, or cumulatively impact a low-income population.

5.16.2.13. ALTERNATIVE WTP A

WTP A is located within census tract 020100. The tract has a low-income population of 9 percent of the total population, which is less than the state average and below the threshold of disproportionate impact. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative WTP A. Therefore, the proposed infrastructure will not have a disproportionate direct, indirect, or cumulative impact on a low-income population.

5.16.2.14. ALTERNATIVE WTP B

WTP B infrastructure does not traverse any census tract that has a low-income population percentage that is greater than the state average. Therefore, no direct, indirect, or cumulative impact that is disproportionate to low-income populations will occur as a result of the construction of Alternative WTP B.

5.16.2.15. ALTERNATIVE WTP C

WTP C infrastructure does not traverse any census tract that has a low-income population percentage that is greater than the state average or above the threshold for a disproportionate impact. No disparity in the location of water treatment and transmission facilities or in the provision of drinking water will result from implementation of Alternative WTP C. Therefore, the proposed infrastructure will not have a disproportionate direct, indirect, or cumulative impact on a low-income population.

5.16.2.16. NO-ACTION ALTERNATIVE

The No-Action Alternative will not affect the existing low-income populations in the project area. The No-Action Alternative will not alter the availability of drinking water available to persons who are currently served by Union County. However, persons in Union County who do not currently have drinking water supplied by the County will likely not be added to the County's service area.

5.17. Introduction of Hazardous, Toxic, and Radioactive Substances

5.17.1. Common Elements to All Alternatives

Impacts from construction activities associated with the proposed alternatives are anticipated to be direct, minor, adverse, and temporary. A short-term cumulative increase in storage and use of hazardous and toxic materials, and generation and disposal of hazardous waste will occur during construction activities associated with all of the project alternatives. Potential sources of toxic substances during construction may include exhaust emissions, oil, fuel, and other vehicle fluids. Escape of these substances will be minimized by proper vehicle maintenance, collection, and disposal of fluid containers. Contractors will be instructed to take precautions to ensure that un-cured concrete is not allowed to contact surface waters. Additionally, during construction, Union County will instruct contractors to take necessary measures to minimize the generation of waste, to recycle materials for which viable markets exist, and to use recycled products and materials in the development of this project, where suitable. Any waste generated by this project that cannot be beneficially reused or recycled will be disposed of at a solid waste management facility approved to manage the respective waste type.

Also, when final locations of the pump station, transmission lines, and water treatment plant are selected during the project design phase, North Carolina Division of Waste Management Superfund Section maps and records will be reviewed to understand where potentially contaminated soil or water may be encountered during construction. CERCLIS and other contaminated sites under the jurisdiction of the Superfund Section are located within the project study area of Anson, Stanly and Union Counties. However, as indicated by the Division of Waste Management Special Remediation Branch, it is unlikely that the proposed project alternatives would impact any known sites in the study area, or visa versa.

Long-term operation of the WTPs, well field, pump stations, and transmission lines will have a negligible, long-term, direct and cumulative impact on the use, generation, and disposal of hazardous and toxic materials and substances. The hazardous and toxic materials will be handled, stored, used, and disposed of in accordance with applicable state and federal requirements during construction activities, and during operation of the WTPs, well field, pump stations, and transmission lines.

Development will increase the amount of traffic and urban uses in the service area, which will increase stormwater runoff. Urban stormwater runoff contains pollutants, sediment and silt, nitrogen and phosphorus from lawn fertilizers, oils and greases, road salts, and pesticides and herbicides. Long-term impact of an increase in urban stormwater runoff could lead to declines in water quality if proper protective measures are not in place.

Permanent impacts are expected to be direct, minor, and adverse. Minor indirect and cumulative impacts to soils from anticipated growth and development in the service area are expected to occur.

5.17.2. No-Action Alternative

The No-Action Alternative does not include construction activities or operation of WTPs, a well field, transmission lines, or pump stations; therefore, the use and storage of hazardous or toxic materials, or generation and disposal of hazardous waste will not occur. Minor indirect impacts are anticipated to occur as a result of the growth and development in the service area regardless of the alternative chosen for the proposed project.

6.0 MITIGATIVE MEASURES TO ADDRESS DIRECT AND INDIRECT IMPACTS

Direct, secondary, and cumulative environmental impacts have the potential to occur as the result of implementation of a project alternative. Secondary impacts are defined as the impacts that are reasonably foreseeable from growth and development induced or supported by an infrastructure project. Cumulative impacts are environmental impacts resulting from the incremental effects of an activity when added to other past, present and reasonable foreseeable future activities.

There are twelve jurisdictions in Union County that have the potential to be served with water as a result of the proposed action. The number of jurisdictions in the service area will vary depending on the selection of a specific project alternative. The Town of Waxhaw, the Town of Mineral Springs, the Town of Weddington, the Town of Indian Trail, the Town of Stallings, the Town of Hemby Bridge, the Town of Fairview, the Town of Unionville, the Town of Mineral Springs, the Village of Wesley Chapel, and the Village of Lake Park are all currently served with finished water provided by the County. The Town of Wingate currently purchases water wholesale from the County. No communities are anticipated to be served outside of county borders.

Existing local, state, and federal programs and ordinances will mitigate the potential for direct and indirect impacts from the proposed action. An alphanumeric EIS key was assigned to each mitigation reference based upon the corresponding jurisdictional authority. The alphabetic characters assigned for each jurisdiction are provided in Table 6-1. A detailed summary of programs for each jurisdiction in the service area is provided in Table 6-2, beginning on page 351. Stormwater, floodplain, riparian buffer, erosion and sedimentation control, wetland protection, open space and parks, water use, land use, historic preservation, tree preservation, endangered species protection, and regional transportation planning measures are discussed for each community, where applicable. An ordinance or reference is provided for each program, plan, ordinance, or rule. A description of the mitigative aspects of each ordinance or reference is also provided. All referenced ordinances or regulations are listed in Section 10.

Table 6-1 EIS Key Identifiers by Jurisdiction

Jurisdiction	EIS Key Identifier	Jurisdiction	EIS Key Identifier
Union County	A	Town of Hemby Bridge	I
Town of Waxhaw	B	Village of Lake Park	J
Town of Mineral Springs	C	Town of Fairview	K
Village of Wesley Chapel	D	Town of Unionville	L
Village of Marvin	E	Town of Wingate	M
Town of Weddington	F	Regional or Interlocal Agreement	R
Town of Indian Trail	G	State of North Carolina	S
Town of Stallings	H	United States	U

In late 2014, Union County adopted a new Unified Development Ordinance (UDO) (Union County, 2014) that serves to update its previous Land Use Ordinance. The latest version of the draft UDO document was adopted in October, 2014 with additional amendments approved in November, 2014. Included in the UDO are new riparian buffer regulations in the Twelve Mile Creek WRF service area and measures to protect and preserve existing communities of Schwienitz's Sunflower and their habitats. Additionally, the County adopted a new Water Use Ordinance (WUO) in May, 2015 (Union County, 2015) that replaces its previous Water Conservation Ordinance. This WUO is discussed in further detail in earlier sections of this EIS. Along with adoption of the new WUO, the County is implementing a program to conduct annual water system audits according to the AWWA M36 Water Audit Method as a means to identify and potentially reduce "Non-revenue" Water volumes, particularly water losses.

Ten of the communities implement regulations that limit fill within the floodplain to the minimum level designated by FEMA. Three communities implement floodplain regulations that are more protective than FEMA minimum standards: unincorporated Union County, Lake Park, and Hemby Bridge. For two of these communities, Union County and Hemby Bridge, fill is not allowed within the floodplain except for essential services such as utilities and roadways. Lake Park allows fill in the floodplain as long as all living spaces are elevated three feet above the BFE.

Union County and the Towns of Fairview, Hemby Bridge, Indian Trail, and Stallings all have portions of their jurisdictions located in the Goose Creek watershed. The Goose Creek watershed provides habitat for a federally listed endangered species, the Carolina heelsplitter (*Lasmigona decorata*). DENR administers a site-specific water quality management plan for the Goose Creek watershed per 15A NCAC 02B .0600-.0609 for the maintenance and recovery of water quality in the watershed to sustain and protect the listed species. These regulations include stormwater control requirements, a prohibition on new NPDES discharges in the watershed, and riparian buffers. The Goose Creek Management regulations were included in the analysis of mitigation measures for those jurisdictions located in the Goose Creek watershed.

Table 6-3, beginning on page 367, provides a summary of the anticipated direct and indirect environmental impacts associated with the project alternatives by environmental resource and jurisdiction. Relevant local, state and federal ordinances that mitigate the potential environmental impact are referenced by the assigned EIS key. The evaluated environmental resources include topography and floodplains, soils, land use, wetlands, prime or unique farmland, public lands, areas of archaeological or historic value, air quality, noise levels, surface water resources, groundwater resources, forest resources, shellfish or fish and habitats, wildlife and natural vegetation, and the introduction of toxic substances.

Per Section 5, environmental resource impacts were evaluated as either temporary or permanent and then rated into one of four categories: negligible, minor, moderate, or major.

Table 6-3 summarizes the most conservative potential impacts for each environmental resource as a result of implementing one or more project alternatives. The following definitions were used in evaluating impacts:

- Temporary impact: A temporary impact is an impact associated with a particular activity for a finite period. Typically, a direct impact occurs during construction.
- Permanent impact: An impact that is persistent or chronic.
- Negligible impacts: Negligible impacts are not detectable or are slight.
- Minor impacts: Minor impacts are not readily noticeable.
- Moderate impacts: Moderate impacts are readily noticeable.
- Major impacts: Major impacts are clearly noticeable and severely adverse or exceptionally beneficial.

Table 6-2 Summary of Federal, State, and Local Programs and Ordinances Mitigating Direct and Indirect Impacts for Each Jurisdiction in the Service Area

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Union County	Stormwater	A.1	Unified Development Ordinance, § 60.170-C(3)	○ Requires peak flow control for 2- and 25-year, 24-hour storm events
		A.2	Unified Development Ordinance, § 60.170-C(2)	○ Contains general language that development is not to impede the natural flow or to cause damage to adjacent properties
		A.3	Unified Development Ordinance, § 15.030	○ Water Supply Watershed Rules • Lake Twitty Watershed Critical Area < 12% impervious • Lake Lee Watershed and Lake Twitty Balance of Watershed < 24% impervious
		S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • Division of Energy, Mineral and Land Resources (DEMLR) enforced and implemented
		S.2	Goose Creek Watershed Management Plan 15A NCAC 2B .0602	○ Portions of Union County are subject to Goose Creek Management Plan • Detention pond draw down no faster than 48 hours and no slower than 120 hours • Discharge rate of storage volume ≤ pre-development rate for 1-year, 24-hr storm • ≥ 85% annual average TSS removal
	Floodplain	A.4	Unified Development Ordinance, § 65.030	○ No fill is allowed ○ Only farm activities and essential services are allowed in the floodplain (roads, railroad, sewer, utilities, stream restoration)
	Riparian Buffer	A.5	Unified Development Ordinance, § 15.030-G	○ 30-foot vegetative buffer on all perennial streams in water supply watersheds
		S.3	Goose Creek Water Quality Management Plan 15A NCAC 2B .0605	○ Portions of Union County are subject to Goose Creek Water Quality Management Plan • 200-foot undisturbed buffer around intermittent and perennial streams, lakes, ponds, and estuaries within the 100-year floodplain • 100-foot buffer in all other areas
		A.6	Unified Development Ordinance § 70.030	○ Portions of Union County in the Twelve Mile Creek WRF Service Area • 100-foot buffer on all perennial streams • 50-foot buffer on all intermittent streams • Streams determined from USGS topographic maps (perennial) and NRCS soil survey maps (intermittent) • Existing ponds, lakes, and wetlands that intersect stream channels have the same buffer requirements as the original streams measured from the top of bank of the pond

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Union County, continued	Erosion and Sedimentation Control	A.7	Unified Development Ordinance, § 60.180	o All land disturbing activities require an approved erosion and sedimentation control plan by DEMLR in accordance with G.S. 113A-57(4) o DEMLR enforced and implemented
	Wetland Protection	U.1	Clean Water Act § 401 and 404	o USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	A.8	Unified Development Ordinance, § 5.030-C	o ≥10% of cluster development sites must be set aside as permanent open space o <50% of open space can be in the FEMA 100-year floodplain
		A.9	2025 Comprehensive Plan, Goal B-5	o Encourage and promote programs and development patterns that result in the protection of open spaces and environmentally sensitive lands
		A.10	Parks and Recreation Master Plan	o Currently in development phase o Action plan to direct future growth of county parks and recreation department
	Water Use	A.11	Union County Water Use Ordinance	o Stage 0 Year-Round Water Conservation • Spray irrigation allowed a maximum of 3 days per week for all customers • Indoor water conservation measures encouraged and recommended o Stage 1 Water Shortage Condition (triggers: Catawba-Wateree LIP declares Stage 1 drought, demand >80% capacity for 7-day average, or treatment or distribution emergency) • Publicity campaign to inform public of water shortage • Encourage spray irrigation a maximum of 2 days per week • Conservation measures encouraged and recommended • Transport of water outside of Union County prohibited o Stage 2 Water Shortage Condition (triggers: Catawba-Wateree LIP declares Stage 2 drought, demand >90% capacity for 7-day average, or treatment or distribution emergency) • Spray irrigation allowed a maximum of 2 days per week for all customers • Washing of residential vehicles and filling new swimming pools and ponds prohibited • Washing of building and outdoor surfaces limited • Using water for construction dust control limited • Hydrant flushing prohibited, except when used to maintain water quality o Stage 3 Water Shortage Condition (triggers: Catawba-Wateree LIP declares Stage 3 drought, demand >100% capacity for 7-day average, or treatment or distribution emergency) • Spray irrigation allowed a maximum of 1 day per week for all customers • Washing of residential vehicles, public buildings, sidewalks, and streets prohibited • Filling all swimming pools and ponds prohibited • Using water for construction dust control prohibited • Serving water in restaurants prohibited, except upon request • Elimination of variances

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Union County, continued	Water Use, continued			○ Stage 4 Water Shortage Condition (triggers: Catawba-Wateree LIP declares Stage 4 drought, demand continues to exceed capacity, or treatment or distribution emergency) • Drafting of ponds or rivers used for fire protection where possible • Throw-away utensil and plate use encouraged at eating establishments • Using water outside a structure for anything other than a fire emergency is prohibited ○ Encourage changes in industrial/manufacturing processes to conserve water ○ Perform annual water system audits in accordance with AWWA M36 Water Audit Method to identify and reduce "non-revenue" water losses
	Land Use	A.12	2025 Comprehensive Plan	○ Includes community goals, policies, growth strategies, and an implementation plan
		A.13	Unified Development Ordinance, § 5.010 and 10.010	○ Land categorized into ten residential and seven commercial or industrial zoning districts
	Historic Preservation	A.14	Union County Historic Preservation Commission	○ Member of Joint Commission dedicated to the conservation of historic districts and landmarks
		A.15	2025 Comprehensive Plan, Goal I	○ Emphasis placed on the preservation of historic buildings and places to maintain an attractive community appearance and image
	Tree Preservation	A.16	Unified Development Ordinance, § 55.030	○ The retention and protection of large trees is encouraged to the maximum extent possible
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
		S.4	Goose Creek Water Quality Management Plan 15A NCAC 2B .0604	○ Prohibits activities that result in a direct or indirect discharge that causes toxicity to the Carolina heelsplitter (*Lasmigona decorata*) endangered mussel ○ Direct or indirect discharges that may cause NH_3-N toxicity to the Carolina heelsplitter must take action to reduce NH_3-N inputs to 0.5 mg/L
		A.17	Unified Development Ordinance § 75.040	○ All new subdivisions within the Twelve Mile Creek WRF service area must perform a field identification survey and assessment of Schwienitz's sunflower habitat areas ○ Identified sunflowers require either a five-foot protection area or relocation to an approved habitat during the sunflower's dormant season
Town of Waxhaw	Stormwater	B.1	Zoning Ordinance § 9-100	○ Development involving the creation of 20,000 square feet or greater of impervious cover requires an approved drainage plan
		S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II post construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • DEMLR enforced and implemented

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Waxhaw, continued	Floodplain	B.2	UDO § 6.5	○ Fill and development is allowed ○ Requirements are similar to FEMA
	Erosion and Sedimentation Control	S.5	N.C. Erosion and Sedimentation Control 15A NCAC 04B	○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	B.3	Parks, Recreation, and Cultural Resources Master Plan	○ Formal planning document established to preserve the economic, social and environmental value of parks in the town
		B.4	UDO § 9.8	○ Landscaping, vegetative buffer, and screening requirements between residential/commercial areas and public areas • ≥ 5 acre industrial land use requires 40-foot buffer between public street • < 5 acre industrial land use requires 20-foot buffer between public street • Commercial land use outside of central business district requires 20-foot buffer between public street • ≥ 2 acre residential land use requires 20-foot buffer between public street • < 2 acre residential land use requires 10-foot buffer between public street
	Water Use	B.5	2030 Comprehensive Plan, Growth and Infrastructure Policy 2.2	○ Established strategies to reduce water consumption and use water resources wisely • Encourage site-level water conservation tools and techniques, such as low-flow toilets and rainwater reuse • Work with county to promote use of gray water for the irrigation of yards and landscaped areas
		A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance
	Land Use	B.6	2030 Comprehensive Plan	○ Includes goals, policies, strategies, and an implementation plan to manage and direct growth
		B.7	UDO § 6.1-6.3	○ Watershed Protection Overlay District • Minimum lot area of 40,000 square feet • Maximum lot coverage of 20% ○ Thoroughfare Protection Overlay District • 20-foot landscaped buffer setback along thoroughfare right-of-way
	Historic Preservation	A.14	Union County Historic Preservation Commission	○ Member of Joint Commission dedicated to the conservation of historic districts and landmarks
		B.8	UDO § 19	○ Prevents the demolition, material alteration, remodeling or removal of buildings or objects in designated historic districts

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Waxhaw, continued	Tree Preservation	B.9	Tree Management and Maintenance Plan	○ Developed to make informed decisions regarding tree planting, maintenance, management and removal on town owned property ○ Includes inventory of trees on town property and recommendations for tree plantings and the pruning or removal of trees that pose threats to public safety
	Regional Transportation Planning	R.1	Western Union County Regional Transportation Plan	○ Multi-community regional and integrated multimodal transportation plan with the purpose of adequately serving the transportation needs of the communities while minimizing direct and cumulative impacts
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
Town of Mineral Springs	Stormwater	C.1	Zoning Ordinance § 4.20	○ Requires peak flow control for 2-, 10-, 25-, 50-, and 100-year, 24 hour storm events
		S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • DEMLR enforced and implemented
	Floodplain	C.2	Zoning Ordinance, Article 14	○ Fill and development is allowed ○ Requirements are similar to FEMA
	Riparian Buffer	C.3	Zoning Ordinance § 4.21	○ Applies to watershed larger than 50 acres • 30-foot buffer prohibiting land disturbance and vegetative clearing • 45-foot managed use zone prohibiting buildings immediately follows buffer zone • 25-foot upland zone allowing only small buildings of less than 12 feet immediately follows managed use zone
	Erosion and Sedimentation Control	S.5	N.C. Erosion and Sedimentation Control 15A NCAC 04B	○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	C.4	Land Use Plan	○ Goal of protecting open space throughout the community
		C.5	Zoning Ordinance § 4.22	○ 50% open space requirement for land zoned as a conservation subdivision ○ Open space must be land in its natural state, used as pastureland for horses, or used for sustainable forestry practices
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance
	Land Use	C.4	Land Use Plan	○ Set of goals, objectives, and strategies for land use and growth decisions
		C.7	Zoning Ordinance § 3.1	○ Land zoned into five residential and three business districts

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Mineral Springs, continued	Tree Preservation	C.6	Zoning Ordinance, Article 15	○ Removal of any tree with 12-inch or greater DBH requires town approval ○ If tree removal is permitted, tree replacements must be added at a rate of one tree per 12-inch DBH removed
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
Village of Wesley Chapel	Stormwater	D.1	Zoning Ordinance § 14.5	○ Requires peak flow control for 1-, 2-, 10-, and 25-year, 24-hour storm events
		S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • DEMLR enforced and implemented
	Floodplain	D.2	Flood Damage Prevention Ordinance, Articles 1-5	○ Fill and development is allowed ○ Requirements are similar to FEMA
	Erosion and Sedimentation Control	D.3	Zoning Ordinance § 14.6	○ Requires DEMLR approved erosion and sedimentation control plan to receive local plan approval ○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	D.4	Land Use Plan, Goal 1, Policy 7	○ Encourages the conservation of open space through conservation easements
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance
	Land Use	D.5	Land Use Plan	○ Goals and policies established to preserve the low-density residential and rural character of the village
		D.6	Zoning Ordinance § 3.1	○ Land zoned into seven residential and four commercial districts
	Regional Transportation Planning	R.1	Western Union County Regional Transportation Plan	○ Multi-community regional and integrated multimodal transportation plan with the purpose of adequately serving the transportation needs of the communities while minimizing direct and cumulative impacts
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
Village of Marvin	Stormwater	E.1	Zoning Ordinance § 4.17	○ Requires peak flow control for 2-, 10-, 25-, 50-, and 100-year, 24-hour storm events

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Village of Marvin, continued	Stormwater, continued	S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • DEMLR enforced and implemented
	Floodplain	E.2	Zoning Ordinance § 4.14	○ Fill and development is allowed, only when: • No-rise condition • Variance approved by Board of Adjustment
	Riparian Buffer	E.3	Zoning Ordinance § 4.18	○ Applies to watershed larger than 50 acres • 30-foot buffer prohibiting land disturbance and vegetative clearing • 45-foot managed use zone prohibiting buildings immediately follows buffer zone • 25-foot upland zone allowing only small buildings of less than 12 feet immediately follows managed use zone
	Erosion and Sedimentation Control	S.5	N.C. Erosion and Sedimentation Control 15A NCAC 04B	○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	E.4	Zoning Ordinance § 5	○ 10% open space requirements for mixed use developments
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance
	Land Use	E.5	Land Use Plan	○ Set of goals established to preserve the low-density residential and rural character of the village
		E.6	Zoning Ordinance § 3	○ Land zoned into four zoning districts or conditional zoning districts
	Tree Preservation	E.7	Code of Ordinances § 93	○ Tree removal permit required for trees that meet any of the following criteria: • Canopy trees that are 12-inches or greater DBH • Trees growing on a slope greater than 25% • Any heritage or specimen trees
	Regional Transportation Planning	R.1	Western Union County Regional Transportation Plan	○ Multi-community regional and integrated multimodal transportation plan with the purpose of adequately serving the transportation needs of the communities while minimizing direct and cumulative impacts
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
Town of Weddington	Stormwater	F.1	Code of Ordinances, Chapter 58, Article XIII, Division 6	○ Contains general language that development is not to impede the natural flow or to cause damage to adjacent properties

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Weddington, continued	Stormwater, continued	S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • DEMLR enforced and implemented
	Floodplain	F.2	Code of Ordinances, Chapter 58, Article XIII, Division 5	○ Fill and development is allowed ○ Requirements are similar to FEMA
	Erosion and Sedimentation Control	S.5	N.C. Erosion and Sedimentation Control 15A NCAC 04B	○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	F.3	Land Use Plan	○ Policy of preserving open space through zoning policies
		F.4	Zoning Ordinance § 58-58	○ Conservation zoning district requires that a minimum of 10% of gross area is open space
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance
	Land Use	F.3	Land Use Plan	○ Serves as guide to achieve community vision, through goals and policies ○ Updated every five years
		F.5	Zoning Ordinance § 58-5	○ Land zoned into four residential, two commercial, or four conditional zoning districts
	Historic Preservation	A.14	Union County Historic Preservation Commission	○ Member of Joint Commission dedicated to the conservation of historic districts and landmarks
	Regional Transportation Planning	R.1	Western Union County Regional Transportation Plan	○ Multi-community regional and integrated multimodal transportation plan with the purpose of adequately serving the transportation needs of the communities while minimizing direct and cumulative impacts
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
Town of Indian Trail	Stormwater	G.1	UDO Chapter 1370	○ Requires peak control for 2-, 10-, 25-, 50-, and 100-year, 24-hour storm events

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Indian Trail, continued	Stormwater, continued	G.2	Post-Construction Stormwater Ordinance § 3	○ Stormwater management in the Twelve Mile, Crooked Creek, and Goose Creek Districts: • Design standards comply with NPDES Phase II Post Construction ▪ >24% impervious threshold (Twelve Mile and Crooked Creek) ▪ >10% impervious threshold (Goose Creek) • Requires additional peak control for the 1-year, 24-hour storm event in the Goose Creek watershed • Requires downstream impact analysis to show no impact at 10% watershed location for 50- and 100-year, 24-hour storm events • All development creating 20,000 square feet or more of impervious area must provide peak control ○ NPDES Phase II Post-Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious, requires infiltration practices • > 24% impervious, requires structural control ▪ 85% TSS removal ▪ Control 1-year, 24-hr storm • Town enforced and implemented
		S.2	Goose Creek Water Quality Management Plan 15A NCAC 2B .0602	○ Portions of Indian Trail are subject to Goose Creek Water Quality Management Plan • Detention pond draw down no faster than 48 hours and no slower than 120 hours • Discharge rate of storage volume ≤ pre-development rate for 1-year, 24-hr storm • ≥ 85% annual average TSS removal
	Floodplain	G.3	UDO Chapter 1360	○ Fill and development is allowed only when: • No-rise condition • Variance approved by Board of Adjustment • Floodplains are required to be mapped for watersheds generating more than 50 cfs
	Riparian Buffer	G.2	Post-Construction Stormwater Ordinance § 3	○ Applies to streams shown on the County soil map (Twelve Mile and Crooked Creek Watersheds): • 30-foot buffer prohibiting land disturbance and vegetative clearing
		S.3	Goose Creek Water Quality Management Plan 15A NCAC 2B .0605	○ Portions of Indian Trail are subject to Goose Creek Water Quality Management Plan • 200-foot undisturbed buffer within 100-year floodplain • 100-foot buffer in all other areas
	Erosion and Sedimentation Control	G.4	UDO Chapter 1150	○ Must comply with requirements of North Carolina Pollution Control Act ○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Indian Trail, continued	Open Space / Parks	G.5	Comprehensive Plan	○ Recommended use of open space as an amenity surrounding development and promotion of residential developments that preserves open space
		G.6	Zoning Ordinance § 660,670, 680	○ ≥ 25% open space required in downtown district ○ ≥ 35% open space required in traditional neighborhood districts ○ ≥ 5% open space required in mixed used districts
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance
	Land Use	G.5	Comprehensive Plan	○ Provides guidance on future development within the Town and establishes the basis for zoning, land use, economic development, public facilities and utilities decision-making by Town officials
		G.7	Zoning Ordinance § 130	○ Land zoned into eight residential, six commercial, three industrial, or six other conditional zoning districts
	Historic Preservation	A.14	Union County Historic Preservation Commission	○ Member of Joint Commission dedicated to the conservation of historic districts and landmarks
	Tree Preservation	G.8	UDO Chapter 830	○ Town approved tree inventory and tree protection plan required prior to removal of trees
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
		S.4	Goose Creek Water Quality Management Plan 15A NCAC 2B .0604	○ Prohibits activities that result in a direct or indirect discharge that causes toxicity to the Carolina heelsplitter (*Lasmigona decorata*) endangered mussel ○ Direct or indirect discharges that may cause NH_3-N toxicity to the Carolina heelsplitter must take action to reduce NH_3-N inputs to 0.5 mg/L
Town of Stallings	Stormwater	H.1	Post-Construction Stormwater Ordinance § 3	○ Stormwater management in the Twelve Mile, Crooked Creek, and Goose Creek Districts • Design standards comply with NPDES Phase II Post Construction ▪ >24% impervious threshold (Twelve Mile and Crooked Creek) ▪ >10% impervious threshold (Goose Creek) • Requires additional peak control for the 1-year, 24-hour storm event in the Goose Creek watershed • Requires downstream impact analysis to show no impact at 10% watershed location for 50- and 100-year, 24-hour storm events • All development creating 20,000 square feet or more of impervious area must provide peak control ○ NPDES Phase II Post-Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious, requires infiltration practices • > 24% impervious, requires structural control ▪ 85% TSS removal ▪ Control 1-year, 24-hr storm • Town enforced and implemented

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Stallings, continued	Stormwater, continued	S.2	Goose Creek Water Quality Management Plan 15A NCAC 2B .0602	○ Portions of Stallings are subject to Goose Creek Water Quality Management Plan • Detention pond draw down no faster than 48 hours and no slower than 120 hours • Discharge rate of storage volume ≤ pre-development rate for 1-year, 24-hr storm • ≥ 85% annual average TSS removal
	Floodplain	H.2	UDO § 5.10	○ Fill and development is allowed ○ Requirements are similar to FEMA
	Riparian Buffer	H.3	UDO § 5.12	○ Applies to streams shown on the County soil map (Twelve Mile and Crooked Creek Watersheds): • 30-foot buffer prohibiting land disturbance and vegetative clearing
		S.3	Goose Creek Water Quality Management Plan 15A NCAC 2B .0605	○ Portions of Stallings are subject to Goose Creek Water Quality Management Plan • 200-foot undisturbed buffer within 100-year floodplain • 100-foot buffer in all other areas
	Erosion and Sedimentation Control	S.5	N.C. Erosion and Sedimentation Control 15A NCAC 04B	○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	H.4	UDO Article 10	○ Minimum of $1/35^{th}$ of an acre must be dedicated to a park or open space per dwelling unit in a planned development ○ Minimum size of dedicated park space is 2 acres
		H.5	UDO Article 6	○ Single Family Residential zoning districts require a minimum of 10% open space for areas with more than 10 lots ○ Multifamily residential zoning districts require 20% open space ○ Town Center and Retail districts require 10% open space for areas between 2 and 5 acres and 15% for areas greater than 5 acres
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance
	Land Use	H.6	Land Use Plan	○ Set of goals, objectives, and policies established to direct land use and growth decisions
		H.7	UDO Article 3	○ Land zoned into six residential, six commercial, two industrial, or six other conditional zoning districts
	Historic Preservation	A.14	Union County Historic Preservation Commission	○ Member of Joint Commission dedicated to the conservation of historic districts and landmarks
	Tree Preservation	H.8	UDO Article 7	○ Town-approved Landscape Protection Plan is required for all development activities

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Stallings, continued	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
		S.4	Goose Creek Water Quality Management Plan 15A NCAC 2B .0604	○ Prohibits activity with a direct or indirect discharge toxic to the Carolina heelsplitter (*Lasmigona decorata*) ○ NH_3-N input limit of 0.5 mg/L
Town of Hemby Bridge	Stormwater	S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • DEMLR enforced and implemented
		S.2	Goose Creek Water Quality Management Plan 15A NCAC 2B .0602	○ Portions of Hemby Bridge are subject to Goose Creek Water Quality Management Plan • Detention pond draw down no faster than 48 hours and no slower than 120 hours • Discharge rate of storage volume ≤ pre-development rate for 1-year, 24-hr storm • ≥ 85% annual average TSS removal
	Floodplain	A.4	Unified Development Ordinance, § 65.030	○ Town adopted Union County's Unified Development Ordinance with floodplain provisions • No development in the floodplain except for essential services
	Riparian Buffer	S.3	Goose Creek Water Quality Management Plan 15A NCAC 2B .0605	○ Portions of Hemby Bridge are subject to Goose Creek Water Quality Management Plan • 200-foot undisturbed buffer within 100-year floodplain • 100-foot buffer in all other areas
	Erosion and Sedimentation Control	S.5	N.C. Erosion and Sedimentation Control 15A NCAC 04B	○ Minimum statewide rules ○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	A.9	Union County 2025 Comprehensive Plan	○ Union County holds planning and zoning jurisdiction in Hemby Bridge
		A.8	Unified Development Ordinance, § 5.030	○ Subject to the open space requirements of Union County Unified Development Ordinance
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Hemby Bridge, continued	Land Use	A.9	Union County 2025 Comprehensive Plan	○ Union County holds planning and zoning jurisdiction in Hemby Bridge
		A.13	Unified Development Ordinance, § 5.010	○ Subject to the zoning requirements of Union County's Unified Development Ordinance
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
		S.4	Goose Creek Water Quality Management Plan 15A NCAC 2B .0604	○ Prohibits activities that result in a direct or indirect discharge that causes toxicity to the Carolina heelsplitter (*Lasmigona decorata*) endangered mussel ○ Direct or indirect discharges that may cause NH_3-N toxicity to the Carolina heelsplitter must take action to reduce NH_3-N inputs to 0.5 mg/L
Village of Lake Park	Stormwater	J.1	UDO Article 14	○ Requires peak control for 1-, 2-, 10-, and 25-year, 24-hour storm events
		J.2	Post-Construction Stormwater Controls Ordinance	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • Village enforced and implemented
	Floodplain	J.3	UDO § 3.10	○ Fill and development is allowed ○ Requirements are similar to FEMA
	Riparian Buffer	J.1	UDO Article 14	○ Applies to streams shown on County soil map • 30-foot buffer prohibiting built-upon area
	Erosion and Sedimentation Control	S.5	N.C. Erosion and Sedimentation Control 15A NCAC 04B	○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	J.4	UDO Article 1	○ Stated purpose includes ensuring the provision of adequate open space
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance
	Land Use	J.4	UDO Article 1	○ Guides growth and development in the Town ○ Goals of preserving and protecting vital environmental resources, preserving character of residential neighborhoods, and providing adequate open space
		J.5	UDO Article 4	○ Land zoned into seven residential and four non-residential districts
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Fairview	Stormwater	S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • DEMLR enforced and implemented
		K.1	Land Use Ordinance, Article XVI, Part II	○ No development that impedes the natural flow of water from higher adjacent properties ○ No development that collects and channels surface waters onto lower adjacent properties, causing damage
		S.2	Goose Creek Water Quality Management Plan 15A NCAC 2B .0602	○ Portions of Fairview are subject to Goose Creek Water Quality Management Plan • Detention pond draw down no faster than 48 hours and no slower than 120 hours • Discharge rate of storage volume ≤ pre-development rate for 1-year, 24-hr storm • ≥ 85% annual average TSS removal
	Floodplain	K.2	Land Use Ordinance, Article XVI, Part I	○ Fill and development is allowed ○ Requirements are similar to FEMA
	Riparian Buffer	S.3	Goose Creek Water Quality Management Plan 15A NCAC 2B .0605	○ Portions of Fairview are subject to Goose Creek Water Quality Management Plan • 200-foot undisturbed buffer within 100-year floodplain • 100-foot buffer in all other areas
	Erosion and Sedimentation Control	S.5	Land Use Ordinance, Article XVI, Part II	○ Program modeled after state program and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	K.3	Land Use Plan	○ Guideline of promoting and preserving open space
		K.4	Land Use Ordinance, Article XII § 187	○ Cluster subdivisions permitted only if deviations from the minimum lot size regulations are offset by common open space
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance
	Land Use	K.5	Land Use Ordinance, Article IX	○ Establishes regulations for zoning, development, and recreational facilities ○ Created to implement planning policies from the Land Use Plan ○ Land Zoned into one of five residential, seven commercial, or one industrial district
	Tree Preservation	K.3	Land Use Plan	○ Guideline of avoiding the destruction of trees and landscape where possible

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Fairview, continued	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
		S.4	Goose Creek Water Quality Management Plan 15A NCAC 2B .0604	○ Prohibits activity with a direct or indirect discharge toxic to the Carolina heelsplitter (*Lasmigona decorata*) ○ NH_3-N input limit of 0.5 mg/L
Town of Unionville	Stormwater	S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • DEMLR enforced and implemented
		L.1	Land Use Ordinance, Article XVI, Part II	○ To the extent practicable, all development shall conform to the natural contours of the land and natural and pre-existing man-made drainage ways shall remain undisturbed ○ To the extent practicable, lot boundaries will be made to coincide with natural and pre-existing man-made drainage ways
		L.2	Land Use Ordinance, Article XXI, § 333	○ Lake Twitty Watershed, Critical Area • Maximum density of single family residential of 1 du/40,000 scf • Maximum development of 12% built upon area ○ Lake Twitty Watershed, Balance of Watershed • Maximum density of single family residential of 2 du/40,000 scf • Maximum development of 24% built upon area
	Floodplain	L.3	Land Use Ordinance, Article XVI, Part I	○ Fill and development is allowed ○ Requirements are similar to FEMA
	Riparian Buffer	L.4	Land Use Ordinance, Article XXI § 335	○ Applies to all perennial waters shown on USGS map • 30-foot buffer prohibiting land disturbance and vegetative clearing
	Erosion and Sedimentation Control	L.1	Land Use Ordinance, Article XVI, Part II	○ Program modeled after state program and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	L.5	Land Use Plan	○ Encourages the reservation of land for parks and open space, and seeking the dedication of parkland or fees-in-lieu through the subdivision process
		L.6	Land Use Ordinance, Article XII § 190	○ Density thresholds within zoning districts permitted to be exceed by up to 25% if smart residential design techniques are used, including setting aside a minimum of 10% open space
	Water Use	A.11	Union County Water Use Ordinance	○ Subject to the requirements of adopted Union County Water Use Ordinance

Jurisdiction	Topic	EIS Key	Ordinance or Reference [1]	Description
Town of Unionville, continued	Land Use	L.5	Land Use Plan	○ Established to guide town planning to preserve the Town's character as an agricultural and low-density residential community with a well-defined downtown area
		L.7	Land Use Ordinance, Article IX	○ Land zoned into one of nine residential, seven commercial, or two industrial districts
	Tree Preservation	L.8	Land Use Ordinance, Article XIX § 315	○ Encourages the retention and protection of existing large trees to the maximum extent possible, consistent with the development process
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats
Town of Wingate	Stormwater	S.1	NPDES Phase II Post Construction Rules 15A NCAC 02H .0154	○ NPDES Phase II Post Construction requirements • Trigger for Phase II review: ≥ 1 acre disturbance • < 24% impervious or > 2 du/acre, requires infiltration practices • > 24% impervious or > 2 du/acre, requires structural control ▪ Treat first 1 inch of rainfall - 85% TSS removal ▪ Control 1-year, 24-hr storm • DEMLR enforced and implemented
	Floodplain	M.1	Land Use Ordinance, Article XVI	○ Fill and development is allowed ○ Requirements are similar to FEMA
	Erosion and Sedimentation Control	S.5	NC Erosion and Sedimentation Control 15A NCAC 04B	○ Program implemented and enforced by DEMLR
	Wetland Protection	U.1	Clean Water Act § 401 and 404	○ USACE permit required for any activity that includes a disturbance of wetlands or streams and for any activity that may result in a discharge to the waters of the U.S.
	Open Space / Parks	M.2	2020 Comprehensive Plan	○ Goal of increasing the amount and number of open space and parks
		M.3	Land Use Ordinance, Article XII § 187	○ Cluster subdivisions permitted only if deviations from the minimum lot size regulations are offset by common open space
	Water Use	M.4	Code of Ordinances, Chapter 52	○ Requirements similar to the Union County Water Conservation Ordinance, last amended in 2009
	Land Use	M.2	2020 Comprehensive Plan	○ Serves as a guide for land use and community planning
		M.5	Land Use Ordinance, Article IX	○ Land zoned into one of seven residential, five commercial, or two industrial districts
	Historic Preservation	A.14	Union County Historic Preservation Commission	○ Member of Joint Commission dedicated to the conservation of historic districts and landmarks
	Endangered Species	U.2	Federal Endangered Species Act	○ Prevents the harming of federal endangered and threatened animals and plants and their habitats

[1] *All references are provided in the reference section of this EIS.*

Table 6-3 Areas of Potential Impacts to be Addressed by Permitting and Mitigation Programs

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Topography and Geology	Alt 1A – Minor	Minor	Direct: • Temporary impacts during construction of raw water collection system and transmission lines • Permanent impacts from grading at pump stations, intakes, access roads, and WTP site Indirect: • Topography changes from development	Union County	Floodplain Protection	A.4
	Alt 1B – Minor	Minor			Riparian Buffer Protection	A.5, S.3, A.6
	Alt 2A – Minor	Minor			Open Space / Parks	A.8, A.9, A.10
	Alt 2B -- Minor	Minor		Town of Waxhaw	Floodplain Protection	B.2
	Alt 3A -- Minor	Minor			Open Space / Parks	B.3, B.4
	Alt 3B -- Minor	Minor		Town of Mineral Springs	Floodplain Protection	C.2
	Alt 4 -- Minor	Minor			Riparian Buffer Protection	C.3
	Alt 5 -- Minor	Minor			Open Space / Parks	C.4, C.5
	Alt 6 -- Minor	Minor		Village of Wesley Chapel	Floodplain Protection	D.2
	Alt 7-- Minor	Minor			Open Space / Parks	D.4
	Alt 8 -- Minor	Minor		Village of Marvin	Floodplain Protection	E.2
	Alt 9 -- Negligible	Minor			Riparian Buffer Protection	E.3
	Alt 11 -- Minor	Minor			Open Space / Parks	E.4
	WTP A -- Minor	Minor		Town of Weddington	Floodplain Protection	F.2
	WTP B -- Minor	Minor			Open Space / Parks	F.3, F.4
	WTP C -- Minor	Minor		Town of Indian Trail	Floodplain Protection	G.3
	No-Action - Minor	Minor			Riparian Buffer Protection	G.2, S.3
					Open Space / Parks	G.5, G.6
				Town of Stallings	Floodplain Protection	H.2
					Riparian Buffer Protection	H.3, S.3
					Open Space / Parks	H.4, H.5
				Town of Hemby Bridge	Floodplain Protection	A.4
					Riparian Buffer Protection	S.3
					Open Space / Parks	A.9, A.8
				Village of Lake Park	Floodplain Protection	J.3
					Riparian Buffer Protection	J.1
					Open Space / Parks	J.4

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Topography and Geology (con't)				Town of Fairview	Floodplain Protection	K.2
					Riparian Buffer Protection	S.3
					Open Space / Parks	K.3, K.4
				Town of Unionville	Floodplain Protection	L.3
					Riparian Buffer Protection	L.4
					Open Space / Parks	L.5, L.6
				Town of Wingate	Floodplain Protection	M.1
					Open Space / Parks	M.2, M.3
Soils	Alt 1A – Minor Alt 1B – Minor Alt 2A – Minor Alt 2B -- Minor Alt 3A -- Minor Alt 3B -- Minor Alt 4 -- Minor Alt 5 -- Minor Alt 6 -- Minor Alt 7-- Minor Alt 8 -- Minor Alt 9 -- Negligible Alt 11 -- Minor WTP A -- Minor WTP B -- Minor WTP C -- Minor No-Action - Minor	Minor Minor Minor Minor Minor Minor Minor Minor Minor Minor Minor Minor Minor Minor Minor Minor Minor	Direct: • Temporary impacts from land clearing and construction activities • Permanent impacts at pump stations, intakes, access roads, transmission lines, and WTP site Indirect: • Soil erosion from new development	Union County	Erosion / Sed Control	A.7
					Open Space / Parks	A.8, A.9, A.10
				Town of Waxhaw	Erosion / Sed Control	S.5
					Open Space / Parks	B.3, B.4
				Town of Mineral Springs	Erosion / Sed Control	S.5
					Open Space / Parks	C.4, C.5
				Village of Wesley Chapel	Erosion / Sed Control	D.3
					Open Space / Parks	D.4
				Village of Marvin	Erosion / Sed Control	S.5
					Open Space / Parks	E.4
				Town of Weddington	Erosion / Sed Control	S.5
					Open Space / Parks	F.3, F.4
				Town of Indian Trail	Erosion / Sed Control	G.4
					Open Space / Parks	G.5, G.6
				Town of Stallings	Erosion / Sed Control	S.5
					Open Space / Parks	H.4, H.5
				Town of Hemby Bridge	Erosion / Sed Control	S.5
					Open Space / Parks	A.9, A.8
				Village of Lake Park	Erosion / Sed Control	S.5
					Open Space / Parks	J.4

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Soils (con't)				Town of Fairview	Erosion / Sed Control	S.5
					Open Space / Parks	K.3, K.4
				Town of Unionville	Erosion / Sed Control	L.3
					Open Space / Parks	L.5, L.6
				Town of Wingate	Erosion / Sed Control	S.5
					Open Space / Parks	M.2, M.3
Land Use	Alt 1A – Minor	Minor	Direct: • Permanent conversion of agricultural and undeveloped, wooded land use for utility easement, pump stations, access roads, and WTP site Indirect: • Conversion of agricultural and undeveloped, wooded land use to residential and commercial use	Union County	Land Use	A.12, A.13
	Alt 1B – Minor	Minor			Open Space / Parks	A.8, A.9, A.10
	Alt 2A – Minor	Minor		Town of Waxhaw	Land Use	B.6, B.7
	Alt 2B -- Minor	Minor			Open Space / Parks	B.3, B.4
	Alt 3A -- Minor	Minor		Town of Mineral Springs	Land Use	C.4, C.7
	Alt 3B -- Minor	Minor			Open Space / Parks	C.4, C.5
	Alt 4 -- Minor	Minor		Village of Wesley Chapel	Land Use	D.5, D.6
	Alt 5 -- Minor	Minor			Open Space / Parks	D.4
	Alt 6 -- Minor	Minor		Village of Marvin	Land Use	E.5, E.6
	Alt 7-- Minor	Minor			Open Space / Parks	E.4
	Alt 8 -- Minor	Minor		Town of Weddington	Land Use	F.3, F.5
	Alt 9 -- Negligible	Minor			Open Space / Parks	F.3, F.4
	Alt 11 -- Minor	Minor		Town of Indian Trail	Land Use	G.5, G.7
	WTP A -- Minor	Minor			Open Space / Parks	G.5, G.6
	WTP B -- Minor	Minor		Town of Stallings	Land Use	H.6, H.7
	WTP C -- Minor	Minor			Open Space / Parks	H.4, H.5
	No-Action - Minor	Minor		Town of Hemby Bridge	Land Use	A.9, A.13
					Open Space / Parks	A.9, A.8
				Village of Lake Park	Land Use	J.4, J.5
					Open Space / Parks	J.4
				Town of Fairview	Land Use	K.5
					Open Space / Parks	K.3, K.4

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Land Use (con't)				Town of Unionville	Land Use	L.5, L.7
					Open Space / Parks	L.5, L.6
				Town of Wingate	Land Use	M.2, M.5
					Open Space / Parks	M.2, M.3
Public Lands and Scenic, Recreational Areas, and State Natural Areas	Alt 1A – Moderate	Minor	Direct: • Temporary impacts during construction • Permanent impacts from utility easement Indirect: • Conversion of adjacent land uses	Union County	Open Space / Parks	A.8, A.9, A.10
	Alt 1B – Moderate	Minor		Town of Waxhaw	Open Space / Parks	B.3, B.4
	Alt 2A – Moderate	Minor		Town of Mineral Springs	Open Space / Parks	C.4, C.5
	Alt 2B – Moderate	Minor		Village of Wesley Chapel	Open Space / Parks	D.4
	Alt 3A – Moderate	Minor		Village of Marvin	Open Space / Parks	E.4
	Alt 3B – Moderate	Minor		Town of Weddington	Open Space / Parks	F.3, F.4
	Alt 4 – Moderate	Minor		Town of Indian Trail	Open Space / Parks	G.5, G.6
	Alt 5 – Moderate	Minor		Town of Stallings	Open Space / Parks	H.4, H.5
	Alt 6 – Moderate	Minor		Town of Hemby Bridge	Open Space / Parks	A.9, A.8
	Alt 7—Moderate	Minor		Village of Lake Park	Open Space / Parks	J.4
	Alt 8 – Moderate	Minor		Town of Fairview	Open Space / Parks	K.3, K.4
	Alt 9 – Negligible	Minor		Town of Unionville	Open Space / Parks	L.5, L.6
	Alt 11 – Moderate	Minor		Town of Wingate	Open Space / Parks	M.2, M.3
	WTP A – Moderate	Minor				
	WTP B – Moderate	Minor				
	WTP C – Moderate	Minor				
	No-Action - Moderate	Minor				
Prime or Unique Agricultural Land	Alt 1A – Negligible	Minor	Direct: • Permanent conversion of agricultural land for utility easement, pump stations, access roads, and WTP site Indirect:	Union County	Land Use	A.12, A.13
	Alt 1B – Negligible	Minor		Town of Waxhaw	Land Use	B.6, B.7
	Alt 2A – Negligible	Minor		Town of Mineral Springs	Land Use	C.4, C.7

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Prime or Unique Agricultural Land (con't)	Alt 2B – Negligible	Minor		Village of Wesley Chapel	Land Use	D.5, D.6
	Alt 3A – Negligible	Minor		Village of Marvin	Land Use	E.5, E.6
	Alt 3B – Negligible	Minor		Town of Weddington	Land Use	F.3, F.5
	Alt 4 -- Negligible	Minor		Town of Indian Trail	Land Use	G.5, G.7
	Alt 5 – Negligible	Minor		Town of Stallings	Land Use	H.6, H.7
	Alt 6 – Negligible	Minor		Town of Hemby Bridge	Land Use	A.9, A.13
	Alt 7 -- Negligible	Minor		Village of Lake Park	Land Use	J.4, J.5
	Alt 8 -- Negligible	Minor		Town of Fairview	Land Use	K.5
	Alt 9 – Negligible	Minor		Town of Unionville	Land Use	L.5, L.7
	Alt 11 – Negligible	Minor		Town of Wingate	Land Use	M.2, M.5
	WTP A -- Minor	Minor				
	WTP B -- Minor	Minor				
	WTP C -- Minor	Minor				
	No-Action - Minor	Minor				
Areas of Archaeological or Historic Value	Alt 1A – Negligible	Negligible	<u>Direct:</u> • No impacts to historic sites • Archaeological impact unknown, analysis to be completed upon review of preferred alternative; however, no impacts anticipated by utilizing existing, previously disturbed right-of-ways. <u>Indirect:</u> • Conversion of adjacent land uses	Union County	Historic Preservation	A.14, A.15
	Alt 1B – Negligible	Negligible		Town of Waxhaw	Historic Preservation	A.14, B.8
	Alt 2A – Negligible	Negligible		Town of Weddington	Historic Preservation	A.14
	Alt 2B -- Negligible	Negligible		Town of Indian Trail	Historic Preservation	A.14
	Alt 3A -- Negligible	Negligible		Town of Stallings	Historic Preservation	A.14
	Alt 3B -- Negligible	Negligible		Town of Wingate	Historic Preservation	A.14
	Alt 4 -- Negligible	Negligible				
	Alt 5 -- Negligible	Negligible				
	Alt 6 -- Negligible	Negligible				
	Alt 7-- Negligible	Negligible				
	Alt 8 -- Negligible	Negligible				
	Alt 9 -- Negligible	Negligible				
	Alt 11 -- Negligible	Negligible				

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Areas of Archaeological or Historic Value (con't)	WTP A -- Minor	Negligible				
	WTP B -- Minor	Negligible				
	WTP C -- Minor	Negligible				
	No-Action - Minor	Negligible				
Air Quality	Alt 1A – Negligible	Negligible	Direct: • Temporary increase in emissions during construction Indirect: • Reduction in air quality due to increased automobile traffic • Negative impacts to human health • Reduced visibility	Union County	Open Space / Parks	A.8, A.9, A.10
	Alt 1B – Negligible	Negligible			Tree Preservation	A.16
	Alt 2A – Negligible	Negligible		Town of Waxhaw	Open Space / Parks	B.3, B.4
	Alt 2B -- Negligible	Negligible			Tree Preservation	B.9
	Alt 3A -- Negligible	Negligible			Regional Trans. Planning	R.1
	Alt 3B -- Negligible	Negligible		Town of Mineral Springs	Open Space / Parks	C.4, C.5
	Alt 4 -- Negligible	Negligible		Village of Wesley Chapel	Open Space / Parks	D.4
	Alt 5 -- Negligible	Negligible			Regional Trans. Planning	R.1
	Alt 6 -- Negligible	Negligible		Village of Marvin	Open Space / Parks	E.4
	Alt 7-- Negligible	Negligible			Tree Preservation	E.7
	Alt 8 -- Negligible	Negligible			Regional Trans. Planning	R.1
	Alt 9 -- Negligible	Negligible		Town of Weddington	Open Space / Parks	F.3, F.4
	Alt 11 -- Negligible	Negligible		Town of Indian Trail	Open Space / Parks	G.5, G.6
	WTP A -- Minor	Negligible			Tree Preservation	G.8
	WTP B -- Minor	Negligible		Town of Stallings	Open Space / Parks	H.4, H.5
	WTP C -- Minor	Negligible			Tree Preservation	H.8
	No-Action - Minor	Negligible		Town of Hemby Bridge	Open Space / Parks	A.9, A.8
				Village of Lake Park	Open Space / Parks	J.4
				Town of Fairview	Open Space / Parks	K.3, K.4
					Tree Preservation	K.3
				Town of Unionville	Open Space / Parks	L.5, L.6
					Tree Preservation	L.8
				Town of Wingate	Open Space / Parks	M.2, M.3

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Noise Levels	Alt 1A – Minor	Minor	Direct: • Temporary increase in noise during construction • Permanent increase in noise associated with pump station and WTP operation Indirect: • Increased overall noise in service area	Union County	Open Space / Parks	A.8, A.9, A.10
	Alt 1B – Minor	Minor		Town of Waxhaw	Open Space / Parks	B.3, B.4
	Alt 2A – Minor	Minor			Regional Trans. Planning	R.1
	Alt 2B - Minor	Minor		Town of Mineral Springs	Open Space / Parks	C.4, C.5
	Alt 3A -- Minor	Minor		Village of Wesley Chapel	Open Space / Parks	D.4
	Alt 3B -- Minor	Minor			Regional Trans. Planning	R.1
	Alt 4 -- Minor	Minor		Village of Marvin	Open Space / Parks	E.4
	Alt 5 -- Minor	Minor			Regional Trans. Planning	R.1
	Alt 6 -- Minor	Minor		Town of Weddington	Open Space / Parks	F.3, F.4
	Alt 7-- Minor	Minor		Town of Indian Trail	Open Space / Parks	G.5, G.8
	Alt 8 -- Minor	Minor		Town of Stallings	Open Space / Parks	H.4, H.5
	Alt 9 -- Negligible	Minor		Town of Hemby Bridge	Open Space / Parks	A.9, A.8
	Alt 11 -- Minor	Minor		Village of Lake Park	Open Space / Parks	J.4
	WTP A -- Minor	Minor		Town of Fairview	Open Space / Parks	K.3, K.4
	WTP B -- Minor	Minor		Town of Unionville	Open Space / Parks	L.5, L.6
	WTP C -- Minor	Minor		Town of Wingate	Open Space / Parks	M.2, M.3
	No-Action - Minor	Minor				
Floodways and 100-year Floodplains	Alt 1A – Minor	Negligible	Direct: • Temporary impacts during construction of raw water collection system and transmission lines • Permanent impacts from grading at pump stations, intakes, access roads, and WTP site Indirect: • Potential loss of 100-year floodplain from development Isolation of floodplain due to stream channel entrenchment	Union County	Floodplain Protection	A.4
	Alt 1B – Minor	Negligible			Riparian Buffer Protection	A.5, S.3, A.6
	Alt 2A – Minor	Negligible			Open Space / Parks	A.8, A.9, A.10
	Alt 2B -- Minor	Negligible		Town of Waxhaw	Floodplain Protection	B.2
	Alt 3A -- Minor	Negligible			Open Space / Parks	B.3, B.4
	Alt 3B -- Minor	Negligible		Town of Mineral Springs	Floodplain Protection	C.2
	Alt 4 -- Minor	Negligible			Riparian Buffer Protection	C.3
	Alt 5 -- Minor	Negligible			Open Space / Parks	C.4, C.5
	Alt 6 -- Minor	Negligible		Village of Wesley Chapel	Floodplain Protection	D.2

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Floodways and 100-year Floodplains, continued	Alt 7-- Minor	Negligible			Open Space / Parks	D.4
	Alt 8 -- Minor	Negligible		Village of Marvin	Floodplain Protection	E.2
	Alt 9 -- Negligible	Negligible			Riparian Buffer Protection	E.3
	Alt 11 -- Minor	Negligible			Open Space / Parks	E.4
	WTP A -- Minor	Negligible		Town of Weddington	Floodplain Protection	F.2
	WTP B -- Minor	Negligible			Open Space / Parks	F.3, F.4
	WTP C -- Minor	Negligible		Town of Indian Trail	Floodplain Protection	G.3
	No-Action - Minor	Negligible			Riparian Buffer Protection	G.2, S.3
					Open Space / Parks	G.5, G.6
				Town of Stallings	Floodplain Protection	H.2
					Riparian Buffer Protection	H.3, S.3
					Open Space / Parks	H.4, H.5
				Town of Hemby Bridge	Floodplain Protection	A.4
					Riparian Buffer Protection	S.3
					Open Space / Parks	A.9, A.8
				Village of Lake Park	Floodplain Protection	J.3
					Riparian Buffer Protection	J.1
					Open Space / Parks	J.4
				Town of Fairview	Floodplain Protection	K.2
					Riparian Buffer Protection	S.3
					Open Space / Parks	K.3, K.4
				Town of Unionville	Floodplain Protection	L.3
					Riparian Buffer Protection	L.4
					Open Space / Parks	L.5, L.6
				Town of Wingate	Floodplain Protection	M.1
					Open Space / Parks	M.2, M.3

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Wetlands	Alt 1A – Negligible	Negligible	<u>Direct:</u> • Temporary impacts during construction to jurisdictional wetlands • Permanent conversion of forested wetlands to non-forested wetlands <u>Indirect:</u> • Wetland loss via development • Loss of habitat and habitat fragmentation • Loss of attenuation in flow • Loss of wetland function from pollutant loading	Union County	Wetland Protection	U.1
	Alt 1B – Minor	Minor			Floodplain Protection	A.4
	Alt 2A – Minor	Minor			Riparian Buffer Protection	A.5, S.3, A.6
	Alt 2B -- Minor	Minor			Stormwater Control	A.1, A.2, A.3, S.1, S.2
	Alt 3A -- Moderate	Minor		Town of Waxhaw	Wetland Protection	U.1
	Alt 3B -- Moderate	Minor			Floodplain Protection	B.2
	Alt 4 – Negligible	Negligible			Stormwater Control	B.1, S.1
	Alt 5 – Moderate	Minor		Town of Mineral Springs	Wetland Protection	U.1
	Alt 6 – Minor	Minor			Floodplain Protection	C.2
	Alt 7 -- Minor	Minor			Riparian Buffer Protection	C.3
	Alt 8 – Minor	Minor			Stormwater Control	C.1, S.1
	Alt 9 – Negligible	Minor		Village of Wesley Chapel	Wetland Protection	U.1
	Alt 11 – Minor	Minor			Floodplain Protection	D.2
	WTP A -- Minor	Minor			Stormwater Control	D.1, S.1
	WTP B -- Minor	Minor		Village of Marvin	Wetland Protection	U.1
	WTP C -- Minor	Minor			Floodplain Protection	E.2
	No-Action - Minor	Minor			Riparian Buffer Protection	E.3
					Stormwater Control	E.1, S.1
				Town of Weddington	Wetland Protection	U.1
					Floodplain Protection	F.2
					Stormwater Control	F.1, S.1
				Town of Indian Trail	Wetland Protection	U.1
					Floodplain Protection	G.3
					Riparian Buffer Protection	G.2, S.3
					Stormwater Control	G.1, G.2, S.2
				Town of Stallings	Wetland Protection	U.1
					Floodplain Protection	H.2
					Riparian Buffer Protection	H.3, S.3
					Stormwater Control	H.1, S.2

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Wetlands, continued				Town of Hemby Bridge	Wetland Protection	U.1
					Floodplain Protection	A.4
					Riparian Buffer Protection	S.3
					Stormwater Control	S.1, S.2
				Village of Lake Park	Wetland Protection	U.1
					Floodplain Protection	J.3
					Riparian Buffer Protection	J.1
					Stormwater Control	J.1, J.2
				Town of Fairview	Wetland Protection	U.1
					Floodplain Protection	K.2
					Riparian Buffer Protection	S.3
					Stormwater Control	S.1, K.1, S.2
				Town of Unionville	Wetland Protection	U.1
					Floodplain Protection	L.3
					Riparian Buffer Protection	L.4
					Stormwater Control	S.1, L.1, L.2
				Town of Wingate	Wetland Protection	U.1
					Floodplain Protection	M.1
					Stormwater Control	S.1
Surface Water Resources	Alt 1A – Moderate	Minor	Direct:	Union County	Floodplain Protection	A.4
	Alt 1B – Moderate	Minor	• Temporary impact from stream crossings during construction		Riparian Buffer Protection	A.5, S.3, A.6
	Alt 2A – Moderate	Minor	• Permanent impact from stream / reservoir withdrawal		Open Space / Parks	A.8, A.9, A.10
	Alt 2B -- Moderate	Minor			Erosion / Sed Control	A.7
	Alt 3A -- Moderate	Minor	Indirect:		Wetland Protection	U.1
	Alt 3B -- Moderate	Minor	• Water quality degradation due to increase in stormwater runoff		Land Use	A.12, A.13
	Alt 4 -- Moderate	Minor			Stormwater Control	A.1, A.2, A.3, S.1, S.2
	Alt 5 -- Moderate	Moderate	• Water quality impacts from withdrawal		Water Conservation	A.11
	Alt 6 – Minor	Minor	• Alteration of natural hydrograph	Town of Waxhaw	Floodplain Protection	B.2
	Alt 7 – Minor	Minor			Open Space / Parks	B.3, B.4
	Alt 8 – Minor	Minor	• Alteration of channel morphology		Erosion / Sed Control	S.5

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Surface Water Resources (con't)	Alt 9 – Negligible	Minor			Wetland Protection	U.1
	Alt 11 – Minor	Minor			Land Use	B.6, B.7
	WTP A -- Minor	Minor			Stormwater Control	B.1, S.1
	WTP B -- Minor	Minor			Water Conservation	B.5, A.11
	WTP C -- Minor	Minor		Town of Mineral Springs	Floodplain Protection	C.2
	No-Action - Minor	Minor			Riparian Buffer Protection	C.3
					Open Space / Parks	C.4, C.5
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	C.4, C.7
					Stormwater Control	C.1, S.1
					Water Conservation	A.11
				Village of Wesley Chapel	Floodplain Protection	D.2
					Open Space / Parks	D.4
					Erosion / Sed Control	D.3
					Wetland Protection	U.1
					Land Use	D.5, D.6
					Stormwater Control	S.1
					Water Conservation	A.11
				Village of Marvin	Floodplain Protection	E.2
					Riparian Buffer Protection	E.3
					Open Space / Parks	E.4
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	E.5, E.6
					Stormwater Control	E.1, S.1
					Water Conservation	A.11
				Town of Weddington	Floodplain Protection	F.2
					Open Space / Parks	F.3, F.4

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Surface Water Resources (con't)					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	F.3, F.4
					Stormwater Control	F.1, S.1
					Water Conservation	A.11
				Town of Indian Trail	Floodplain Protection	G.3
					Riparian Buffer Protection	G.2, S.3
					Open Space / Parks	G.5, G.6
					Erosion / Sed Control	G.4
					Wetland Protection	U.1
					Land Use	G.5, G.7
					Stormwater Control	G.1, G.2, S.2
					Water Conservation	A.11
				Town of Stallings	Floodplain Protection	H.2
					Riparian Buffer Protection	H.3, S.3
					Open Space / Parks	H.4, H.5
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	H.6, H.7
					Stormwater Control	H.1, S.1
					Water Conservation	A.11
				Town of Hemby Bridge	Floodplain Protection	A.4
					Riparian Buffer Protection	S.3
					Open Space / Parks	A.9, A.8
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	A.9, A.13
				Town of Hemby Bridge, continued	Stormwater Control	S.1, S.2
					Water Conservation	A.11
				Village of Lake Park	Floodplain Protection	J.3
					Riparian Buffer Protection	J.1

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Surface Water Resources (con't)					Open Space / Parks	J.4
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	J.4, J.5
					Stormwater Control	J.1, J.2
					Water Conservation	A.11
				Town of Fairview	Floodplain Protection	K.2
					Riparian Buffer Protection	S.3
					Open Space / Parks	K.3, K.4
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	K.5
					Stormwater Control	S.1, K.1, S.2
					Water Conservation	A.11
				Town of Unionville	Floodplain Protection	L.3
					Riparian Buffer Protection	L.4
					Open Space / Parks	L.5, L.6
					Erosion / Sed Control	L.1
					Wetland Protection	U.1
					Land Use	L.5, L.7
					Stormwater Control	S.1, L.1, L.2
					Water Conservation	A.11
				Town of Wingate	Floodplain Protection	M.1
					Open Space / Parks	M.2, M.3
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
				Town of Wingate, continued	Land Use	M.2, M.5
					Stormwater Control	S.1
					Water Conservation	M.4

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Groundwater Resources	Alt 1A – Negligible	Negligible	Direct: • Permanent impact from groundwater withdrawal Indirect: • Potential for contamination leading to reduction in use for drinking water • Decrease in groundwater inflow reduces stream base flow, particularly during droughts	Union County	Land Use	A.12, A.13
	Alt 1B – Negligible	Negligible		Town of Waxhaw	Land Use	B.6, B.7
	Alt 2A – Negligible	Negligible		Town of Mineral Springs	Land Use	C.4, C.7
	Alt 2B -- Negligible	Negligible		Village of Wesley Chapel	Land Use	D.5, D.6
	Alt 3A -- Negligible	Negligible		Village of Marvin	Land Use	E.5, E.6
	Alt 3B -- Negligible	Negligible		Town of Weddington	Land Use	F.3, F.4
	Alt 4 – Moderate	Moderate		Town of Indian Trail	Land Use	G.5, G.7
	Alt 5 – Moderate	Moderate		Town of Stallings	Land Use	H.6, H.7
	Alt 6 -- Negligible	Negligible		Town of Hemby Bridge	Land Use	A.9, A.13
	Alt 7-- Negligible	Negligible		Village of Lake Park	Land Use	J.4, J.5
	Alt 8 – Major	Major		Town of Fairview	Land Use	K.5
	Alt 9 -- Negligible	Negligible		Town of Unionville	Land Use	L.5, L.7
	Alt 11 -- Negligible	Negligible		Town of Wingate	Land Use	M.2, M.5
	WTP A -- Minor	Negligible				
	WTP B -- Minor	Negligible				
	WTP C -- Minor	Negligible				
	No-Action - Minor	Negligible				
Shellfish or Fish and Habitats	Alt 1A – Minor	Minor	Direct: • Temporary impact during construction • Permanent impact from stream withdrawal and low head dams Indirect: • Aquatic habitat degradation • Change in stream morphology • Reduction in aquatic diversity • Reduction in long-term population sustainability	Union County	Floodplain Protection	A.4
	Alt 1B – Minor	Minor			Riparian Buffer Protection	A.5, S.3, A.6
	Alt 2A – Minor	Minor			Open Space / Parks	A.8, A.9, A.10
	Alt 2B – Minor	Minor			Erosion / Sed Control	A.7
	Alt 3A -- Minor	Minor			Wetland Protection	U.1
	Alt 3B – Minor	Minor			Land Use	A.12, A.13
	Alt 4 – Minor	Minor			Stormwater Control	A.1, A.2, A.3, S.1, S.2
	Alt 5 -- Minor	Minor			Water Conservation	A.11
	Alt 6 -- Minor	Minor		Town of Waxhaw	Floodplain Protection	B.2
	Alt 7-- Minor	Minor			Open Space / Parks	B.3, B.4
	Alt 8 -- Minor	Minor			Erosion / Sed Control	S.5
	Alt 9 -- Negligible	Minor			Wetland Protection	U.1

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Shellfish or Fish and Habitats (con't)	Alt 11 -- Minor	Minor			Land Use	B.6, B.7
	WTP A -- Minor	Minor			Stormwater Control	B.1, S.1
	WTP B -- Minor	Minor			Water Conservation	B.5, A.11
	WTP C -- Minor	Minor		Town of Mineral Springs	Floodplain Protection	C.2
	No-Action - Minor	Minor			Riparian Buffer Protection	C.3
					Open Space / Parks	C.4, C.5
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	C.4, C.7
					Stormwater Control	C.1, S.1
					Water Conservation	A.11
				Village of Wesley Chapel	Floodplain Protection	D.2
					Open Space / Parks	D.4
					Erosion / Sed Control	D.3
					Wetland Protection	U.1
					Land Use	D.5, D.6
					Stormwater Control	D.1, S.1
					Water Conservation	A.11
				Village of Marvin	Floodplain Protection	E.2
					Riparian Buffer Protection	E.3
					Open Space / Parks	E.4
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	E.5, E.6
					Stormwater Control	E.1, S.1
					Water Conservation	A.11
				Town of Weddington	Floodplain Protection	F.2
					Open Space / Parks	F.3, F.4
					Erosion / Sed Control	S.5
					Wetland Protection	U.1

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Shellfish or Fish and Habitats (con't)					Land Use	F.3, F.5
					Stormwater Control	F.1, S.1
					Water Conservation	A.11
				Town of Indian Trail	Floodplain Protection	G.3
					Riparian Buffer Protection	G.2, S.3
					Open Space / Parks	G.5, G.6
					Erosion / Sed Control	G.4
					Wetland Protection	U.1
					Land Use	G.5, G.7
					Stormwater Control	G.1, G.2, S.2
					Water Conservation	A.11
				Town of Stallings	Floodplain Protection	H.2
					Riparian Buffer Protection	H.3, S.3
					Open Space / Parks	H.4, H.5
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	H.6, H.7
					Stormwater Control	H.1, S.2
					Water Conservation	A.11
				Town of Hemby Bridge	Floodplain Protection	A.4
					Riparian Buffer Protection	S.3
					Open Space / Parks	A.9, A.8
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
				Town of Hemby Bridge, continued	Land Use	A.9, A.13
					Stormwater Control	S.1, S.2
					Water Conservation	A.11
				Village of Lake Park	Floodplain Protection	J.3

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Shellfish or Fish and Habitats (con't)					Riparian Buffer Protection	J.1
					Open Space / Parks	J.4
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	J.4, J.5
					Stormwater Control	J.1, J.2
					Water Conservation	A.11
				Town of Fairview	Floodplain Protection	K.2
					Riparian Buffer Protection	S.3
					Open Space / Parks	K.3, K.4
					Erosion / Sed Control	S.5
					Wetland Protection	U.1
					Land Use	K.5
					Stormwater Control	S.1, K.1, S.2
					Water Conservation	A.11
				Town of Unionville	Floodplain Protection	L.3
					Riparian Buffer Protection	L.4
					Open Space / Parks	L.5, L.6
					Erosion / Sed Control	L.1
					Wetland Protection	U.1
					Land Use	L.5, L.7
					Stormwater Control	S.1, L.1, L.2
					Water Conservation	A.11
				Town of Wingate	Floodplain Protection	M.1
					Open Space / Parks	M.2, M.3
					Erosion / Sed Control	S.5
				Town of Wingate, continued	Wetland Protection	U.1
					Land Use	M.2, M.5
					Stormwater Control	S.1
					Water Conservation	M.4

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Forest Resources	Alt 1A – Minor	Minor	Direct: • Permanent conversion to other land uses at pump stations, transmission lines, access roads, and WTP sites Indirect: • Conversion to other land uses • Habitat fragmentation • Potential reduction in air quality	Union County	Riparian Buffer Protection	A.5, S.3, A.6
	Alt 1B – Minor	Minor			Open Space / Parks	A.8, A.9, A.10
	Alt 2A – Minor	Minor			Tree Preservation	A.16
	Alt 2B – Minor	Minor		Town of Waxhaw	Open Space / Parks	B.3, B.4
	Alt 3A – Minor	Minor			Tree Preservation	B.9
	Alt 3B – Minor	Minor		Town of Mineral Springs	Riparian Buffer Protection	C.3
	Alt 4 – Minor	Minor			Open Space / Parks	C.4, C.5
	Alt 5 – Minor	Minor		Village of Wesley Chapel	Open Space / Parks	D.4
	Alt 6 – Minor	Minor		Village of Marvin	Riparian Buffer Protection	E.3
	Alt 7-- Minor	Minor			Open Space / Parks	E.4
	Alt 8 -- Minor	Minor			Tree Preservation	E.7
	Alt 9 -- Negligible	Minor		Town of Weddington	Open Space / Parks	F.3, F.4
	Alt 11 -- Minor	Minor		Town of Indian Trail	Riparian Buffer Protection	G.2, S.3
	WTP A -- Minor	Minor			Open Space / Parks	G.5, G.6
	WTP B -- Minor	Minor		Town of Stallings	Riparian Buffer Protection	H.3, S.3
	WTP C -- Minor	Minor			Open Space / Parks	H.4, H.5
	No-Action - Minor	Minor			Tree Preservation	H.8
				Town of Hemby Bridge	Riparian Buffer Protection	S.3
					Open Space / Parks	A.9, A.8
				Village of Lake Park	Riparian Buffer Protection	J.1
					Open Space / Parks	J.4
				Town of Fairview	Riparian Buffer Protection	S.3
					Open Space / Parks	K.3, K.4
					Tree Preservation	K.3
				Town of Unionville	Riparian Buffer Protection	L.4
					Open Space / Parks	L.5, L.6
					Tree Preservation	L.8
				Town of Wingate	Open Space / Parks	M.2, M.3

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Wildlife and Natural Vegetation	Alt 1A – Minor	Minor	Direct: • Temporary impacts to habitat during construction • Permanent impacts to habitat at pump station, access road, and WTP sites Indirect: • Reduction in habitat • Habitat fragmentation • Reduction in species diversity and tolerance • Reduction in long-term population sustainability	Union County	Floodplain Protection	A.4
	Alt 1B – Minor	Minor			Riparian Buffer Protection	A.5, S.3, A.6
	Alt 2A – Minor	Minor			Open Space / Parks	A.8, A.9, A.10
	Alt 2B -- Minor	Minor			Land Use	A.12, A.13
	Alt 3A -- Minor	Minor			Endangered Spec Protection	U.2, S.4, A.17
	Alt 3B -- Minor	Minor		Town of Waxhaw	Floodplain Protection	B.2
	Alt 4 -- Minor	Minor			Open Space / Parks	B.3, B.4
	Alt 5 -- Minor	Minor			Land Use	B.6, B.7
	Alt 6 -- Minor	Minor			Endangered Spec Protection	U.2
	Alt 7-- Minor	Minor		Town of Mineral Springs	Floodplain Protection	C.2
	Alt 8 -- Minor	Minor			Riparian Buffer Protection	C.3
	Alt 9 -- Negligible	Minor			Open Space / Parks	C.4, C.5
	Alt 11 -- Minor	Minor			Land Use	C.4, C.7
	WTP A -- Minor	Minor			Endangered Spec Protection	U.2
	WTP B -- Minor	Minor		Village of Wesley Chapel	Floodplain Protection	D.2
	WTP C -- Minor	Minor			Open Space / Parks	D.4
	No-Action - Minor	Minor			Land Use	D.5, D.6
					Endangered Spec Protection	U.2
				Village of Marvin	Floodplain Protection	E.2
					Riparian Buffer Protection	E.3
					Open Space / Parks	E.4
					Land Use	E.5, E.6
					Endangered Spec Protection	U.2
				Town of Weddington	Floodplain Protection	F.2
					Open Space / Parks	F.3, F.4
					Land Use	F.3, F.5
					Endangered Spec Protection	U.2
				Town of Indian Trail	Floodplain Protection	G.3
					Riparian Buffer Protection	G.2, S.3
					Open Space / Parks	G.5, G.6

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Wildlife and Natural Vegetation (con't)					Land Use	G.5, G.7
					Endangered Spec Protection	U.2, S.4
				Town of Stallings	Floodplain Protection	H.2
					Riparian Buffer Protection	H.3, S.3
					Open Space / Parks	H.4, H.5
					Land Use	H.6, H.7
					Endangered Spec Protection	U.2, S.4
				Town of Hemby Bridge	Floodplain Protection	A.4
					Riparian Buffer Protection	S.3
					Open Space / Parks	A.9, A.8
					Land Use	A.9, A.13
					Endangered Spec Protection	U.2, S.4
				Village of Lake Park	Floodplain Protection	J.3
					Riparian Buffer Protection	J.1
					Open Space / Parks	J.4
					Land Use	J.4, J.5
					Endangered Spec Protection	U.2
				Town of Fairview	Floodplain Protection	K.2
					Riparian Buffer Protection	S.3
					Open Space / Parks	K.3, K.4
					Land Use	K.5
					Endangered Spec Protection	U.2, S.4
				Town of Unionville	Floodplain Protection	L.3
					Riparian Buffer Protection	L.4
					Open Space / Parks	L.5, L.6
					Land Use	L.5, L.7
					Endangered Spec Protection	U.2
				Town of Wingate	Floodplain Protection	M.1
					Open Space / Parks	M.2, M.3
					Land Use	M.2, M.5
					Endangered Spec Protection	U.2

Environmental Resource	Direct Impact Potential	Indirect and Cumulative Impact Potential	Types of Potential Impacts	Community	Mitigation Programs	EIS Key
Introduction of Toxic Substances	Alt 1A – Minor	Negligible	Direct: • Temporary increase in use of hazardous and toxic materials during construction Indirect: • Increase in likelihood of contamination • Negative impacts to human health	Union County	Land Use	A.12, A.13
	Alt 1B – Minor	Negligible			Stormwater Control	A.1, A.2, A.3, S.1, S.2
	Alt 2A – Minor	Negligible		Town of Waxhaw	Land Use	B.6, B.7
	Alt 2B -- Minor	Negligible			Stormwater Control	B.1, S.1
	Alt 3A -- Minor	Negligible		Town of Mineral Springs	Land Use	C.4, C.7
	Alt 3B -- Minor	Negligible			Stormwater Control	C.1, S.1
	Alt 4 -- Minor	Negligible		Village of Wesley Chapel	Land Use	D.5, D.6
	Alt 5 -- Minor	Negligible			Stormwater Control	D.1, S.1
	Alt 6 -- Minor	Negligible		Village of Marvin	Land Use	E.5, E.6
	Alt 7-- Minor	Negligible			Stormwater Control	E.1, S.1
	Alt 8 -- Minor	Negligible		Town of Weddington	Land Use	F.3, F.5
	Alt 9 -- Negligible	Negligible			Stormwater Control	F.1, S.1
	Alt 11 -- Minor	Negligible		Town of Indian Trail	Land Use	G.5, G.7
	WTP A -- Minor	Negligible			Stormwater Control	G.1, G.2, S.2
	WTP B -- Minor	Negligible		Town of Stallings	Land Use	H.6, H.7
	WTP C -- Minor	Negligible			Stormwater Control	H.1, S.2
	No-Action - Minor	Negligible		Town of Hemby Bridge	Land Use	A.9, A.13
					Stormwater Control	S.1, S.2
				Village of Lake Park	Land Use	J.4, J.5
					Stormwater Control	J.1, J.2
				Town of Fairview	Land Use	K.5
					Stormwater Control	S.1, K.1, S.2
				Town of Unionville	Land Use	L.5, L.7
					Stormwater Control	S.1, L.1, L.2
				Town of Wingate	Land Use	M.2, M.5
					Stormwater Control	S.1

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7.0 PREFERRED ALTERNATIVE

Alternative 1A is designated as the Preferred Alternative after a thorough assessment of each alternative's ability to meet the project's purpose and need of delivering a safe, sustainable water supply to meet the County's current and future water demands in their Yadkin River Basin Service Area, as well as the associated environmental impacts, mitigation measures, technical feasibility, financial impacts, and political and community acceptance. Alternative 1A includes the withdrawal of water from Lake Tillery in the Yadkin River IBT Basin and the transfer of this water into the Rocky River IBT Basin in Union County for treatment and distribution. A portion of the water will be returned via treated wastewater effluent back through the Rocky River into the Pee Dee River approximately five miles downstream from the Lake Tillery dam.

Alternative 1A, in conjunction with the existing grandfathered IBT from the Catawba River Basin, is capable of delivering the stated 28.9 mgd maximum month average day projected 30-year demands (23.0 mgd from the Yadkin River Basin, supplemented by up to 5.9 mgd from the existing Catawba supply) and 35.3 mgd maximum day demands (28.0 mgd from the Yadkin River Basin, supplemented by up to 7.3 mgd from the existing Catawba supply) of Union County. The water modeling efforts completed for this EIS indicate that withdrawal from Lake Tillery has less impact on lake aesthetics, other water withdrawal interests including during drought conditions, and hydropower production than withdrawal of water from other locations along the main stem of the Yadkin-Pee Dee River. Further, as described in Sections 4-5 of this document, the environmental impacts of Alternative 1A are similar, or significantly less, than the other alternatives evaluated. Table 7-1 provides a summary of the environmental impacts associated with each of the project alternatives. Mitigation measures are in place (as described in Section 6) throughout the proposed service area to mitigate these environmental impacts.

An evaluation of project costs is summarized in Table 7-2. The cost of developing a water supply solution for Union County's Yadkin River Basin Service Area is significant and represents the largest future capital expenditure for the County over the next twenty years. As illustrated in Table 7-2, Alternative 1A represents on of the lowest cost project alternatives and has been determined to be a financially feasible option for this water supply. In developing this project, Union County held discussions with numerous entities along the Yadkin-Pee Dee River regarding potential partnerships for water supply. Of all those contacted, the Town of Norwood was the only political jurisdiction who expressed a desire to participate in a partnership with mutual benefits for both parties. Currently, Union County and the Town of Norwood have an Interlocal Intake and Transmission Agreement in place for water withdrawal from a common raw water intake in Lake Tillery at the site of the Town of Norwood's current intake. The progress realized on water supply regionalization between the Town of Norwood and Union County easily makes this the most politically acceptable alternative, as well.

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Table 7-1 Summary of Temporary and Permanent Direct Impacts and Indirect Impacts for YRWSP Alternatives

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Topography and Geology	Direct, Temporary	No impacts	Minor from pipe installation	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from grading for construction of WTP	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Minor from grading for raw water intake, pump station and access road	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from grading for WTP, raw water intake, pump station and access road	Same as Alternative 1A	Minor from grading for low-head dam, raw water intake, pump station and access road	Minor from grading for raw water intake and WTP expansion, pump station, and access road	Minor from grading for pump station and access road	Minor from grading for WTP and groundwater well installation	Minor from grading for discharge, pump station and access road	Minor from grading for WTP	Same as WTP A	Same as WTP A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Soils	Direct, Temporary	No impacts	Minor from: ○ Impacts from land clearing, excavation and grading ○ Fuel, oil, and other emissions from construc-tion vehicles	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Minor from construction of raw water intake, pump station, and access road	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from construction of WTP, raw water intake, pump station, and access road	Same as Alternative 1A	Minor from construction of low-head dam, raw water intake, pump station, and access road	Minor from construction of raw water intake and WTP expansion, pump station, and access road	Minor from construction of pump station and access road	Minor from construction of WTP and groundwater well installation	Minor from construction of discharge, pump station, and access road	Minor from construction of WTP	Same as WTP A	Same as WTP A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Land Use	Direct, Temporary	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Direct, Permanent	No impacts	Moderate from conversion of wooded/ undeveloped areas and residential, commercial, and agricultural uses to permanent utility use	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Land Use (con't)	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Public Lands and Scenic, Recreational Areas, and State Natural Areas	Direct, Temporary	No impacts	Minor to 5.3 miles of bike routes and 7.2 acres of other areas from transmission line	Minor to 0.3 mile of bike routes and 6.5 acres of other areas from transmission line	Minor to 14.0 miles of bike routes and 5.6 acres of other areas from transmission line	Minor to 14.0 miles of bike routes and 9.4 acres of other areas from transmission line	Minor to 46.5 acres from transmission line	Minor to 15.5 acres from transmission line	Minor to 0.5 acre from transmission line	Minor to 5.5 acres from transmission line	No impacts	Minor to 0.6 acre from transmission line	Impacts from well field are not known	Minor to10.6 miles of bike routes and 8.4 acres of other areas from transmission line	No impacts	No impacts	Minor to 7.2 acres from transmission line
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	No impacts	Minor to 0.5 acre of Pee Dee River State Game Land from pump station and access road	Minor to 0.8 acre of Pee Dee River State Game Land from pump station and access road	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Indirect	Same as Alternative 1A	Minor from conversion of adjacent land uses	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Prime or Unique Agricultural Land	Direct, Temporary	No impacts	Minor to 18.9 acres from pipe installation	Minor to 22.8 acres from pipe installation	Minor to 30.8 acres from pipe installation	Minor to 23.1 acres from pipe installation	Minor to 25.4 acres from pipe installation	Minor to 6.2 acres from pipe installation	Minor to 25.5 acres from pipe installation	No impacts	Minor to 41.4 acres from pipe installation	Minor to 4.8 acres from pipe installation	Minor to 5.2 acres from pipe installation	Minor to 41.9 acres from pipe installation	No impacts	Minor to 2.5 acres from pipe installation	Minor to 3.6 acres from pipe installation
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	Minor to less than 0.1 acre from pump station and access road	No impacts	Impact from WTP is not known	Minor to 0.9 acre from access road	No impacts	No impacts	No impacts	Impacts from WTP and well field are not known	No impacts	No impacts	Impacts from WTP is not known	Impacts from WTP is not known
	Indirect	Same as Alternative 1A	Minor from conversion of agricultural land to residential and commercial use	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Areas of Archaeological or Historic Value	Direct, Temporary	No impacts	o No impacts to historic sites o Impacts to archaeological resources unknown, but unlikely	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Areas of Archaeological or Historic Value (con't)	Direct, Permanent	No impacts	○ No impacts to historic sites ○ Impacts to archaeological resources unknown but unlikely	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Air Quality	Direct, Temporary	No impacts	Minor from increase in airborne particulates during project construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Negligible from intermittent generator operation	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Noise Levels	Direct, Temporary	No impacts	Minor nuisance noise associated with project construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Negligible from intermittent generator operation	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Negligible from increased overall noise in service area	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Floodways and 100 year Floodplains	Direct, Temporary	No impacts	Minor impacts from construction to 13.5 acres of 100-year floodplain	Minor impacts from construction to 32.2 acres of 100-year floodplain	Minor impacts from construction to: ○ 1.6 acres of floodway ○ 21.2 acres of 100-year floodplain	Minor impacts from construction to: ○ 1.0 acre of floodway ○ 19.9 acres of 100-year floodplain	Minor impacts from construction to 86.9 acres of 100-year floodplain	Minor impacts from construction to: ○ 6.7 acres of floodway ○ 49.3 acres of 100-year floodplain	Minor impacts from construction to 33.4 acres of 100-year floodplain	Minor impacts from construction to 1.7 acres of 100-year floodplain	Minor impacts from construction to: ○ 0.6 acre of floodway ○ 7.6 acres of 100-year floodplain	Minor impacts from construction to: ○ 0.2 acre of floodway ○ 4.7 acres of 100-year floodplain	Minor impacts from construction to 0.2 acre of 100-year floodplain	Minor impacts from construction to: ○ 0.6 acre of floodway ○ 28.1 acres of 100-year floodplain	No impacts	No impacts	Minor impacts from construction to 0.8 acre of 100-year floodplain
	Direct, Permanent	No impacts	Minor impacts to 0.1 acre of 100-year floodplain	Minor impacts to 0.1 acre of 100-year floodplain	Minor impacts to 0.3 acre of 100-year floodplain	No impacts	Minor impacts to 2.0 acres of 100-year floodplain	Minor impacts to 2.0 acres of 100-year floodplain	Minor impacts to 0.2 acre of 100-year floodplain	Minor impacts to 0.5 acre of 100-year floodplain	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Indirect	Same as Alternative 1A	Negligible from: ○ Potential loss of 100-year floodplain from development ○ Topography changes from development ○ Isolation of floodplain due to stream channel entrenchment	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Wetlands	Direct, Temporary	No impacts	No impacts	Minor impacts to 7.5 acres of forested wetland from transmission line	Minor impacts to 0.6 acre of forested wetland from transmission line	Minor impacts to 0.6 acre of forested wetland from transmission line	Minor impacts from transmission line to: ○ 44.8 acres of forested wetland ○ 8.7 acres of non-forested wetland	Minor impacts from transmission line to: ○ 2.8 acres of forested wetland ○ 0.5 acre of non-forested wetland	No impacts	No impacts	Minor impacts from transmission line to: ○ 0.5 acre of forested wetland ○ 0.1 acre of non-forested wetland	Minor impacts from transmission line to 0.1 acre of forested wetland	No impacts from transmission line Impacts from well field are not known	Minor impacts to 0.9 acre of forested wetland from transmission line	No impacts	No impacts	No impacts
	Direct, Permanent	No impacts	No impacts	Minor impacts to 0.5 acre of forested wetland from transmission line	No impacts	No impacts	Minor impacts to 3.2 acres of forested wetland from transmission line	No impacts	No impacts	○ No impacts associated with transmission line or pump station. ○ Impacts due to low-head dam unknown	Minor impacts to less than 0.1 acre of forested wetland from transmission line	No impacts	Minor impacts expected, but not quantified	No impacts	No impacts	No impacts	No impacts

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Wetlands (con't)	Indirect	Same as Alternative A1	Minor from: o Wetland loss via development o Loss of habitat and fragmentation o Loss of wetland function from pollutant loading	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1
Surface Water Resources	Direct, Temporary	No impacts	Minor from transmission line to: o 2,848 feet of perennial streams from 11 crossings o 11,014 feet of intermittent streams from 20 crossings o 0.3 acre of buffer	Minor from transmission line to: o 5,857 feet of perennial streams from 14 crossings o 10,598 feet of intermittent streams from 31 crossings o 1.7 acre of buffer	Minor from transmission line to: o 2,339 feet of perennial streams from 11 crossings o 9,498 feet of intermittent streams from 22 crossings o 1.0 acre of buffer	Minor from transmission line to: o 1,914 feet of perennial streams from 9 crossings o 9,572 feet of intermittent streams from 27 crossings o 0.9 acre of buffer	Minor from transmission line to: o 5,242 feet of perennial streams from 20 crossings o 8,194 feet of intermittent streams from 22 crossings o 4.1 acres of buffer	Minor from transmission line to: o 4,634 feet of perennial streams from 16 crossings o 7,683 feet of intermittent streams from 24 crossings o 8.2 acres of buffer	Minor from transmission line to: o 1,715 feet of perennial streams from 7 crossings o 6,979 feet of intermittent streams from 14 crossings o 11.6 acres of buffer	Minor from transmission line to 1,343 feet of intermittent streams from 3 crossings	Minor from transmission line to: o 1,509 feet of perennial streams from 7 crossings o 3,913 feet of intermittent streams from 18 crossings o 3.8 acres of buffer	o No impacts due to use of trenchless construction methods for installation of the installation line across 2 perennial streams and 7 intermittent streams o 6.4 acres of buffer	Minor from transmission line to: o 407 feet of perennial streams from 2 crossings o 1,530 feet of intermittent streams from 5 crossings	Minor from transmission line to: o 4,508 feet of perennial streams from 18 crossings o 17,449 feet of intermittent streams from 25 crossings o 3.7 acres of buffer	No impacts	Minor from transmission line to 1,438 feet of intermittent streams from 5 crossings	Minor from transmission line to 3,426 feet of intermittent streams from 11 crossings
	Direct, Permanent	No impacts	Minor to: o 50 feet of Pee Dee River from raw water intake o Less than 0.1 acre of buffer from raw water intake and transmission line	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.1 acre of buffer	Minor to: o 50 feet of Yadkin River for raw water intake o 0.1 acre of buffer	Minor to: o 50 feet of Yadkin River for raw water intake o 0.1 acre of buffer	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.2 acre of buffer	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.3 acre of buffer	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.6 acre of buffer	o Minor impacts to 100 feet of Rocky River for raw water intake and low-head dam or Ranney wells o Unknown impacts to 6,000 feet of Rocky River due to low-head dam effects	Minor to: o 50 feet of Catawba River for raw water intake expansion o 0.2 acre of buffer	Minor impacts to 0.3 acre of buffer	No impacts	Minor to: o 50 feet of Pee Dee River for discharge o 0.2 acre of buffer	No impacts	No impacts	No impacts

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Surface Water Resources (con't)	Indirect	Same as Alternative 1A	Minor from: ○ Water quality degradation due to increase in stormwater runoff ○ Alteration of natural hydrography ○ Alteration of channel morphology ○ Increased natural utilization of buffers due to increase in stormwater	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Surface Water Quantity and Quality	Lake Levels - Aesthetics	No Impacts	Negligible to minor direct, permanent impacts to lake levels due to lower average lake elevations	Same as Alternative 1A	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor direct, permanent impacts to lake levels due to lower average lake elevations	Minor to moderate direct, permanent impacts to lake levels due to lower average lake elevations	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
	Lake Levels – Water Withdrawals	No Impacts	Negligible impact to water withdrawals based on restricted operation at lake located intakes	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor impact to water withdrawals based on restricted operation at lake located intakes	Minor impact to water withdrawals based on restricted operation at lake located intakes	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts

Environmental Resource	Duration of Impact	Alternative [1]														
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Surface Water Quantity and Quality (con't)	Reservoir Outflows	No Impacts	Negligible to minor direct, permanent impacts due to increased days below specified reservoir release values	Same as Alternative 1A	Minor to moderate direct, permanent impacts due to increased days below specified reservoir release values	Minor to moderate direct, permanent impacts due to increased days below specified reservoir release values	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Negligible impact to reservoir outflows based on days below specified reservoir release values	Negligible to minor direct, permanent impacts due to increased days below specified reservoir release values	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
	Water Quantity Mgmt	No Impacts	Negligible impact to water quantity management, based on time in LIP stages	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor impact to water quantity management, based on increased time in more severe LIP stages	Minor to moderate impact to water quantity management, based on increased time in more severe LIP stages	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
	Hydropower Generation	No Impacts	Negligible to minor direct, permanent impacts to lake levels due to lower average lake elevations	Same as Alternative 1A	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor direct, permanent impacts to lake levels due to lower average lake elevations	Minor to moderate direct, permanent impacts to lake levels due to lower average lake elevations	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
Groundwater Resources	Direct, Temporary	No impacts	Negligible from construction of transmission line, raw water intake, pump station and access road	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Negligible from construction of transmission line, WTP, raw water intake, pump station and access road	Same as Alternative 1A	Negligible from construction of transmission line, low-head dam, raw water intake, pump station and access road	Negligible from construction of transmission line, raw water intake and WTP expansion, pump station, and access road	Negligible from construction for transmission line, pump station, and access road	Negligible from construction of transmission line, WTP, and groundwater well installation	Negligible from construction of transmission line, discharge, pump station, and access road	Negligible from construction of WTP	Negligible from construction of WTP and transmission line	Negligible from construction of WTP and transmission line
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	Moderate if Ranney well option is selected	Moderate if Ranney well option is selected	No impacts	No impacts	Major from extraction of 28 mgd of raw water from 1,295 wells	No impacts	No impacts	No impacts	No impacts

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Groundwater Resources (con't)	Indirect	Same as Alternative 1A	Minor from: ○ Potential for contamination leading to reduction in use for drinking water ○ Reduction in groundwater inflow contribution to stream base flow, particularly during droughts	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Shellfish or Fish and Habitats	Direct, Temporary	No impacts	Minor from erosion and sedimentation during construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Negligible from erosion and sedimentation during construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 7	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Minor from raw water intake	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from low-head dam and raw water intake	Same as Alternative 1A	No impacts	Anticipated to be negligible from infrastructure footprint	Minor from discharge	No impacts	Same as Alternative 8	Same as Alternative 8
	Indirect	Same as Alternative 1A	Minor from: ○ Aquatic habitat degradation ○ Change in stream morphology ○ Reduction in aquatic diversity ○ Reduction in long-term population sustainability	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Forest Resources	Direct, Temporary	No impacts	Minor impacts to 130 acres for transmission corridor	Minor impacts to 226 acres for transmission corridor	Minor impacts to 129 acres for transmission corridor	Minor impacts to: ○ 126 acres for transmission corridor ○ 1 acre for access road	Minor impacts to: ○ 325 acres for transmission corridor ○ Less than 1 acre for access road	Minor impacts to: ○ 116 acres for transmission corridor ○ Less than 1 acre for access road	Minor impacts to 121 acres for transmission corridor	Minor impacts to 4 acres for transmission corridor	Minor impacts to 56 acres for transmission corridor	Minor impacts to 34 acres for transmission corridor	Minor impacts to 14 acres for transmission corridor Impacts from WTP and well field are not known	Minor impacts to 163 acres for transmission corridor	No impacts	Minor impacts to 18 acres for transmission corridor	Minor impacts to 27 acres for transmission corridor

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Forest Resources (con't)	Direct, Permanent	No impacts	Minor impacts to 11 acres for transmission corridor	Minor impacts to 18 acres for transmission corridor	Minor impacts to 1 acre for transmission corridor	Minor impacts to: o 9 acres for transmission corridor o Less than 0.5 acre for pump station o Less than 0.5 acre for access road	Minor impacts to: o 27 acres for transmission corridor o Less than 0.5 acre for pump station o Less than 0.5 acre for access road	Minor impacts to: o 3 acres for transmission corridor o Less than 0.5 acre for pump station o Less than 0.5 acre for access road o Impacts not known for WTP	Minor impacts to: o 11 acres for transmission corridor o Less than 0.5 acre for pump station	Minor impacts to less than 0.5 acre for transmission corridor	Minor impacts to 7 acres for transmission corridor	Minor impacts to 3 acres for transmission corridor	Minor impacts to: o 1 acre for transmission corridor o Impacts not known for WTP or well field	Minor impacts to 13 acres for transmission corridor	Impacts not known for WTP	Minor impacts to: o 1 acre for transmission corridor o Impacts not known for WTP	Minor impacts to: o 2 acres for transmission corridor o Impacts not known for WTP
	Indirect	Same as Alternative 1A	Minor from: o Conversion to other land uses o Habitat fragmentation o Potential reduction in air quality	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Wildlife and Natural Vegetation	Direct, Temporary	No impacts	o Minor during construction in project areas o Potential impacts to threatened or endangered species are unknown	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	o Minor with less than 30 percent of the total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 30 percent and fifth largest impact on wildlife habitat based on the percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 25 percent of the total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 20 percent of the total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 36 percent and second largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 37 percent and largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 35 percent and fourth largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 25 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 35 percent and third largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 25 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 20 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 25 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 30 percent of total WTP area located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 30 percent of total project corridor and 65 percent of the total WTP area located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 35 percent of total project corridor and less than 30 percent of total WTP area located on forested land o Potential impacts to threatened or endangered species are unknown

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Wildlife and Natural Vegetation (con't)	Indirect	Same as Alternative 1A	Minor from: o Reduction in habitat o Habitat fragmentation o Reduction in species diversity and tolerance o Reduction in long-term population sustainability	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Environmental Justice	Direct, Temporary	No impacts	No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	o No dis-proportionate impacts to minority or low-income populations	o Minor dis-proportionate impacts from 9.4 miles of pipe corridor traversing 3 block groups with minority populations greater than 50 percent o No disproportion ate impacts to low-income populations	Minor dis-pro-portionate impacts as 10 of 15 block groups in which pipe corridor is located are comprised of minority populations greater than 50 percent o No disproportion ate impacts to low-income populations	o No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	o No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	o Minor dis-proportionate impacts from well field having two block groups with minority populations greater than 50 percent o No disproportion ate impacts to low-income populations	Minor dis-proportionate impacts from pipe corridor traversing one block group comprised of minority population greater than 50 percent o No disproportion ate impacts to low-income populations	No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Indirect	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
Introduction of Toxic Substances	Direct, Temporary	Same as Alternative 1A	Minor from increase in storage and use of hazardous and toxic materials, and generation and disposal of hazardous waste during construction activities	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Introduction of Toxic Substances (con't)	Direct, Permanent	Same as Alternative 1A	Minor from increase in storage and use of hazardous and toxic materials, and generation and disposal of hazardous waste during operations	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Minor from: ○ Increase in likelihood of contamination ○ Impacts to human health	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Total Project Cost			$239.7 M	Costs similar to Alternative 1A	$294.1 M	$294.0 M	$282.2 M	$248.9 M	$332.2 M	$190.6 M	$252.0 M	$261.1 M	$294.6 M	$377.2 M			

[1] It should be noted Alternative 9 is located exclusively within areas currently in use as water treatment facilities. This alternative does not require new infrastructure or the use of land outside of the treatment facilities, so direct impacts to natural resources are not anticipated. As such, a discussion of direct impacts for Alternative 9 is not provided. Alternative 10, direct potable reuse, is also not assessed in this evaluation due to this alternative being eliminated from consideration based on current regulatory framework.

Table 7-2 Union County YRWSP – Conceptual Cost Opinion (in Millions of $) for YRWSP Alternatives

Project Cost Item	ALTERNATIVE[1]												
	1A	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**[2]
Raw Water Intake & Pump Station	$7.9	$7.9	$7.9	$7.9	$7.9	$8.2	$19.9	$10.2	$9.1	$155.4	NA	NA	See Alt 1
Raw Water Transmission	$152.7	$206.5	$206.4	$194.9	$162.4	$203.0	$49.3	-	$16.9	$61.6	NA	NA	See Alt 1
Raw Water Transmission - Land	$1.8	$2.4	$2.4	$2.1	$1.7	$2.2	$0.6	-	-	$0.7	NA	NA	See Alt 1
Terminal Reservoir	-	-	-	-	-	$30.7	$42.2	-	-		NA	NA	-
Terminal Reservoir – Land	-	-	-	-	-	$0.8	$1.3	-	-	-	NA	NA	-
Water Treatment Plant	$76.6	$76.6	$76.6	$76.6	$76.6	$76.6	$76.6	$60.4	$65.0	$76.6	NA	NA	See Alt 1
Water Treatment Plant – Land	$0.7	$0.7	$0.7	$0.7	$0.3	$0.7	$0.7	-	-	$0.3	NA	NA	See Alt 1
Finished Water Transmission to WTP Site C/D (excluding land)[3]	-	-	-	-	-	-	-	$181.4	$170.1		NA	NA	-
Wastewater Returns to Tillery	-	-	-	-	-	-	-	-	-	-	NA	NA	$137.5
TOTAL	**$239.7**	**$294.1**	**$294.0**	**$282.2**	**$248.9**	**$322.2**	**$190.6**	**$252.0**	**$261.1**	**$294.6**	**NA**	**NA**	**$377.2**
Ranking by Cost (Lowest to Highest)	2	8	7	6	3	9	1	4	5	6	NA	NA	10

Notes:

[1]Alternative Cost Descriptions:

- Alternative 1A - Water supply from Lake Tillery with transmission to WTP Site Area C (note - Alternative 1B project cost is similar, but raw water transmission costs and land are higher due to increased length of alignment)
- Alternative 2A - Water supply from Narrows Reservoir with transmission to WTP Site Area C
- Alternative 2B - Water supply from Tuckertown Reservoir with transmission to WTP Site Area C
- Alternative 3A - Water supply from Blewett Falls Lake with transmission to WTP Site Area C
- Alternative 3B - Water supply from Blewett Falls Lake with transmission to WTP Site Area D
- Alternative 4 - Water supply from Pee Dee River with transmission to WTP Site Area C
- Alternative 5 - Water supply from Rocky River with transmission to WTP Site Area C
- Alternative 6 - Water supply from Catawba River Water Supply Project (Catawba River)
- Alternative 7 - Water supply from Charlotte Water (Mountain Island Lake) and Catawba River Water Supply Project (Catawba River)
- Alternative 8 - Water supply from groundwater with transmission to WTP Site Area D
- Alternative 9 - Water demand management / conservation
- Alternative 10 - Direct potable reuse
- Alternative 11 - Wastewater returns to Lake Tillery (total cost shown includes Alternative 1 water supply plus Alternative 11 costs

[2] Wastewater returns to Lake Tillery is an additive cost to the selected water supply alternatives. For comparison, it has been added to Alternative 1.

[3] Costs determined for Alternatives 6 & 7 to provide a basis of comparison against the other alternatives.

Table 7-3, below, provides a brief, practical review of the key differentiators between alternatives and the rationale for selecting the Preferred Alternative. As illustrated and summarized in this table, Alternative 1A is recommended as the Preferred Alternative for Union County's Yadkin River Water Supply Project.

Table 7-3 Review of Key Differentiators for Project Alternatives

Alt.	Description	Key Differentiators in Comparison to Alternative 1
1A	Lake Tillery to Union County	**Preferred Alternative**
1B	Lake Tillery to Union County	▪ Longer raw water transmission lengths with greater environmental impacts. ▪ More costly/cost prohibitive.
2A, 2B	Narrows Reservoir (2A) or Tuckertown Reservoir (2B) to Union County	▪ More significant consequences for water interests in the Yadkin River Basin including lake elevations, reservoir discharges, hydropower generation and surface water quality. ▪ Less politically acceptable. ▪ Longer raw water transmission lengths. ▪ More costly/cost prohibitive.
3A, 3B	Blewett Falls Reservoir to Union County via Alternative Transmission Routes (3A, 3B)	▪ More significant consequences for water interests in the Yadkin River Basin including reservoir discharges during drought periods. ▪ Less politically acceptable. ▪ Longer raw water transmission lengths. ▪ More costly/cost prohibitive.
4	Pee Dee River to Union County	▪ More significant environmental consequences associated with raw water storage (i.e. terminal reservoir). ▪ Source water not classified for public drinking water supply by NC. ▪ Is cost prohibitive.
5	Rocky River to Union County	▪ May not meet the purpose and need for overall water demand. ▪ Source water not classified as a drinking water source by NC. ▪ More significant environmental consequences associated with raw water collection (i.e. low head dam) and storage (i.e. terminal reservoir).
6	Catawba River to Union County via Existing Catawba River Water Supply Project	▪ Places additional demands on existing high-demand surface waters. ▪ More significant environmental consequences for surface water quantity and quality interests in the Catawba River Basin, as indicated in Table 7-1. ▪ Likely would not be acceptable from a political/community perspective. ▪ More costly than Preferred Alternative.
7	Catawba River to Union County via Charlotte Water's Mountain Island Lake Withdrawal	▪ Places additional demands on existing high-demand surface waters. ▪ More significant environmental consequences for surface water quantity and quality interests in the Catawba River Basin, as indicated in Table 7-1. ▪ Likely would not be acceptable from a political/community perspective. ▪ More costly than Preferred Alternative.
8	Groundwater Supply	▪ Has more significant environmental consequences associated with magnitude of groundwater well system. ▪ Requires extensive, prohibitive land acquisition to meet purpose & need ▪ Is cost prohibitive.
9	Water Demand Management and Conservation	▪ Does not meet the purpose and need. ▪ Demand management and conservation reflected in historical water demand and future projections for Union County.
10	Direct Potable Reuse	▪ Does not meet the purpose and need since no regulatory framework exists to make this alternative possible in North Carolina. ▪ Likely cost prohibitive and not accepted politically or by the community.

Alt.	Description	Key Differentiators in Comparison to Alternative 1
11	Alternative 1 with Wastewater Returns to Lake Tillery	▪ Has greater environmental consequences associated with wastewater return transmission mains and treated effluent discharge to Lake Tillery. ▪ Provides little additional environmental benefits. ▪ Is cost prohibitive from a capital cost perspective; long-term cost and environmental impacts from continuous pumping of wastewater effluent.
12	No Action Alternative	▪ Does not meet purpose and need. ▪ Development and population growth within the County will continue to occur, but with less planning and mitigation. ▪ Additional strains put on other water supply sources (e.g. groundwater).

8.0 REQUIRED STATE AND FEDERAL PERMITS

The following State and Federal permits are expected to be required for the water withdrawal, transfer and distribution/treatment infrastructure construction associated with Union County's proposed Yadkin River Water Supply Project.

- State Environmental Policy Act Environmental Impact Statement review and issuance of a Record of Decision.
- Interbasin Transfer Certificate from the Environmental Management Commission.
- Lake Use Permit from Duke Energy Lake Services.
- County Building Permit (as applicable, per alternative).
- Soil Disturbance Permit from North Carolina Department of Cultural Resources.
- Clean Water Act Section 404/401 Nationwide Permit from the U.S. Army Corps of Engineers and Division of Water Resources.
- Erosion and Sedimentation Control from the Division of Land Resources.
- Authorization to Construct from the Division of Water Resources.
- Encroachment Agreements with North Carolina Department of Transportation.
- Air Quality Permit for emergency generators from the Division of Air Quality.
- No-Rise Certification or Conditional Letter of Map Revision (as applicable, per alternative)

9.0 PUBLIC INVOLVEMENT AND AGENCY COORDINATION

Throughout the development of this Environmental Impact Statement, there has been, and will continue to be, the opportunity for public involvement through open meeting forums and public document review and comment periods. Union County is abiding by the public involvement requirements of North Carolina Statute G.S. 143.215.22L as part of the procedure for obtaining an IBT Certificate.

9.1. Notice of Intent and Public Scoping Meetings

Following issuance of the Notice of Intent to File a Petition (NOI) to the EMC on August 12, 2013, Union County conducted three public scoping meetings for the project. One meeting was held in the source river basin (Yadkin River Basin) upstream of the proposed withdrawal point, one in the source river basin downstream of the proposed withdrawal point, and one in the receiving river basin (Rocky River Basin). The public meetings describing the project and EIS development process were conducted as follows:

Meeting 1 – Receiving Basin
October 3, 2013, 4:30 PM
Stanly County Public Library
133 East Main Street
Albemarle, NC 28001

Meeting 2 – Source Basin (Upstream)
October 14, 2013, 5:00 PM
Rowan-Cabarrus Community College – Salisbury Campus
1333 Jake Alexander Blvd. South
Salisbury, NC 28146-1595

Meeting 3 – Source Basin (Downstream)
October 15, 2013, 5:00 PM
Northeast Technical College – Cheraw Campus
1201 Chesterfield Highway
Cheraw, SC 29520

Public notice of these meetings was published in the September 3, 2013 edition of the North Carolina Register and additional advertisement of the meetings was provided through local and regional newspapers, email and mailed letters, in accordance with the requirements of G.S. 143.215.22L. The purpose of each meeting was to present the project and permitting process to the public and allow discussion to occur between the public and representatives from the County and the engineering consultant. Exhibits, maps, project descriptions and sign-in and comment sheets were at the meeting for use and tracking. It is noted that, at each of these meetings, public attendance was very light. The members of the public who attended were given the opportunity to provide written, verbal or email comments. Each meeting was voice recorded for documentation purposes. Details of meeting notifications and any comments received are located in Appendix D.

9.2. State Environmental Review Clearinghouse Notice of Scoping

A Notice of Scoping for the project was provided to the North Carolina State Environmental Review Clearinghouse on November 12, 2013, in accordance with the State Environmental Policy Act. The purpose of this scoping letter was to gather relevant comments on the proposed action and incorporate them in the water supply alternatives evaluation and environmental analyses which would be completed to develop the draft EIS. This notice included descriptions of the project background, purpose and need, proposed action, area of impact, proposed alternatives and associated figures.

Under the provisions of the North Carolina Environmental Policy Act, this Notice of Scoping was reviewed by the State Clearinghouse on December 30, 2013, and comments were provided by various state resource agencies. Details of the Notice of Scoping and associated comments are located in Appendix D.

9.3. Draft EIS Public Hearing

In accordance with G.S. 143.215.22L and upon submission of the draft EIS to the North Carolina Department of Administration State Environmental Review Clearinghouse, notice of public hearing was provided thirty days in advance of a public hearing held by the EMC on the draft document as follows:

Draft EIS Public Hearing
Wednesday, September 16, 2015, 6:00 PM
Norwood Community Building
247 West Turner Street, Norwood, NC 28128

Supporting environmental documents were made available for public review two weeks prior to the public hearing on the NCDWR website, as well as through the North Carolina Department of Administration State Environmental Review Clearinghouse. Anyone wishing to view the environmental document and submit written comments was given an opportunity to do so. Written comments were initially accepted by the EMC for 30 days after the hearing, through October 16, 2015, and then subsequently extended an additional 30 days through November 16, 2015. After the public hearing the EMC prepared a record of all comments, including written responses to those questions posed in writing. The record also includes complete copies of scientific or technical comments related to the potential impact of the IBT. Details of the public hearing for the Draft EIS and associated comments are located in Appendix D.

9.4. Draft Determination Hearings

Within 90 days after submission of Union County's petition for an IBT Certificate, the EMC will issue a draft determination on whether or not to grant the certificate. Within 60 days of the issues of this draft determination, the EMC will hold several public hearings:

- At least one in the affected area of the source river basin,
- At least one in the affected area of the receiving river basin,
- Additional hearing based on various interests of either upstream or downstream parties potentially affected by the proposed transfer.

Thirty-day written notice of the public hearing will be provided and written comments on the draft determination will be accepted for a minimum of 30 days following the last public hearing. The EMC will prepare a record of all comments, including written responses to those questions posed in writing. The record will also include complete copies of scientific or technical comments related to the potential impact of the IBT. After this process, the EMC will make a final determination as to whether or not to issue the IBT certificate.

10.0 LITERATURE CITED

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11.0 QUALIFICATION OF PREPARERS

11.1. Key HDR Staff

Kevin Mosteller, PE, B. Civil Eng., of HDR specializes in the planning, design, and construction of water supply, water treatment, and wastewater treatment, distribution, and collection facilities. Mr. Mosteller has nearly 25 years of experience with these types of projects in the Carolinas, with a special focus on water supply for the last decade. His project experience includes the preparation of technical reports, feasibility studies, permitting, engineering drawings, specifications, and contract documents. His responsibilities have also included hydraulic analyses, cost estimates, quality control, and water supply master planning. His contributions to this Environmental Impact Statement include logistical and technical aspects of proposed water supply, transmission and treatment infrastructure for the alternatives evaluated within this document. He also led the effort as the overall project manager.

Jonathan Williams, PE, MS Civil Eng., of HDR specializes in water supply planning and the design of facilities associated with water and wastewater treatment. He provides engineering expertise to both municipal clients and regional water planning associations related to long-range water supply planning, feasibility studies, regional water quantity and water quality modeling, contingency/emergency planning and preliminary infrastructure engineering. His contributions to this Environmental Impact Statement include preparation of the alternatives analysis and evaluation of environmental impacts related to water quantity for surface water resources.

Brian Krolak, , of HDR is a Senior Water Resources Modeler with 17 years of experience designing, constructing, and using computer systems and information systems. He has been involved in projects requiring data manipulation, processing, and presentation, with a particular focus on hydroelectric reservoir operations and water quantity modeling. For the past eight years Mr. Krolak has been primarily involved in the programming of HDR's proprietary hydroelectric reservoir operations model, CHEOPS. This has involved acquiring and validating vast amounts of historic operations parameters, programming the model to simulate actual operations, and evaluating output to determine benefits of alternative operating scenarios. His contributions to this Environmental Impact Statement include development and oversight of the water quantity modeling for alternatives analysis.

Vickie Miller, MS Env., of HDR is an Environmental Scientist with 14 years of experience conducting investigations to evaluate terrestrial and aquatic resources. She is a Professional Wetland Scientist and is AICP certified. Her responsibilities include field investigations for stream classification, biotic community typing and land use mapping, and is experienced in evaluating impacts to streams, wetlands, protected species, and historic/archaeological resources. She has prepared environmental reports, restoration plans, and permits including Environmental Assessments (EA), Natural Resources Technical Reports (NRTR), and riparian/wetland restoration plans for the North Carolina Department of Transportation, North

Carolina Ecosystem Enhancement Program, Tennessee Department of Transportation and numerous private clients. Her contributions to the Environmental Impact Statement include the environmental impacts analysis of air quality, noise levels and areas of archeological or historic value.

Bryan Roden-Reynolds, BS Wildlife & Fisheries Sci., of HDR is a regulatory specialist responsible for assisting in the generation of the surface water quality sections of this Environmental Impact Statement. He has over 5 years of experience evaluating environmental issues (i.e. fishery and water resources) and has reviewed permit applications and prepared environmental assessments and other NEPA documents that comply with FERC policies and other federal laws such as the Federal Power Act, Clean Water Act and the Endangered Species Act. Mr. Roden-Reynolds has prepared or assisted in the preparation of more than a half dozen Environmental Assessments/Impact Statements throughout the Unites States, with the majority of experience in the Midwest and southern United States.

Andrew Zimba, BS Ind. & Systems Eng., of HDR specializes in geographic information systems, global positioning systems, and project execution. Mr. Zimba is a Certified GIS Professional and ESRI ArcGIS Desktop Developer Professional. He has designed large GIS- and GPS-based field data collection projects, performed complex GIS-based analyses, managed GIS-based projects and project tasks, and has overseen custom GIS applications development. He has been involved in the preparation of extensive GIS-based analysis and mapping efforts associated with numerous environmental permitting documents.

11.2. Key Hazen and Sawyer Staff

Mary Sadler, PE, MS Env., of Hazen and Sawyer specializes in municipal wastewater treatment processes and modeling, planning and design of wastewater treatment facilities, and environmental permitting. She has been an active participant in over twenty-five environmental permitting projects in North Carolina. Her environmental documents cover a range of projects and issues: new water and wastewater treatment plants, water and wastewater capacity expansions, water supply, new NPDES discharges, and impacts to state and federally listed species. Significant environmental permitting achievements include the Dempsey E. Benton WTP and associated Biological Opinion for direct impacts to the federally endangered dwarf wedgemussel and an Interbasin Transfer for the Greenville Utilities Commission.

Linda Diebolt, BS M.Bio., of Hazen and Sawyer is a senior biologist responsible for assisting in the generation of the natural resources sections of the EIS. She has over twenty-eight years of experience. Ms. Diebolt has performed and managed biological assessments, wetland delineations (tidal and non-tidal), permit applications, mitigation site searches, mitigation design and specifications, and preparation of environmental documents. Ms. Diebolt has prepared or assisted in the preparation of more than forty environmental documents throughout the United States.

Keven Arrance, BS Bio., of Hazen and Sawyer is a biologist responsible for assisting in the generation of the natural resources sections of the EIS. She has over thirteen years of experience and has performed and managed biological assessments, wetland delineations, permit applications, mitigation design and specifications, and preparation of environmental documents. Ms. Arrance has prepared or assisted in the preparation of more than thirty environmental documents throughout the United States.

Tim Devine, PE, MS Env Mgmt, MBA, of Hazen and Sawyer has assisted with water and wastewater process evaluations, hydrologic assessments, and preparation of environmental documents. He specializes in environmental design and permitting with experience in water quality analysis, water/wastewater analysis and design, statistical analysis, and hydrologic analysis and modeling. Mr. Devine has assisted in the preparation of ten environmental documents.

APPENDICES

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APPENDIX A – EIS Maps and Figures

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APPENDIX A – Maps and Figures

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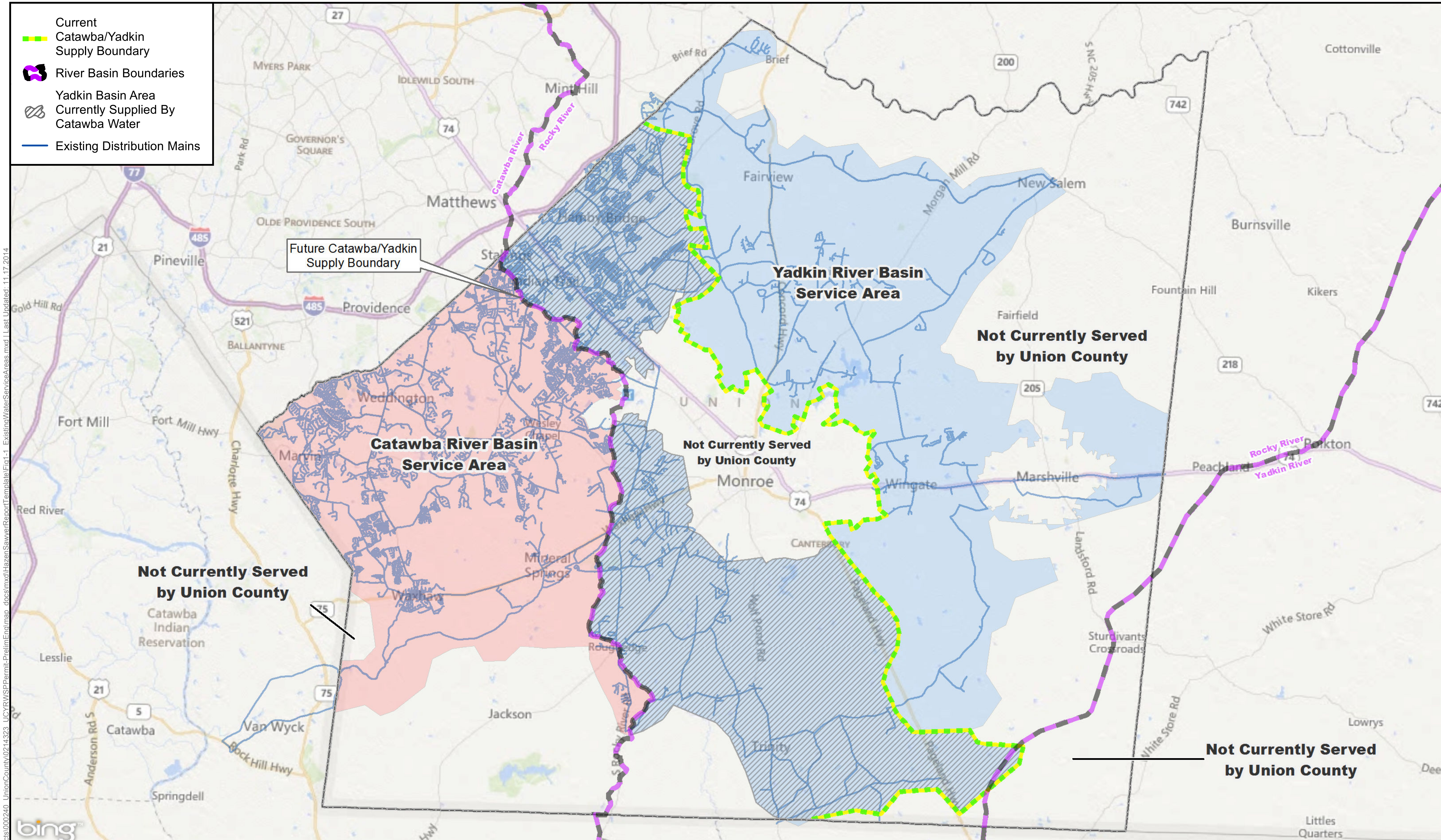

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1 inch = 3 miles

N W E S

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UNION COUNTY NORTH CAROLINA

Figure 1-1: Existing Union County Water Service Areas

Yadkin River Water Supply Project

Union County, North Carolina

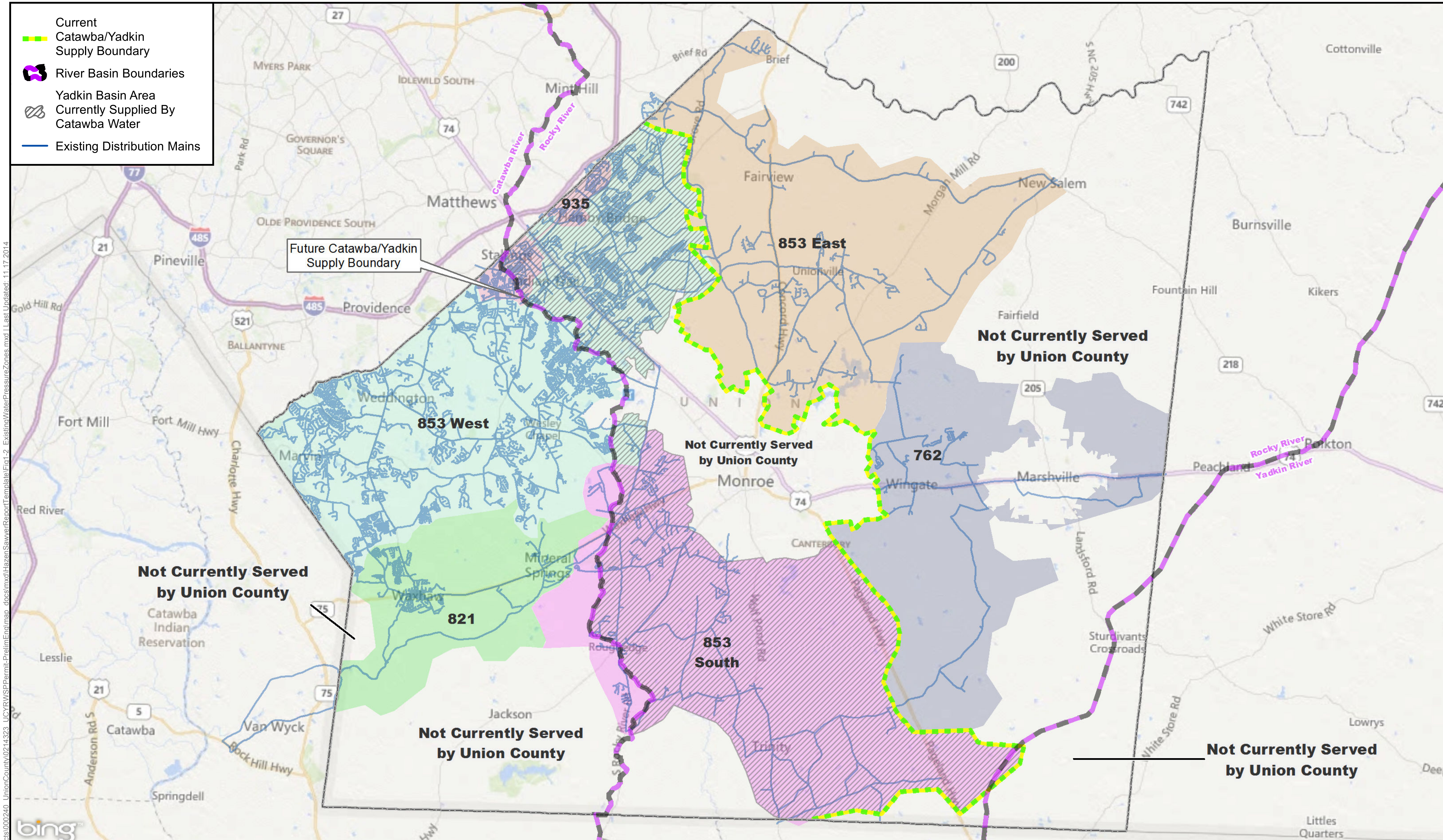

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Figure 1-2: Existing Union County Water Pressure Zones

Yadkin River Water Supply Project

Union County, North Carolina

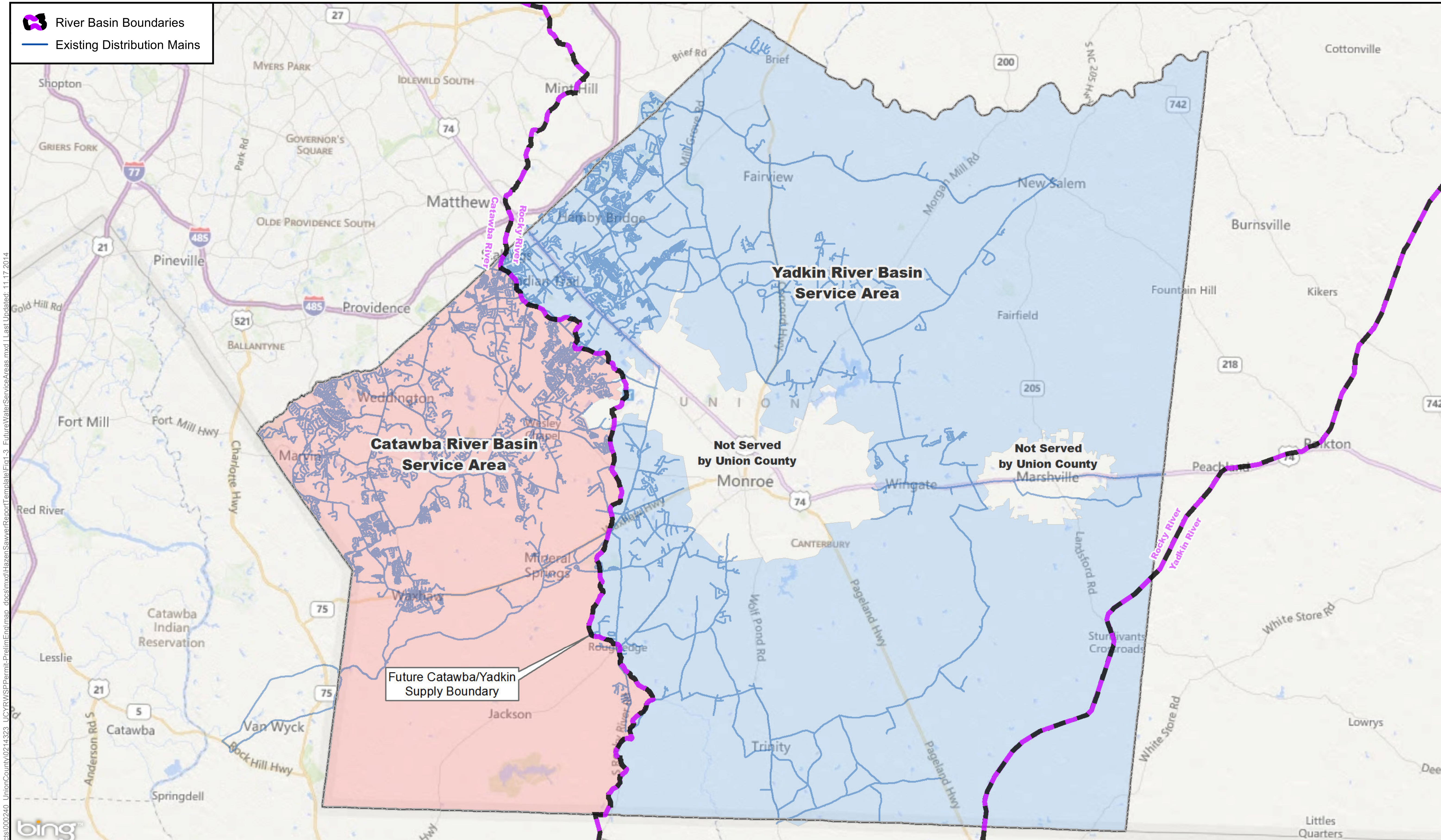

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Figure 1-3: Future Union County Water Service Areas

Yadkin River Water Supply Project
Union County, North Carolina

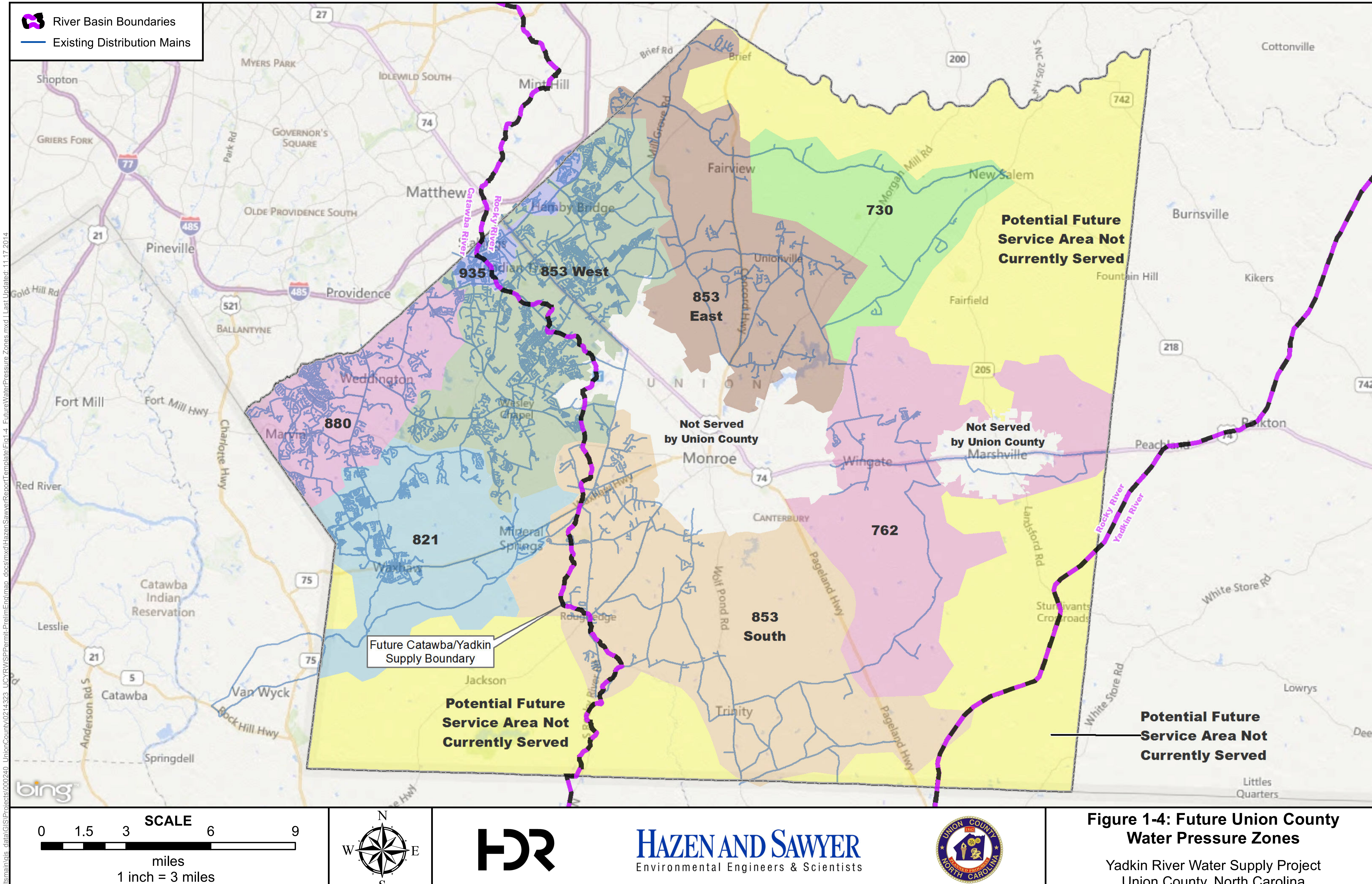

Figure 1-4: Future Union County Water Pressure Zones

Yadkin River Water Supply Project
Union County, North Carolina

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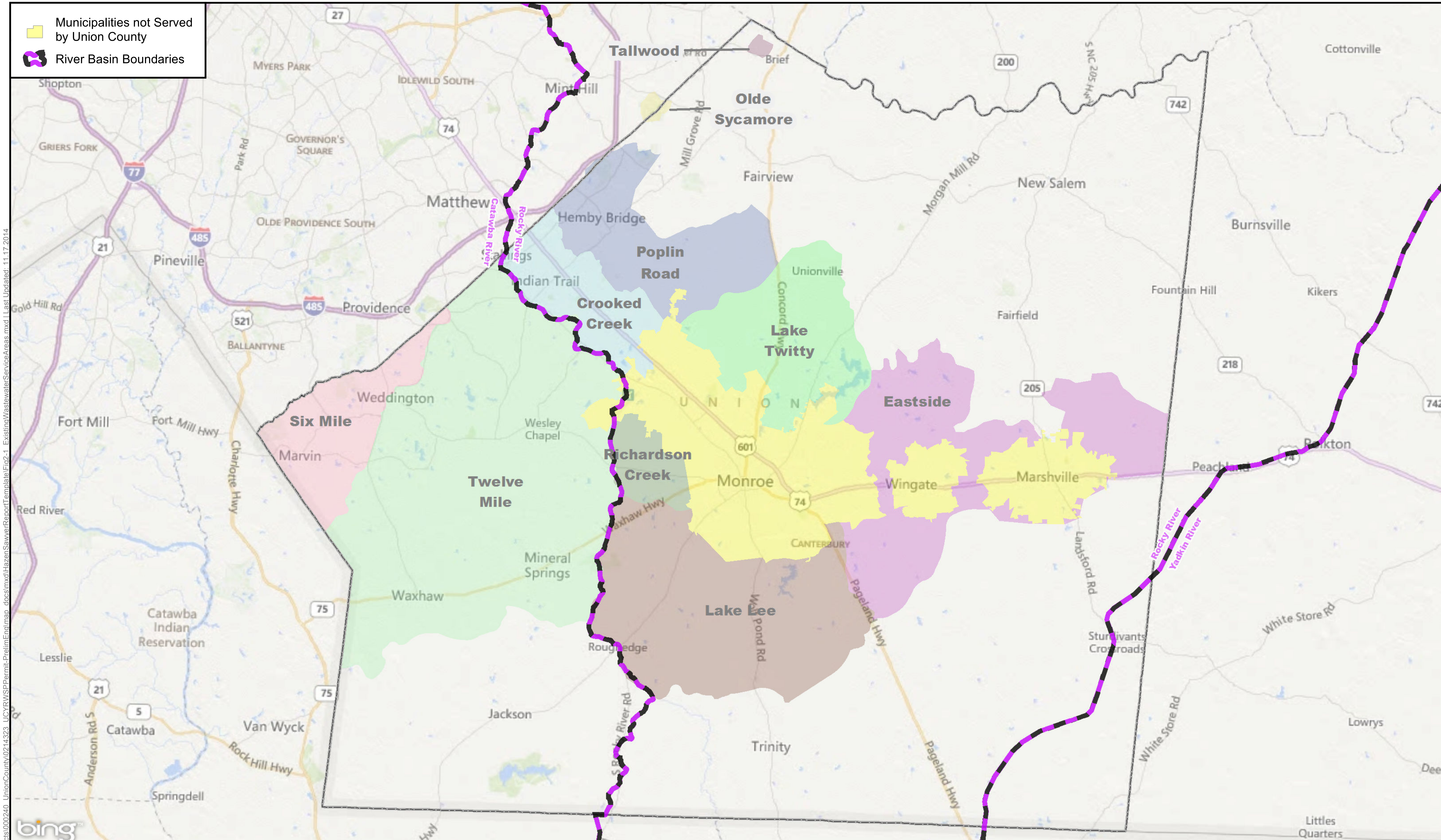

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1 inch = 3 miles

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Figure 2-1: Union County Wastewater Service Basins

Yadkin River Water Supply Project
Union County, North Carolina

Union County Water Supply Projections for the Yadkin River Water Supply Project

Catawba Inputs		Yadkin Inputs	
Population Growth 2010-2020	*2.4%*	Population Growth 2010-2020	*2.7%*
Population Growth 2021-2030	*1.8%*	Population Growth 2021-2030	*2.7%*
Population Growth 2031-2040	*1.8%*	Population Growth 2031-2040	*2.4%*
Population Growth 2041-2050	*1.8%*	Population Growth 2041-2050	*1.8%*
Service Area Growth	*0.20%*	Service Area Growth	*1.00%*
Per Capita Use	*120*	Per Capita Use	*120*
Peaking Factor	*1.7*	Peaking Factor	*1.7*
IBT Limit (mgd)	*5.0*	Add'l Anson Supply (mgd)	*0*
CRWTP 2018 Add'l Capacity (mgd)	*9*	YRWSP 2022 Capacity (mgd)	*12*
CRWTP 2039 Add'l Capacity (mgd)	*18*	YRWSP 2032 Capacity (mgd)	*20*
		YRWSP 2044 Capacity (mgd)	*28*

Legend

User input/selection required
Value referenced from user input/selection
Dependent calculation value
Calculation Result of Importance

Planning Year	Average Day Water Demands: Catawba (mgd)	Average Day Water Demands: Yadkin (mgd)	Average Day Water Demands: Total (mgd)	MDD:ADD Peaking Factor - Catawba	MDD:ADD Peaking Factor - Yadkin	Maximum Month Daily Water: Catawba* (mgd)	Maximum Month Daily Water: Yadkin (mgd)	Maximum Month Daily Water: Total (mgd)	Maximum Day Water: Catawba* (mgd)	Maximum Day Water: Yadkin (mgd)	Maximum Day Water: Total (mgd)	Water Supply (MMDD): Catawba (mgd): CRWTP Existing	Catawba (mgd): CRWTP New	Catawba (mgd): Total	Yadkin (mgd): Anson Existing	Yadkin (mgd): Anson New	Yadkin (mgd): Anson Total	Yadkin (mgd): YRWSP	Yadkin (mgd): Total	Total Supply (mgd)	Supply Adequacy: Demand % of Supply	Supply Adequacy: Sufficient Supply?	Grandfathered Catawba IBT Balance: Catawba Supply Surplus/ Deficit (mgd)	Yadkin Supply Surplus/Deficit (mgd)	Water Transfer Amount (mgd)	WW Transfer (mgd)	Net IBT - Max Month Daily Avg (mgd)	Transfer Direction
A	B	C	D	E	F	G	H	I	G	H	I	J	K	L	M	N		O	P	Q	R	S	T	U	V	W	z	AA
2010	**5.6**	**4.9**	**10.5**			**8.0**	**6.9**	**14.8**	**9.7**	**8.4**	**18.1**	14.8	0.0	14.8	2.5	0.0	2.5	0.0	2.5	17.2	86.2%	YES	6.8	-4.4	4.4	0.7	**3.7**	**Catawba to Yadkin**
2011	**5.9**	**5.1**	**11.0**	1.70	1.70	**8.2**	**7.1**	**15.3**	**10.0**	**8.7**	**18.7**	14.8	2.5	17.2	2.5	0.0	2.5	0.0	2.5	19.7	77.8%	YES	9.0	-4.6	4.6	0.8	**3.9**	**Catawba to Yadkin**
2012	**6.2**	**5.3**	**11.5**	1.70	1.70	**8.6**	**7.4**	**16.0**	**10.5**	**9.0**	**19.5**	14.8	2.5	17.2	2.5	0.0	2.5	0.0	2.5	19.7	81.2%	YES	8.6	-4.9	4.9	0.8	**4.1**	**Catawba to Yadkin**
2013	6.4	5.5	11.9	1.70	1.70	8.9	7.7	16.6	10.8	9.4	20.2	14.8	2.5	17.2	2.5	0.0	2.5	**0.0**	2.5	19.7	84.2%	YES	8.4	-5.2	5.2	0.9	4.3	Catawba to Yadkin
2014	6.6	5.8	12.3	1.70	1.70	10.7	8.0	18.7	13.0	9.8	22.8	14.8	2.5	17.2	2.5	0.8	3.3	0.0	3.3	20.5	91.4%	YES	6.5	-4.7	4.7	1.0	**3.7**	**Catawba to Yadkin**
2015	6.8	6.0	12.8	1.70	1.70	11.0	8.4	19.4	13.4	10.2	23.6	14.8	2.5	17.2	2.5	0.8	3.3	0.0	3.3	20.5	94.4%	YES	6.2	-5.1	5.1	1.1	**4.0**	**Catawba to Yadkin**
2016	7.0	6.3	13.2	1.70	1.70	11.3	8.7	20.0	13.8	10.6	24.4	14.8	2.5	17.2	2.5	0.8	3.3	0.0	3.3	20.5	97.6%	YES	5.9	-5.4	5.4	1.2	**4.3**	**Catawba to Yadkin**
2017	7.2	6.5	13.7	1.70	1.70	11.6	9.1	20.7	14.1	11.1	25.2	14.8	2.5	17.2	2.5	0.8	3.3	0.0	3.3	20.5	100.8%	YES	5.6	-5.8	5.8	1.3	**4.5**	**Catawba to Yadkin**
2018	7.4	6.8	14.2	1.70	1.70	11.9	9.5	21.4	14.5	11.5	26.0	14.8	7.4	22.1	2.5	0.8	3.3	0.0	3.3	25.4	84.0%	YES	10.2	-6.2	6.2	1.6	**4.6**	**Catawba to Yadkin**
2019	7.6	7.1	14.7	1.70	1.70	12.2	9.8	22.1	14.9	12.0	26.9	14.8	7.4	22.1	2.5	0.8	3.3	0.0	3.3	25.4	86.8%	YES	9.9	-6.6	6.6	1.7	**4.9**	**Catawba to Yadkin**
2020	7.9	7.4	15.2	1.70	1.70	12.6	10.2	22.8	15.3	12.5	27.8	14.8	7.4	22.1	2.5	0.8	3.3	**0.0**	3.3	25.4	89.7%	YES	9.6	-7.0	7.0	1.8	**5.2**	Catawba to Yadkin
2021	8.1	7.7	15.7	1.70	1.70	12.8	10.7	23.5	15.6	13.0	28.6	14.8	7.4	22.1	2.5	0.8	3.3	0.0	3.3	25.4	92.4%	YES	9.3	-7.4	7.4	1.8	**5.6**	**Catawba to Yadkin**
2022	8.3	8.0	16.2	1.70	1.70	13.1	11.1	24.2	15.9	13.5	29.5	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	75.6%	YES	9.1	-1.3	1.3	1.9	**0.0**	
2023	8.5	8.3	16.7	1.70	1.70	13.3	11.6	24.9	16.3	14.1	30.4	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	77.8%	YES	8.8	-1.7	1.7	2.0	**0.0**	
2024	8.7	8.6	17.3	1.70	1.70	13.6	12.0	25.6	16.6	14.7	31.3	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	80.2%	YES	8.5	-2.2	2.2	2.1	**0.1**	**Catawba to Yadkin**
2025	8.9	9.0	17.8	1.70	1.70	13.9	12.5	26.4	17.0	15.3	32.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	82.6%	YES	8.2	-2.7	2.7	2.1	**0.5**	**Catawba to Yadkin**
2026	9.1	9.3	18.4	1.70	1.70	14.2	13.0	27.2	17.3	15.9	33.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	85.0%	YES	8.0	-3.2	3.2	2.2	**1.0**	**Catawba to Yadkin**
2027	9.3	9.7	19.0	1.70	1.70	14.5	13.5	28.0	17.7	16.5	34.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	87.6%	YES	7.7	-3.7	3.7	2.3	**1.4**	**Catawba to Yadkin**
2028	9.5	10.1	19.6	1.70	1.70	14.8	14.1	28.8	18.0	17.2	35.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	90.2%	YES	7.4	-4.2	4.2	2.4	**1.9**	**Catawba to Yadkin**
2029	9.7	10.5	20.2	1.70	1.70	15.1	14.6	29.7	18.4	17.8	36.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	92.9%	YES	7.1	-4.8	4.8	2.4	**2.4**	**Catawba to Yadkin**
2030	9.9	10.9	20.8	1.70	1.70	15.4	15.2	30.6	18.8	18.6	37.3	14.8	7.4	22.1	0.0	0.0	0.0	**9.8**	9.8	32.0	95.7%	YES	6.8	-5.4	5.4	2.5	2.9	Catawba to Yadkin
2031	10.1	11.3	21.5	1.70	1.70	15.7	15.8	31.5	19.2	19.2	38.4	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	98.4%	YES	6.4	-5.9	5.9	2.6	**3.4**	**Catawba to Yadkin**
2032	10.4	11.7	22.1	1.70	1.70	16.0	16.3	32.4	19.5	19.9	39.5	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	84.0%	YES	6.1	0.1	0.0	2.6	**0.0**	
2033	10.6	12.1	22.8	1.70	1.70	16.4	16.9	33.3	19.9	20.7	40.6	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	86.4%	YES	5.8	-0.5	0.5	2.7	**0.0**	
2034	10.9	12.6	23.4	1.70	1.70	16.7	17.5	34.2	20.4	21.4	41.8	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	88.8%	YES	5.4	-1.1	1.1	2.8	**0.0**	
2035	11.1	13.0	24.1	1.70	1.70	17.0	18.2	35.2	20.8	22.2	42.9	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	91.4%	YES	5.1	-1.8	1.8	2.8	**0.0**	
2036	11.4	13.5	24.9	1.70	1.70	17.4	18.8	36.2	21.2	23.0	44.2	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	94.0%	YES	4.8	-2.4	2.4	2.9	**0.0**	
2037	11.6	14.0	25.6	1.70	1.70	17.7	19.5	37.2	21.6	23.8	45.4	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	96.7%	YES	4.4	-3.1	3.1	2.9	**0.2**	**Catawba to Yadkin**
2038	11.9	14.5	26.4	1.70	1.70	18.1	20.2	38.3	22.1	24.7	46.7	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	99.4%	YES	4.0	-3.8	3.8	3.0	**0.8**	**Catawba to Yadkin**
2039	12.1	15.0	27.2	1.70	1.70	18.5	20.9	39.4	22.5	25.5	48.1	14.8	14.8	29.5	0.0	0.0	0.0	16.4	16.4	45.9	85.8%	YES	11.1	-4.5	4.5	3.0	**1.5**	**Catawba to Yadkin**
2040	12.4	15.6	28.0	1.70	1.70	18.8	21.7	40.5	23.0	26.4	49.4	14.8	14.8	29.5	0.0	0.0	0.0	**16.4**	16.4	45.9	88.3%	YES	10.7	-5.3	5.3	3.1	2.2	Catawba to Yadkin
2041	12.7	16.0	28.7	1.70	1.70	19.2	22.3	41.6	23.5	27.2	50.7	14.8	14.8	29.5	0.0	0.0	0.0	16.4	16.4	45.9	90.5%	YES	10.3	-5.9	5.9	3.2	**2.8**	**Catawba to Yadkin**
2042	13.0	16.5	29.4	1.70	1.70	19.6	23.0	42.6	23.9	28.0	52.0	14.8	14.8	29.5	0.0	0.0	0.0	16.4	16.4	45.9	92.8%	YES	9.9	-6.6	6.6	3.2	**3.4**	**Catawba to Yadkin**
2043	13.2	17.0	30.2	1.70	1.70	20.0	23.7	43.7	24.4	28.8	53.3	14.8	14.8	29.5	0.0	0.0	0.0	16.4	16.4	45.9	95.1%	YES	9.5	-7.3	7.3	3.3	**4.0**	**Catawba to Yadkin**
2044	13.5	17.5	31.0	1.70	1.70	20.4	24.3	44.8	24.9	29.7	54.6	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	85.3%	YES	9.1	-1.4	1.4	3.3	**0.0**	
2045	13.8	18.0	31.8	1.70	1.70	20.9	25.1	45.9	25.4	30.6	56.0	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	87.5%	YES	8.7	-2.1	2.1	3.4	**0.0**	
2046	14.1	18.5	32.6	1.70	1.70	21.3	25.8	47.1	25.9	31.5	57.4	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	89.7%	YES	8.2	-2.8	2.8	3.5	**0.0**	
2047	14.5	19.0	33.5	1.70	1.70	21.7	26.5	48.3	26.5	32.4	58.8	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	91.9%	YES	7.8	-3.6	3.6	3.5	**0.1**	**Catawba to Yadkin**
2048	14.8	19.6	34.4	1.70	1.70	22.2	27.3	49.5	27.0	33.3	60.3	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	94.3%	YES	7.4	-4.4	4.4	3.6	**0.8**	**Catawba to Yadkin**
2049	15.1	20.2	35.3	1.70	1.70	22.6	28.1	50.7	27.6	34.3	61.8	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	96.6%	YES	6.9	-5.2	5.2	3.6	**1.5**	**Catawba to Yadkin**
2050	15.4	20.8	36.2	1.70	1.70	23.1	28.9	52.0	28.1	35.3	63.4	14.8	14.8	29.5	0.0	0.0	0.0	**23.0**	23.0	52.5	99.1%	YES	6.5	-6.0	6.0	3.7	2.3	Catawba to Yadkin

* Includes 1.99 MGD (max day) supply to City of Monroe by contract, beginning in 2014.

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Figure 2-2: Union County Water Supply Projections for the Yadkin River Water Supply Project

Yadkin River Water Supply Project
Union County, North Carolina

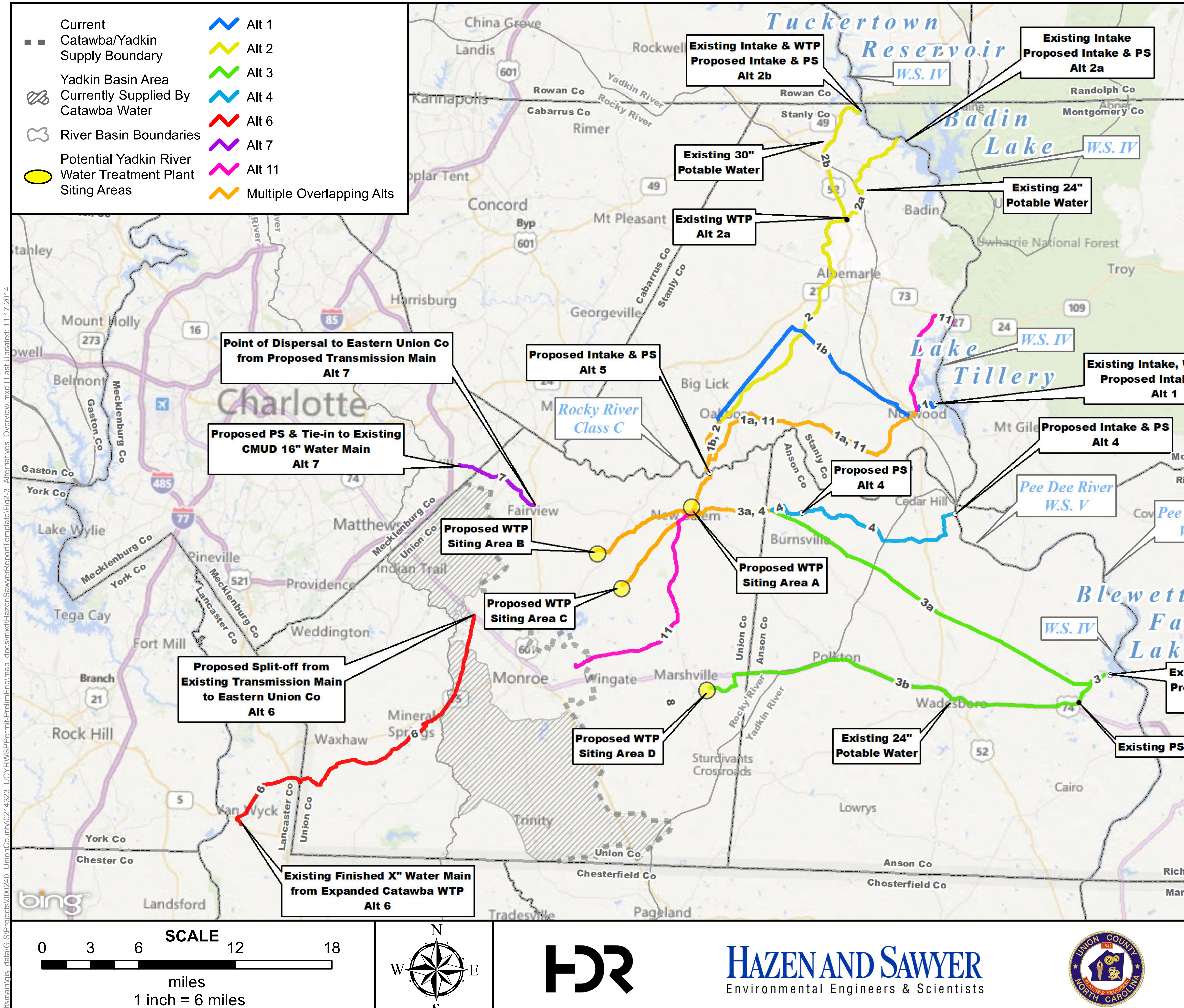

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Figure 2-3: Alternatives Overview

Yadkin River Water Supply Project
Union County, North Carolina

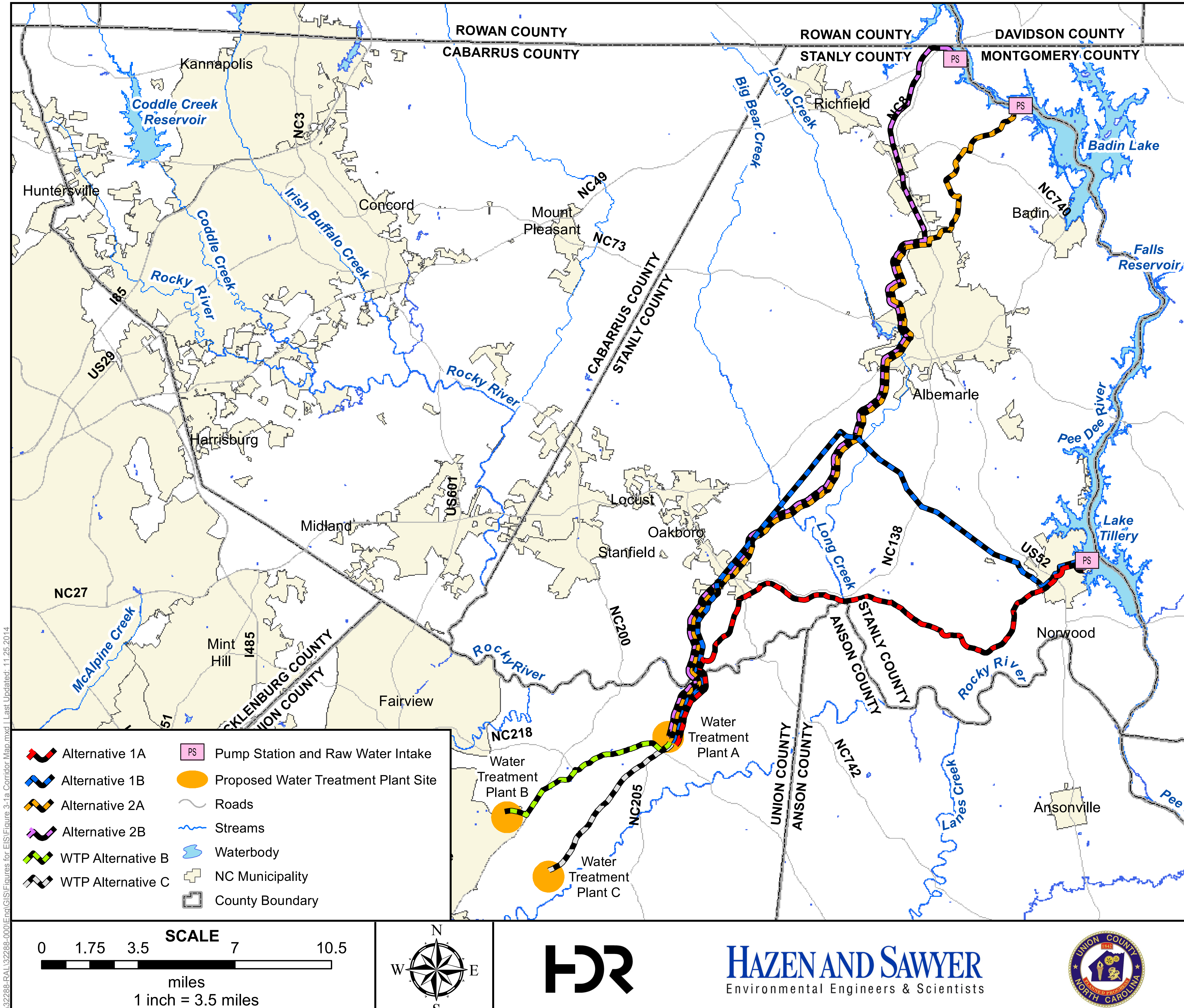

Figure 3-1a:
Alternative Map
Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives B and C
Yadkin River Water Supply Project
Union County, North Carolina

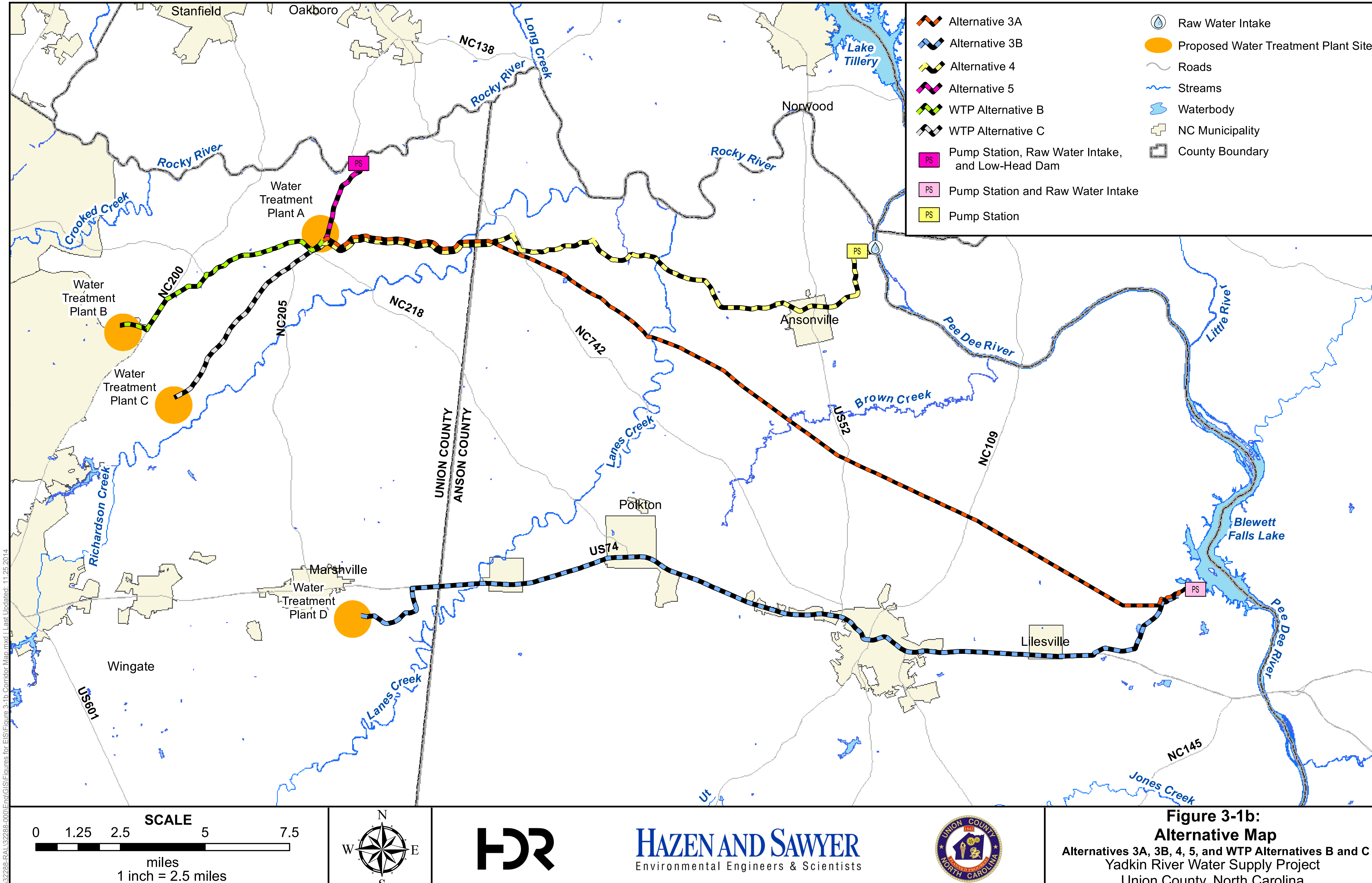

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Figure 3-1b: Alternative Map

Alternatives 3A, 3B, 4, 5, and WTP Alternatives B and C

Yadkin River Water Supply Project
Union County, North Carolina

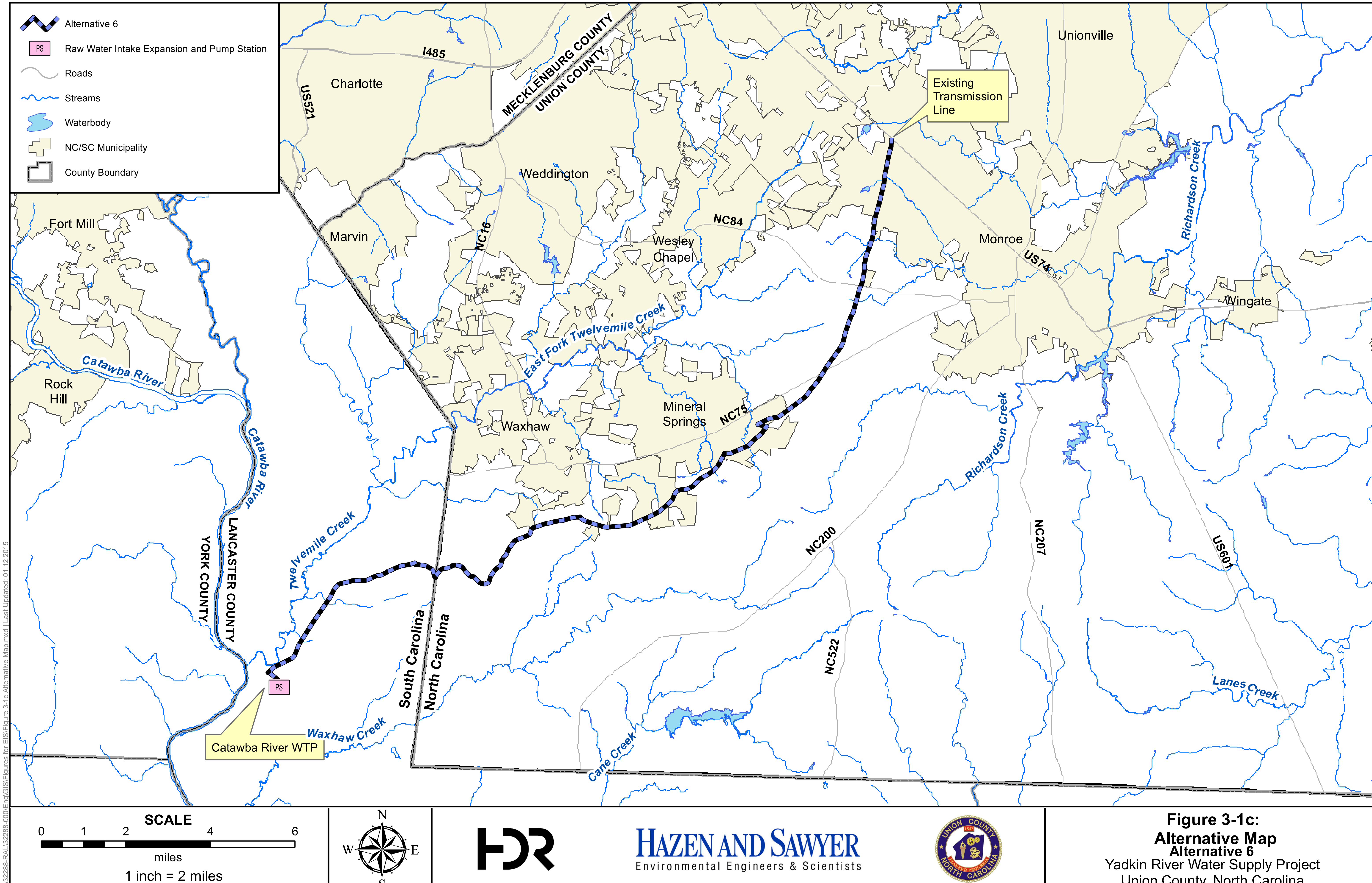

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Figure 3-1c:
Alternative Map
Alternative 6
Yadkin River Water Supply Project
Union County, North Carolina

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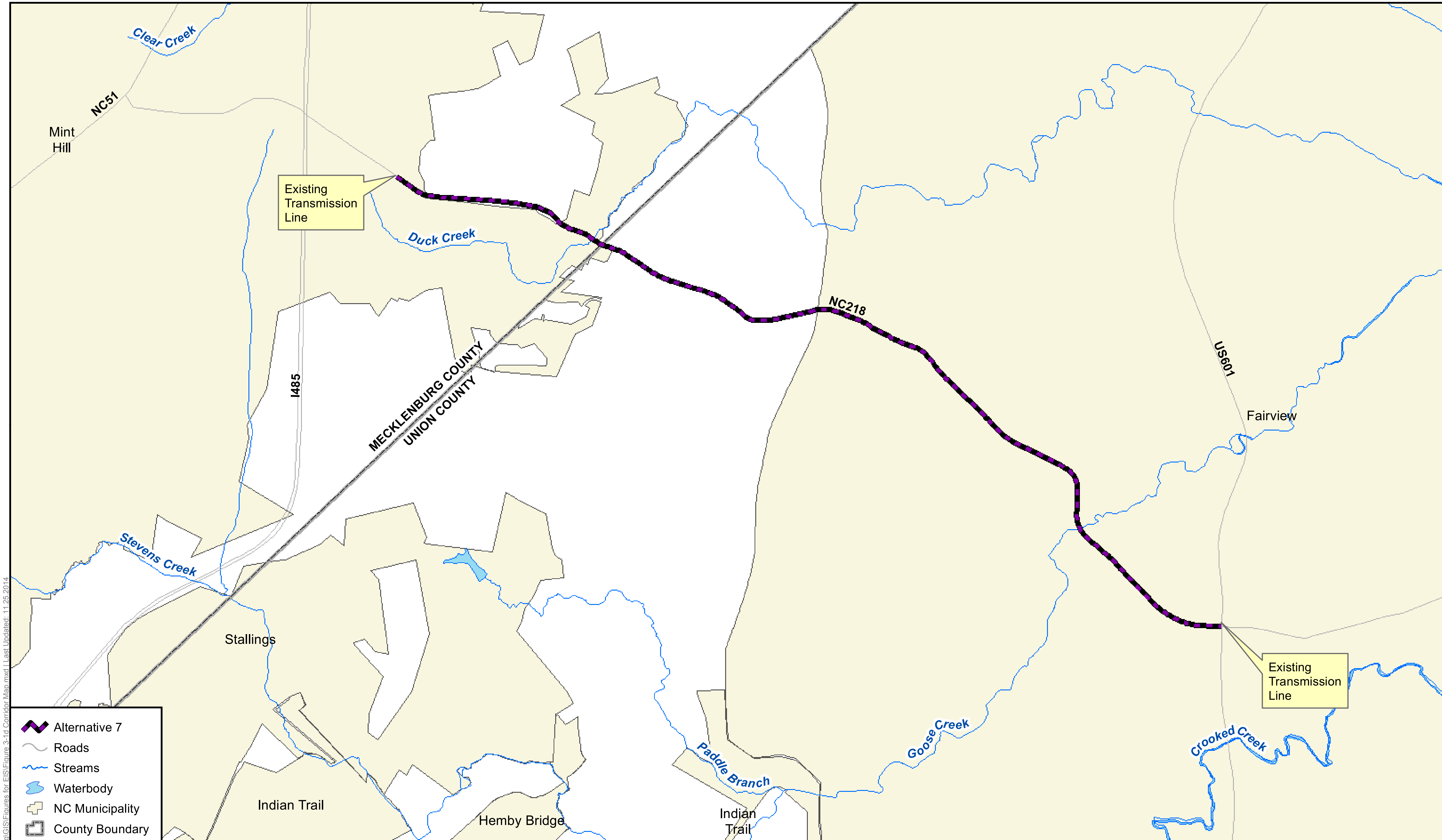

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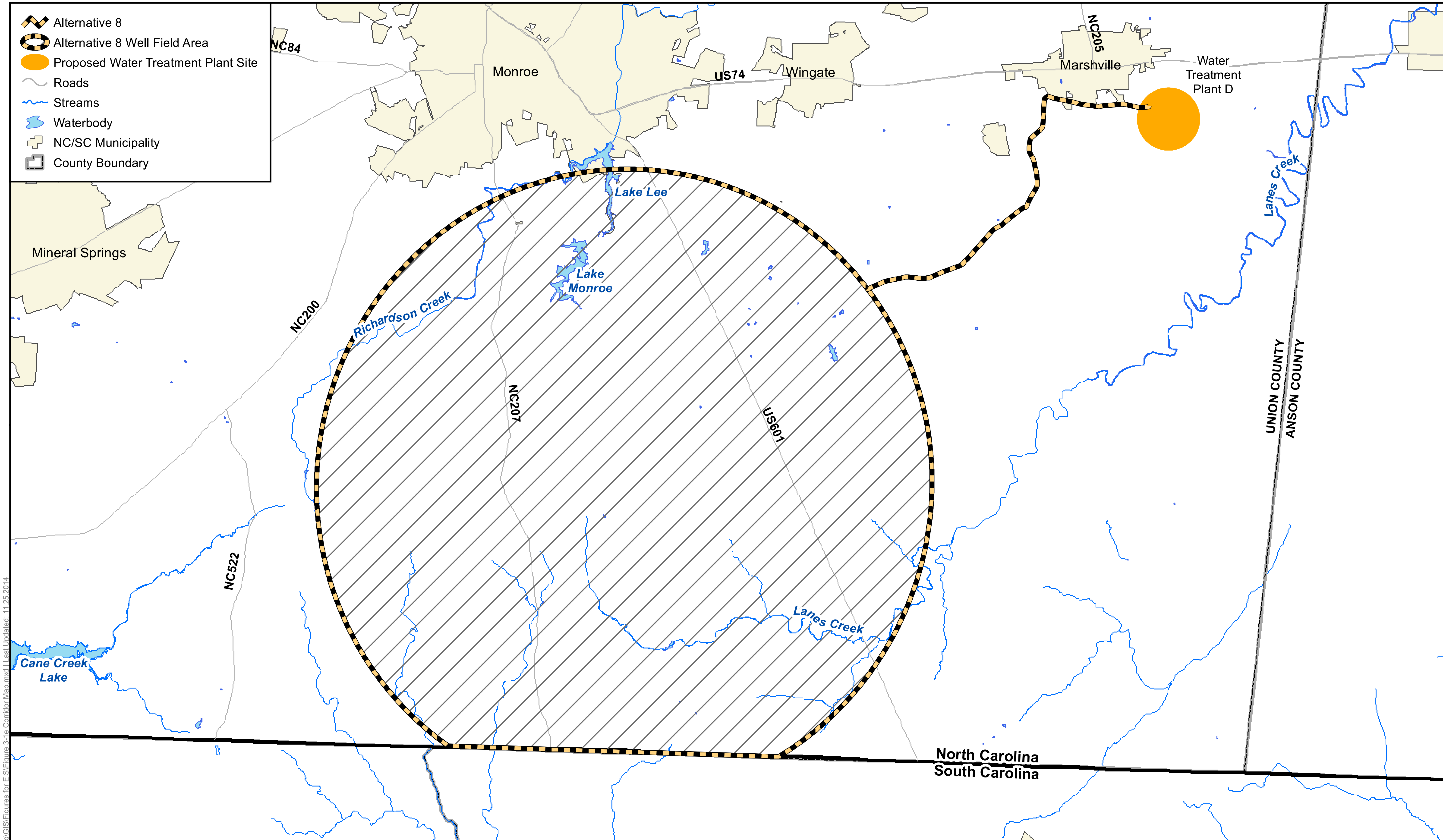
Figure 3-1d:
Alternative Map
Alternative 7
Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 0.75 1.5 3 4.5

miles

1 inch = 1.5 miles

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Figure 3-1e:
Alternative Map
Alternative 8
Yadkin River Water Supply Project
Union County, North Carolina

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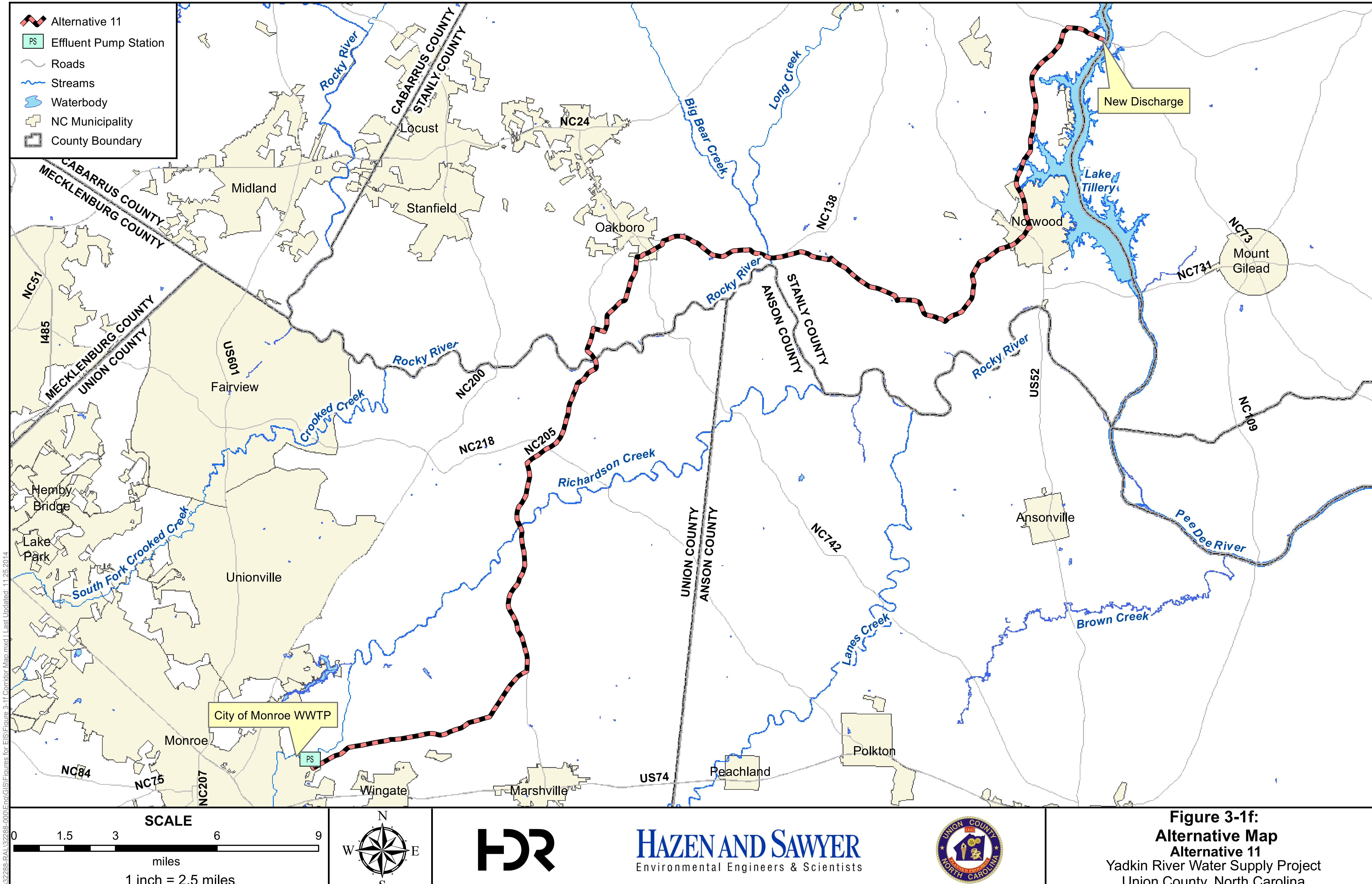

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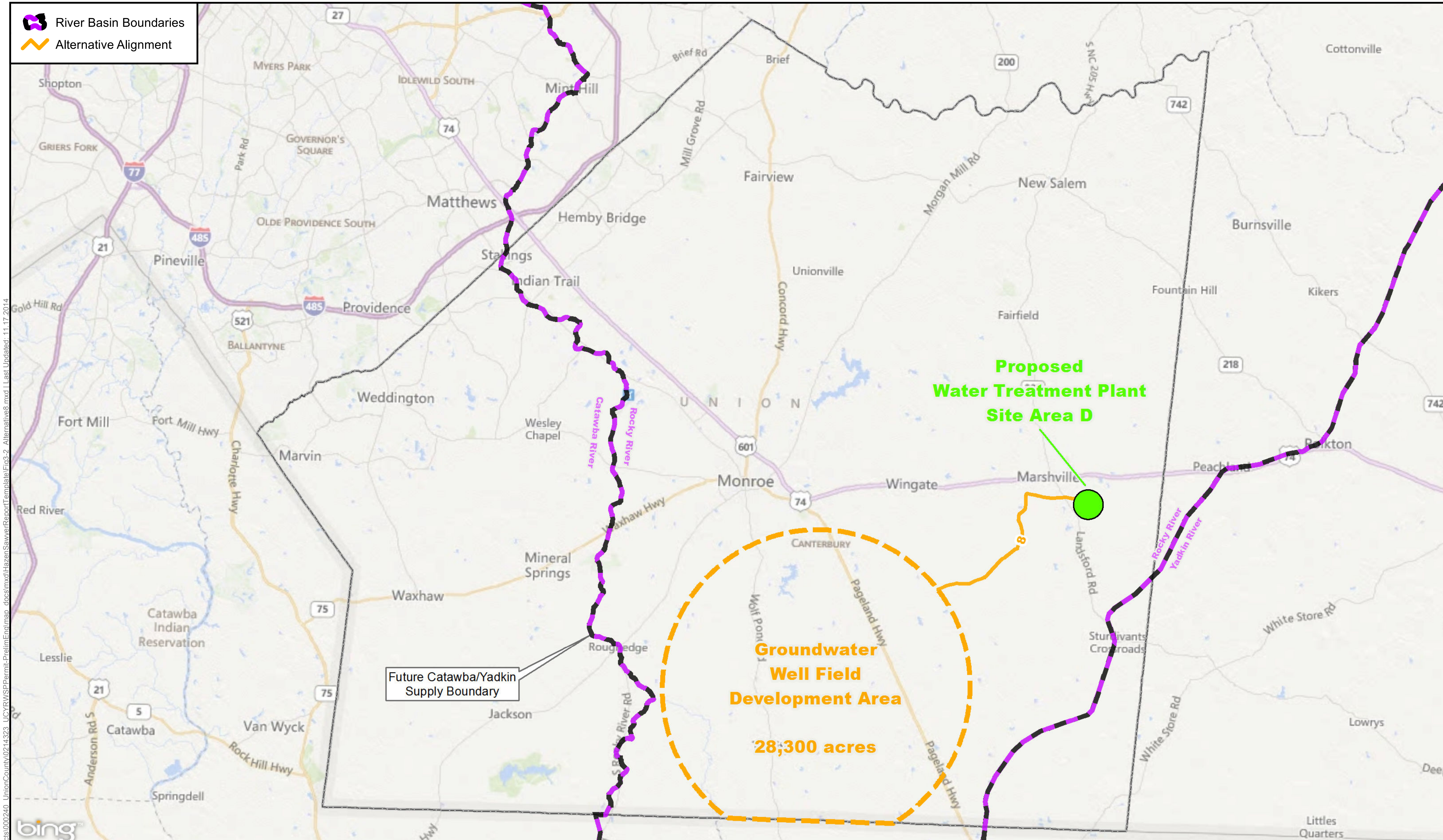
Figure 3-1f:
Alternative Map
Alternative 11
Yadkin River Water Supply Project
Union County, North Carolina



SCALE				
0	1.5	3	6	9

miles
1 inch = 3 miles

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Figure 3-2: Alternative 8 - Groundwater

Yadkin River Water Supply Project
Union County, North Carolina

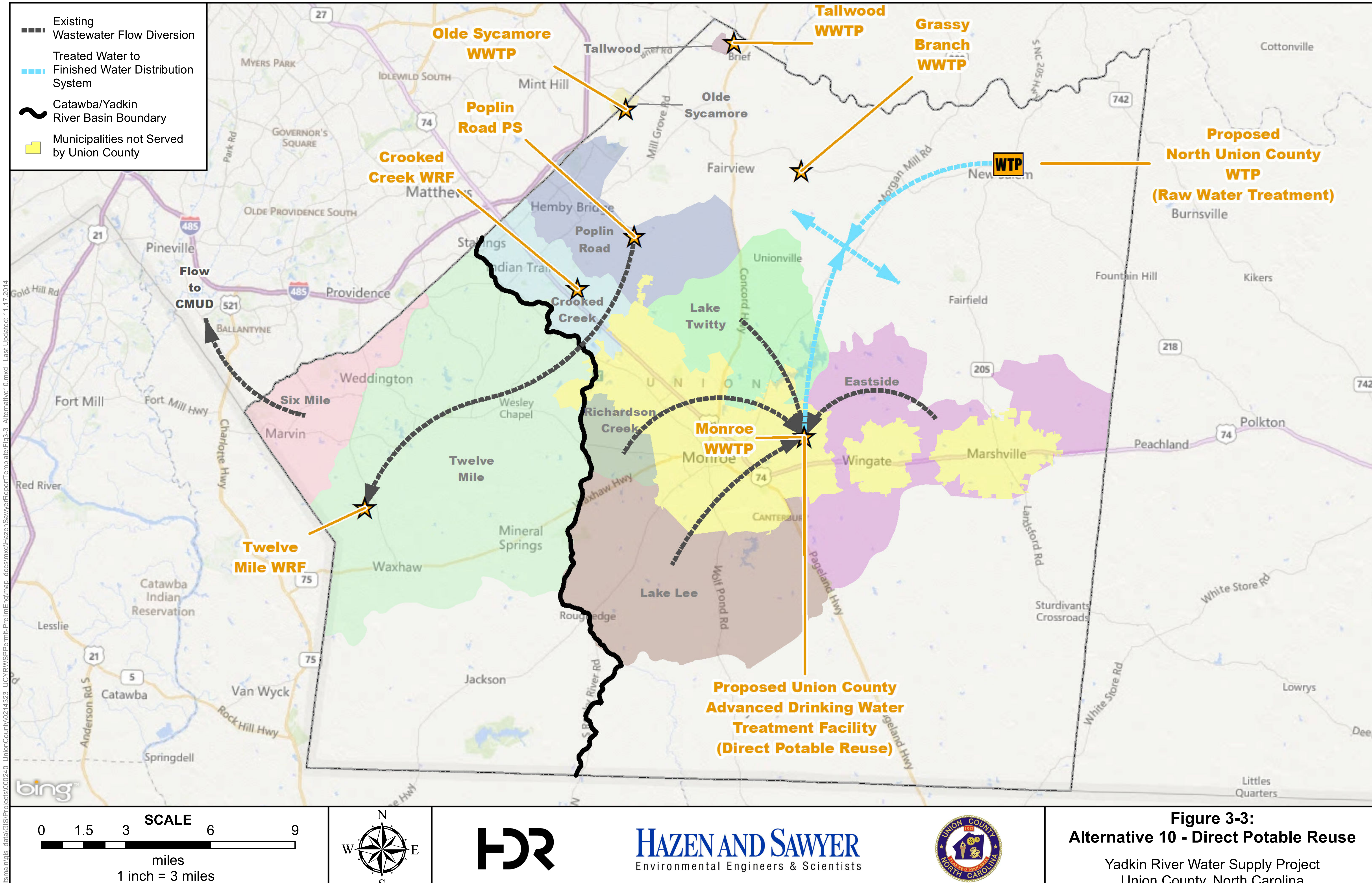


Figure 3-3: Alternative 10 - Direct Potable Reuse

Yadkin River Water Supply Project
Union County, North Carolina

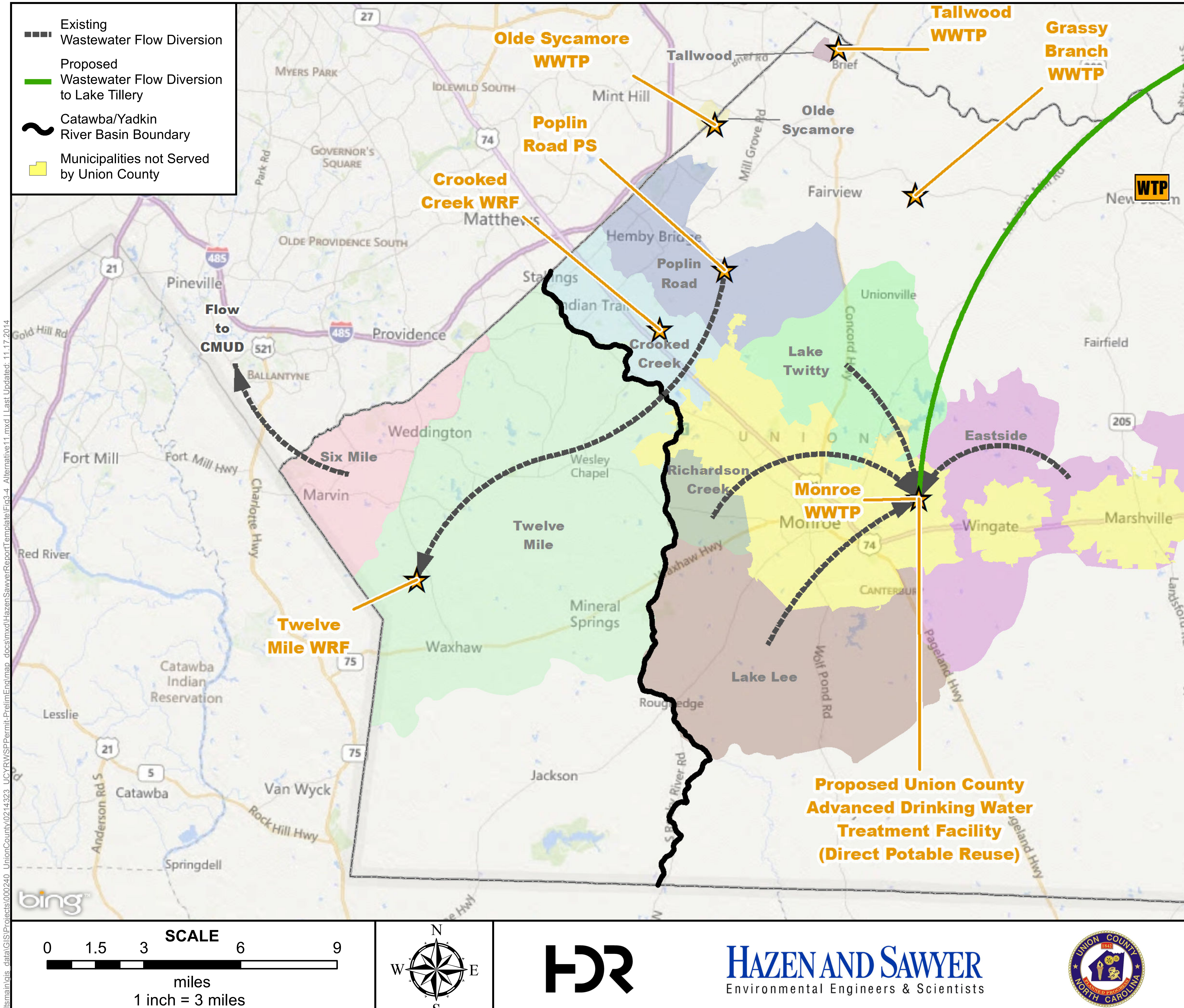
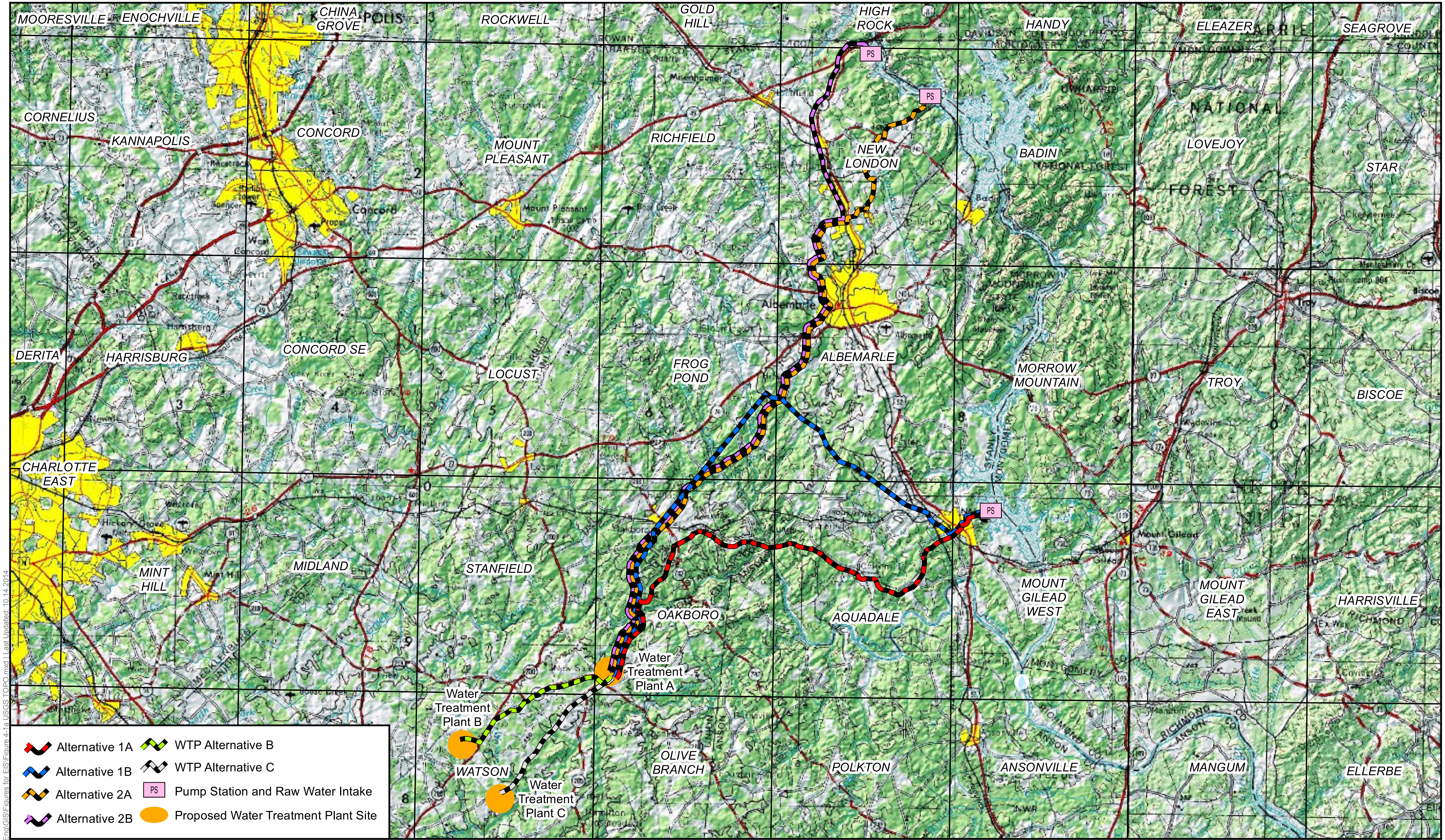


Figure 3-4: Alternative 11 - Wastewater Returns to Lake Tillery

Yadkin River Water Supply Project
Union County, North Carolina



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SCALE

0 1.75 3.5 7 10.5

miles

1 inch = 3.5 miles

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Figure 4-1a:
USGS Topographic Quadrangle Maps
Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives B and C
Yadkin River Water Supply Project
Union County, North Carolina

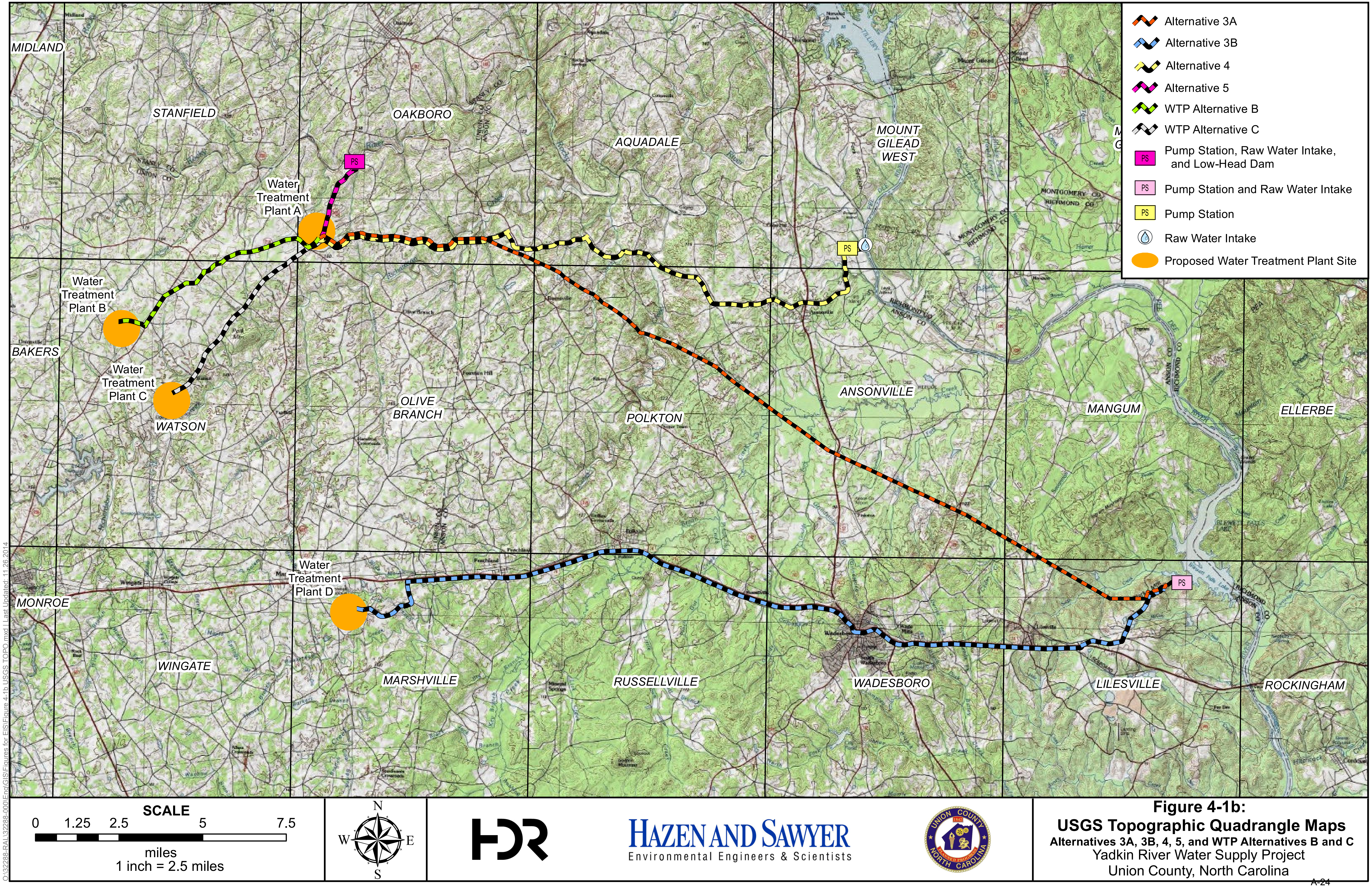

Figure 4-1b:
USGS Topographic Quadrangle Maps

Alternatives 3A, 3B, 4, 5, and WTP Alternatives B and C

Yadkin River Water Supply Project

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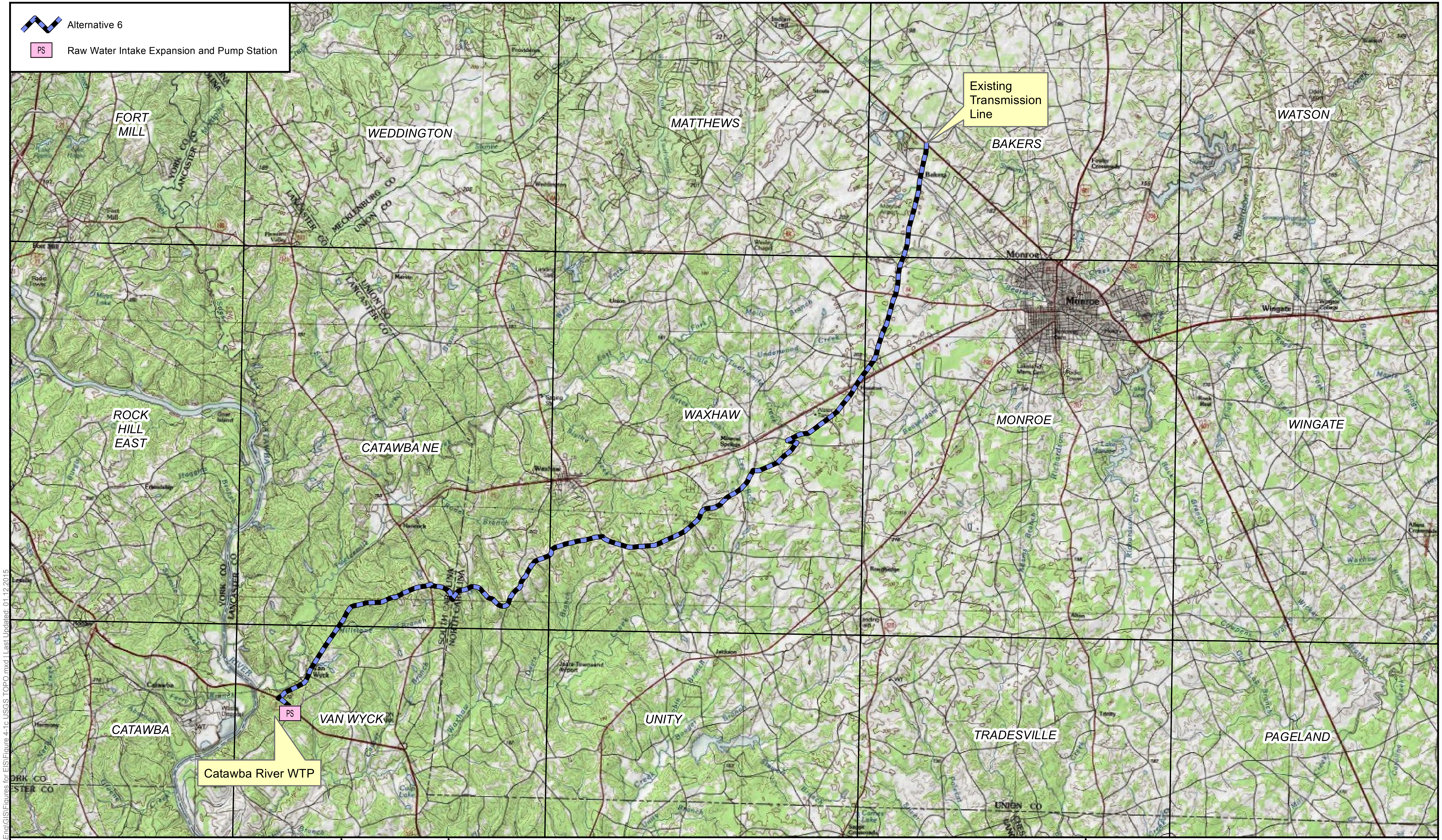

SCALE

0 1 2 4 6

miles

1 inch = 2 miles

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Figure 4-1c:
USGS Topographic Quadrangle Maps
Alternative 6
Yadkin River Water Supply Project
Union County, North Carolina

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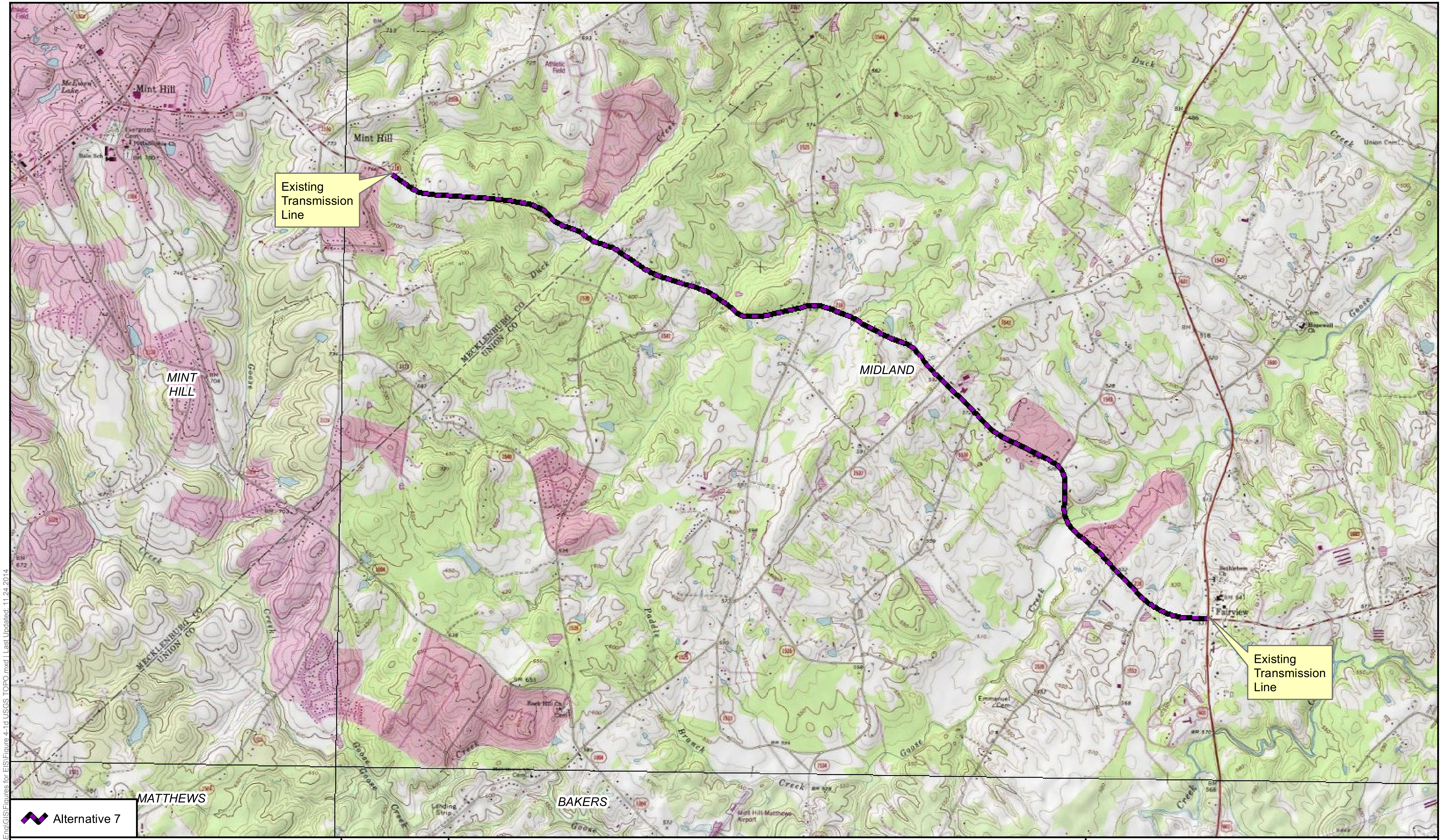


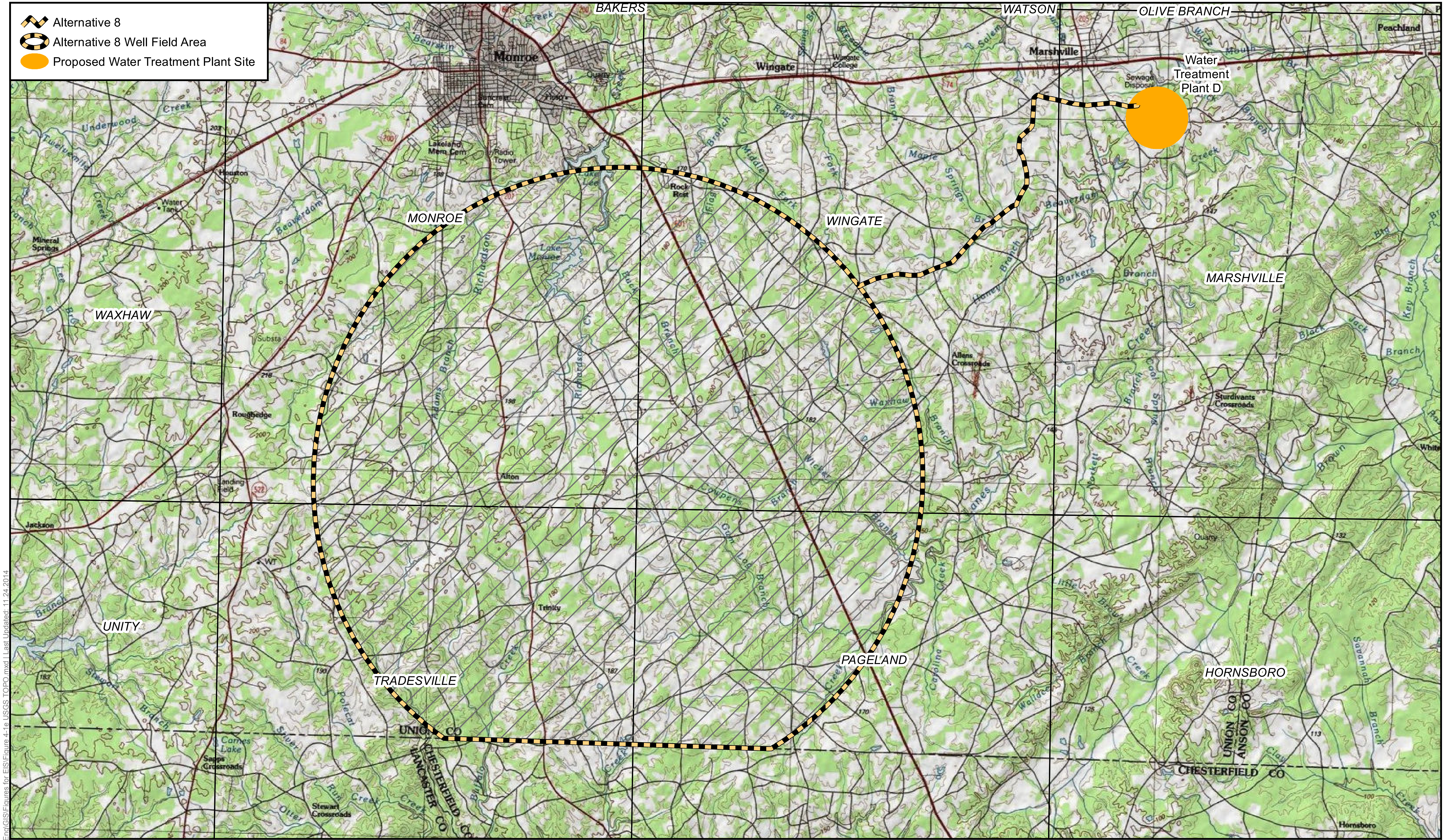
SCALE

0 0.25 0.5 1 1.5

miles

1 inch = 0.5 mile

Figure 4-1d:
USGS Topographic Quadrangle Maps
Alternative 7
Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 0.75 1.5 3 4.5

miles

1 inch = 1.5 miles

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Figure 4-1e:
USGS Topographic Quadrangle Maps
Alternative 8
Yadkin River Water Supply Project
Union County, North Carolina

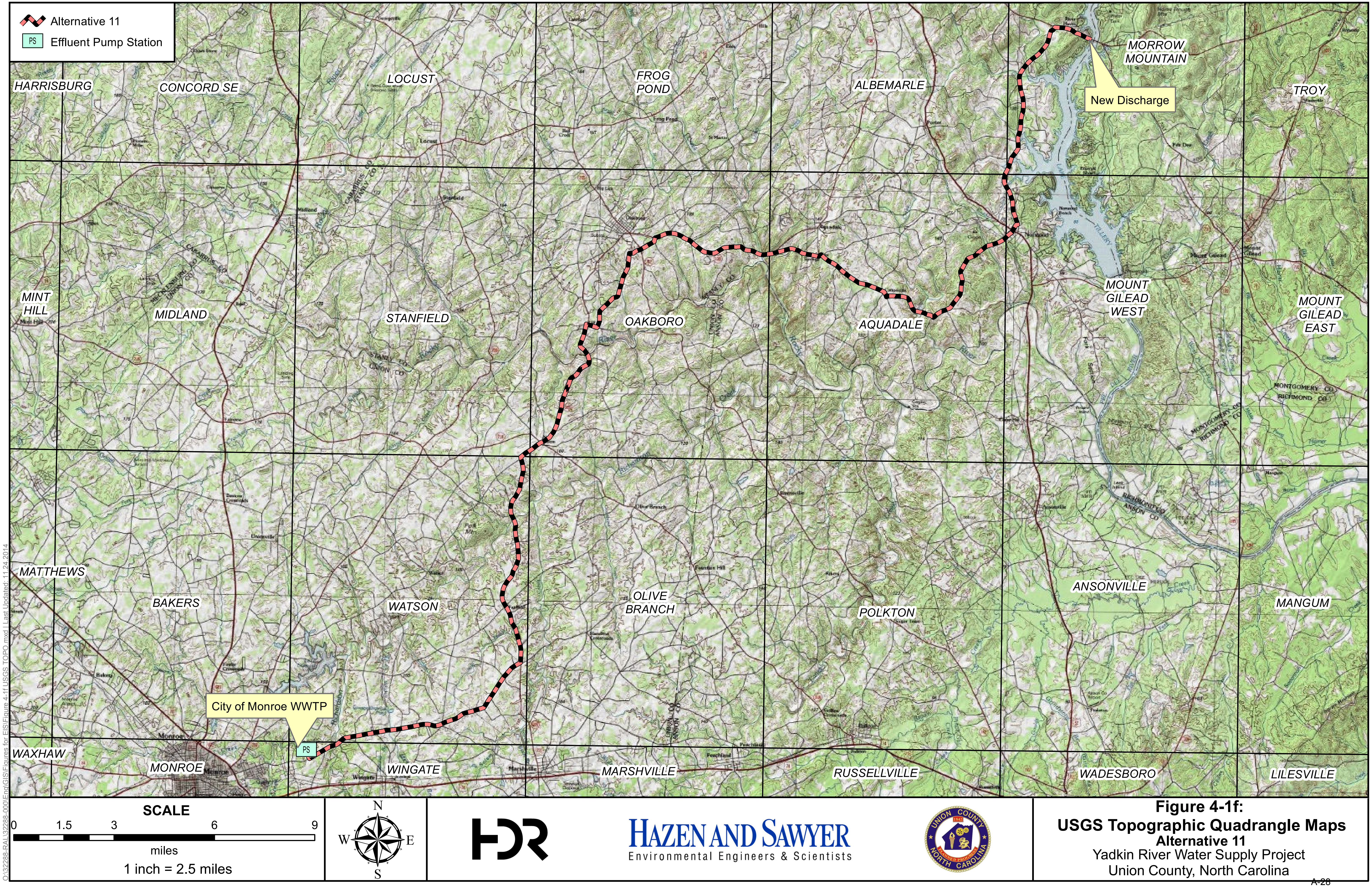

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Figure 4-1f:
USGS Topographic Quadrangle Maps
Alternative 11
Yadkin River Water Supply Project
Union County, North Carolina

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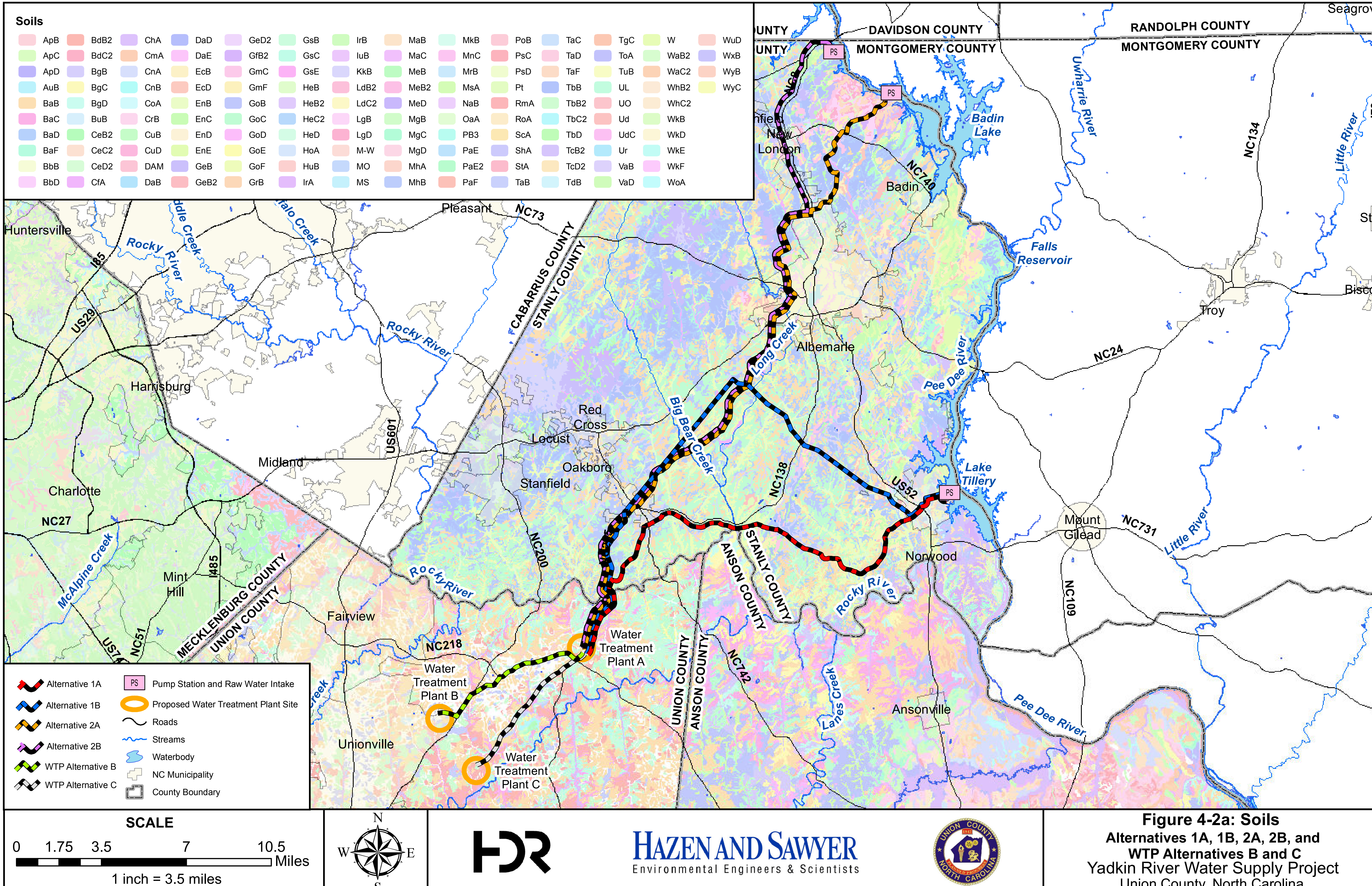

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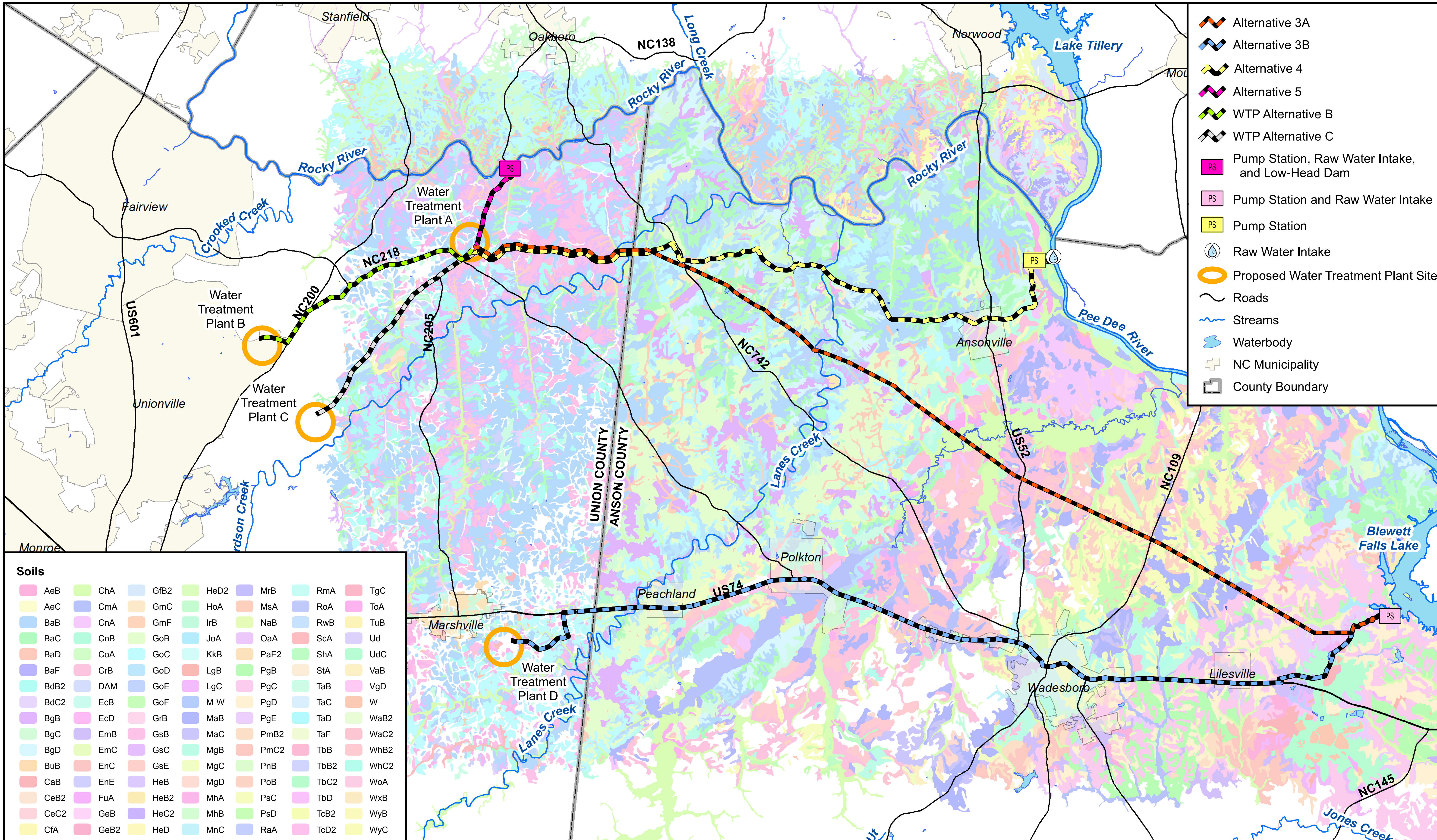
Figure 4-2a: Soils
Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives B and C
Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 1.25 2.5 5 7.5

miles

1 inch = 2.5 miles

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Figure 4-2b: Soils
Alternatives 3A, 3B, 4, 5, and
WTP Alternatives B and C
Yadkin River Water Supply Project
Union County, North Carolina

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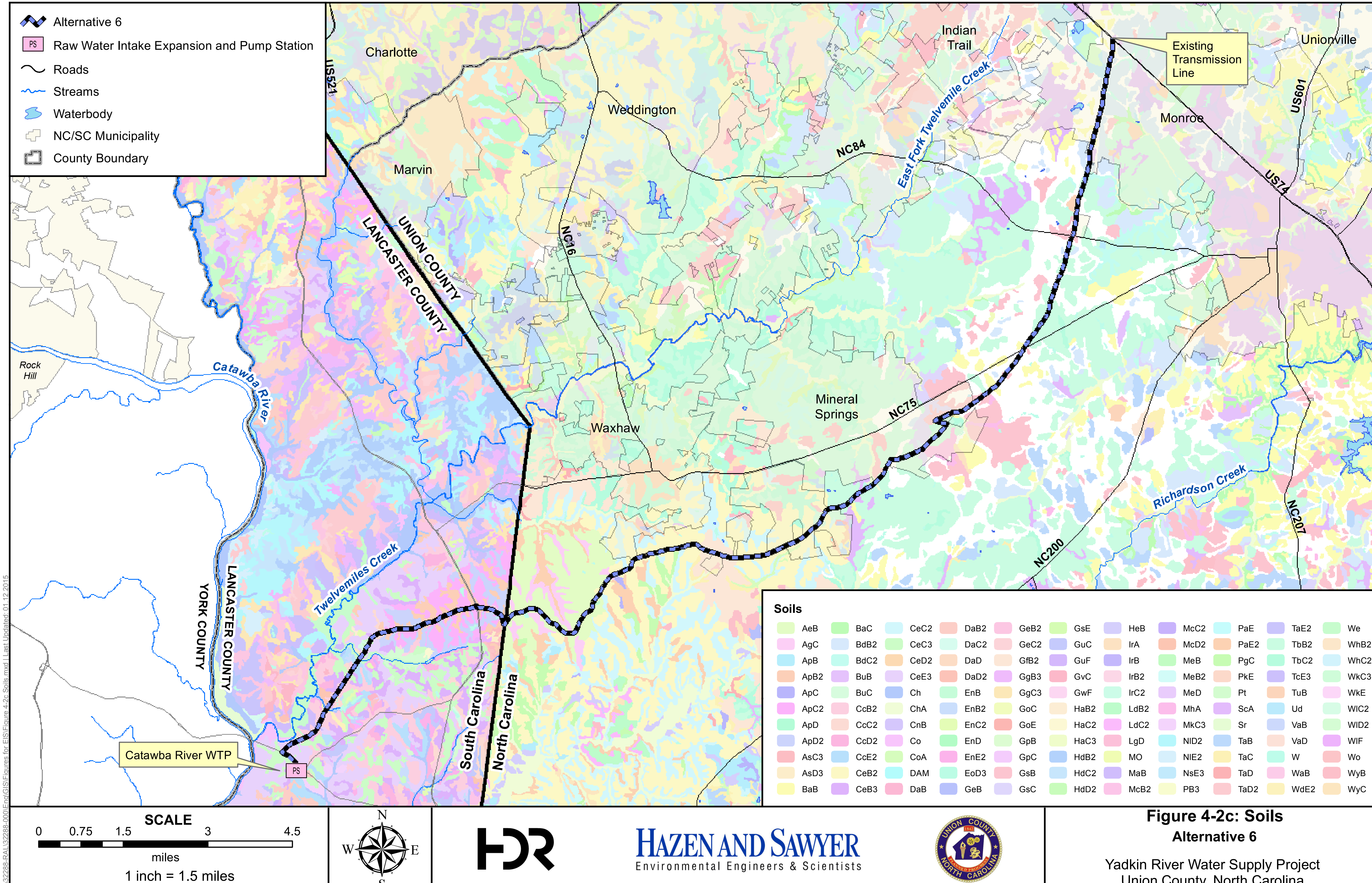

Figure 4-2c: Soils
Alternative 6

Yadkin River Water Supply Project
Union County, North Carolina

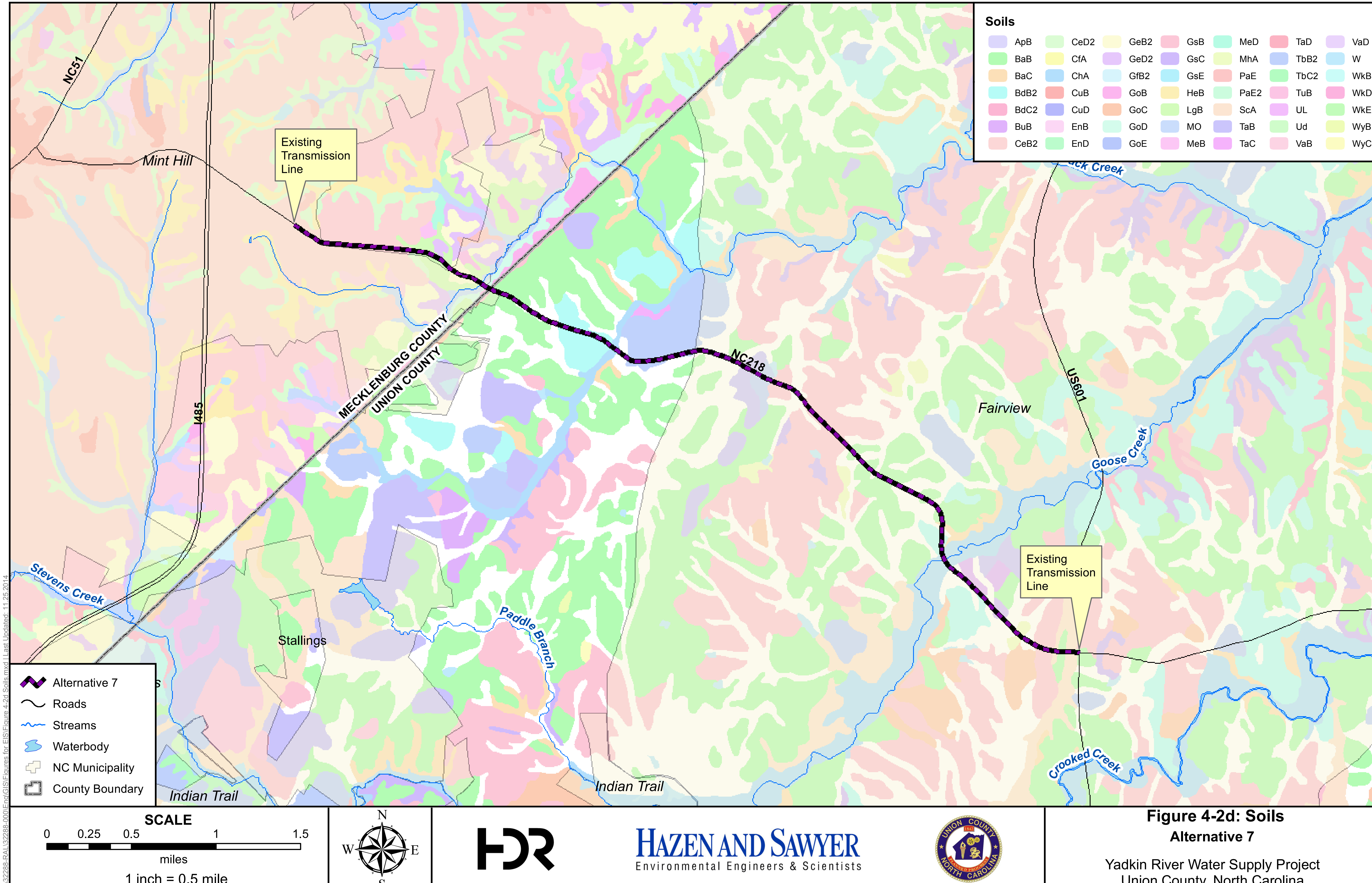

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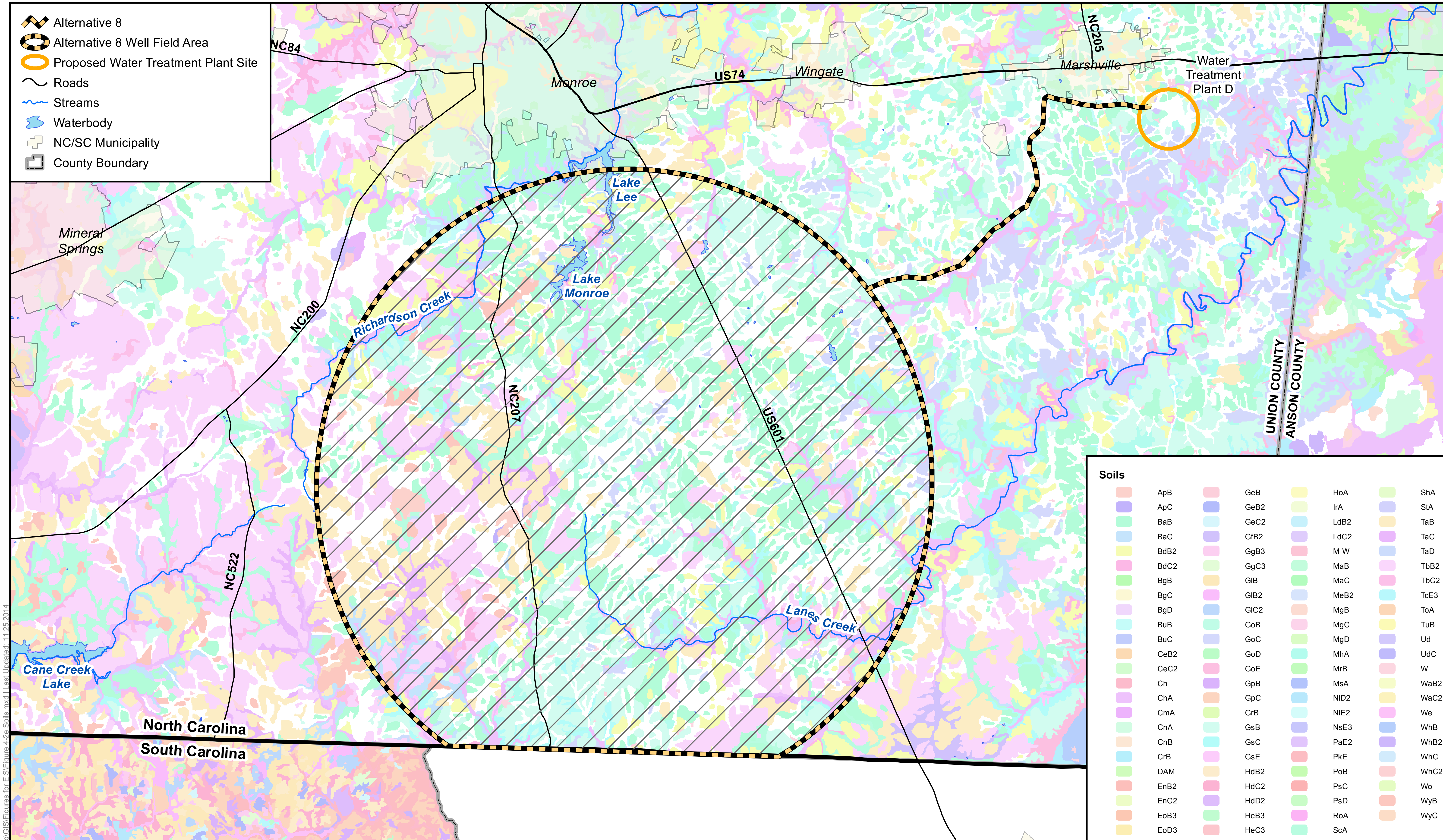
Figure 4-2d: Soils
Alternative 7

Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 0.75 1.5 3 4.5

miles

1 inch = 1.5 miles

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Figure 4-2e: Soils

Alternative 8

Yadkin River Water Supply Project
Union County, North Carolina

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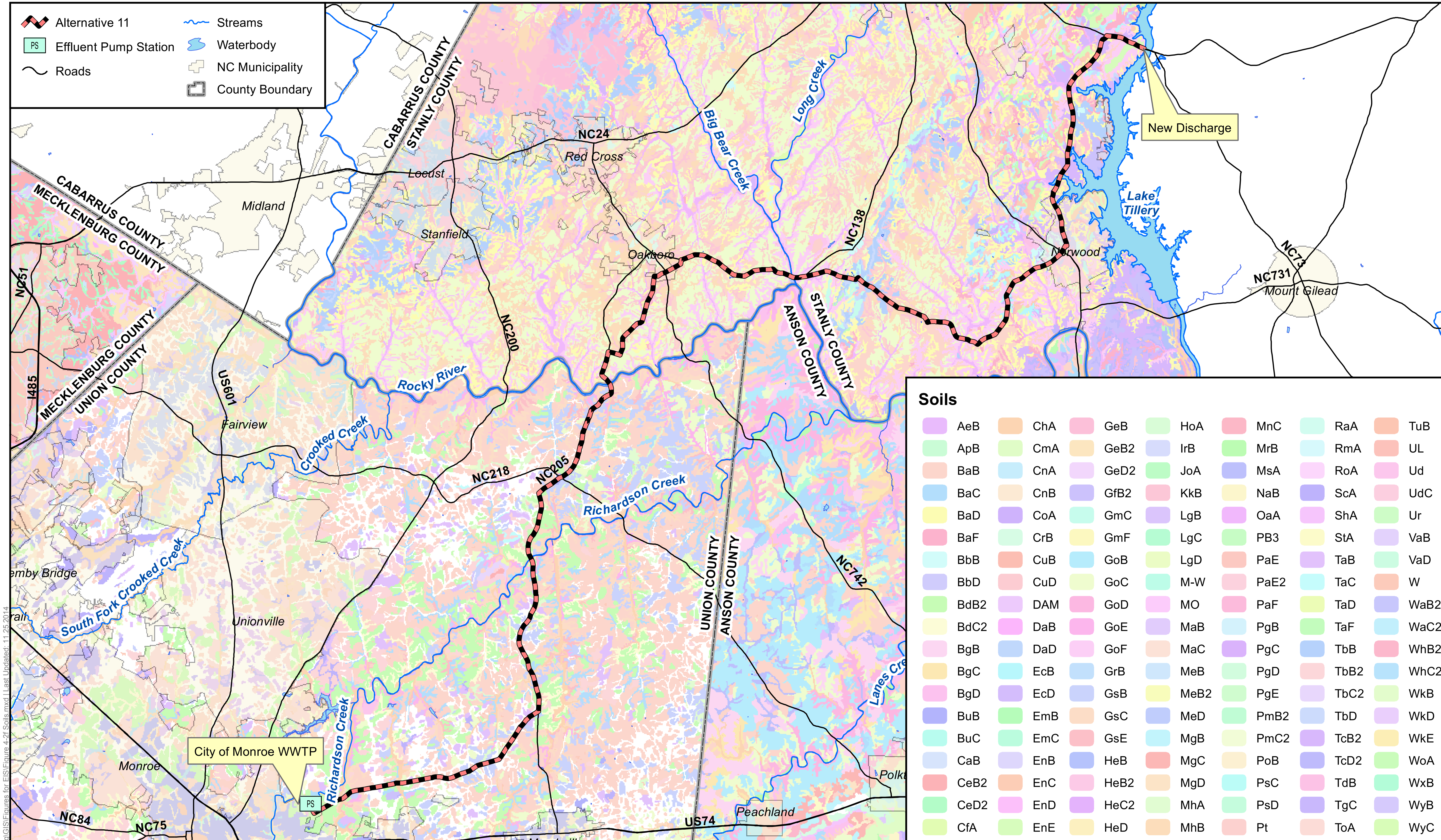

SCALE

0 1.5 3 6 9

miles

1 inch = 2.5 miles

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Figure 4-2f: Soils

Alternative 11

Yadkin River Water Supply Project
Union County, North Carolina

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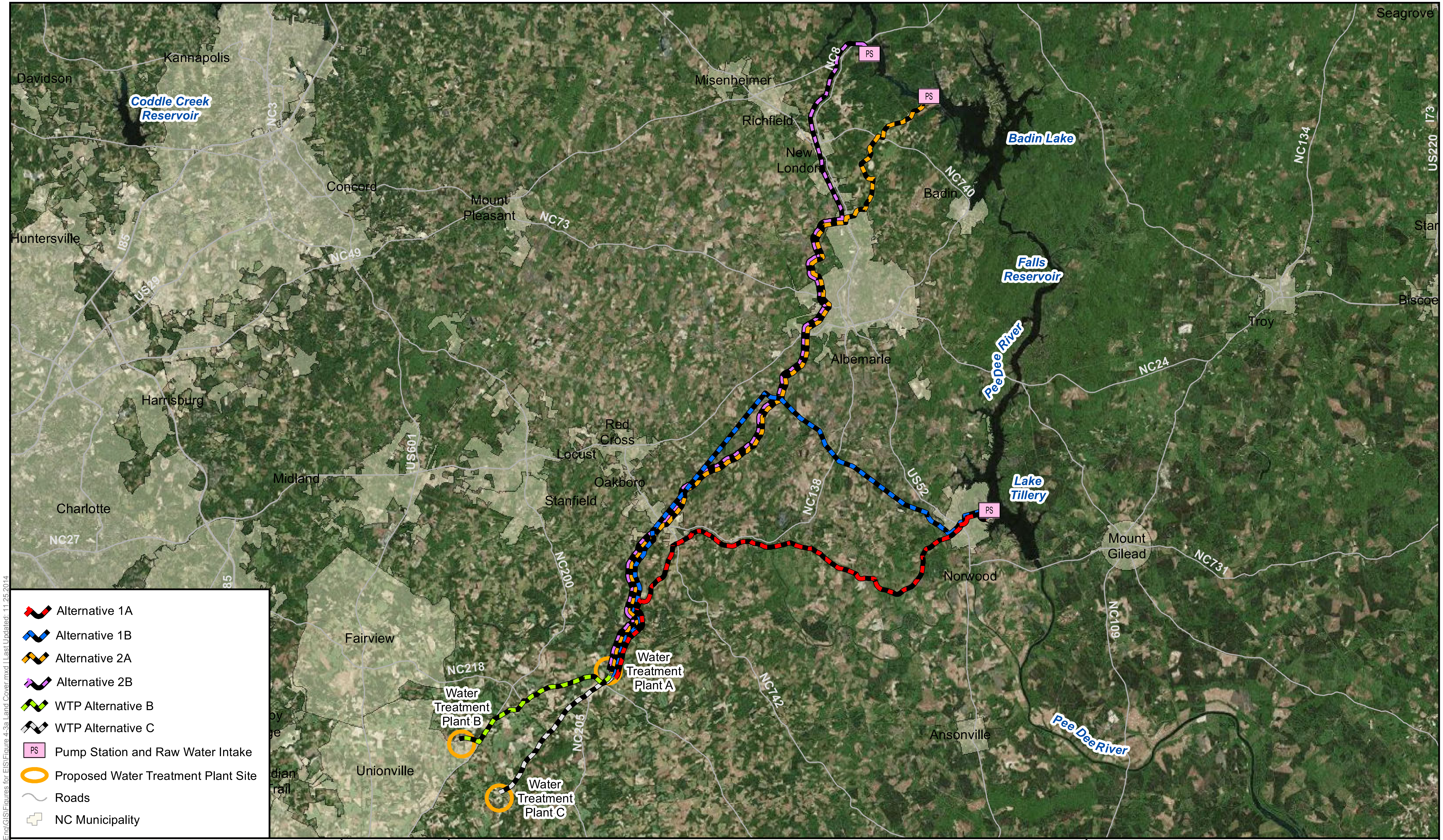

SCALE

0 1.75 3.5 7 10.5

miles

1 inch = 3.5 miles

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Figure 4-3a: Land Cover

Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives B and C

Yadkin River Water Supply Project
Union County, North Carolina

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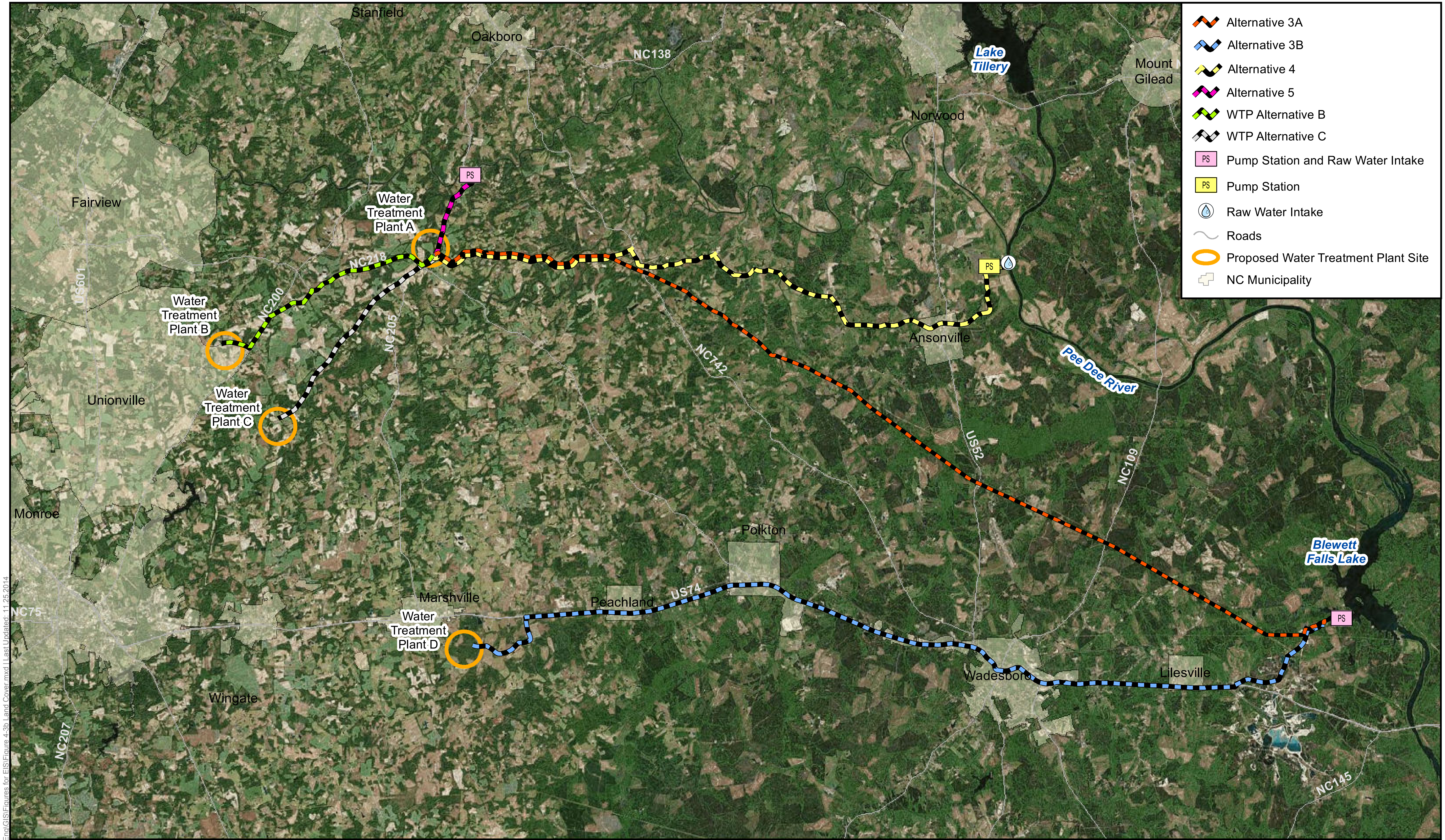

SCALE

0 1.5 3 6 9

miles

1 inch = 3 miles

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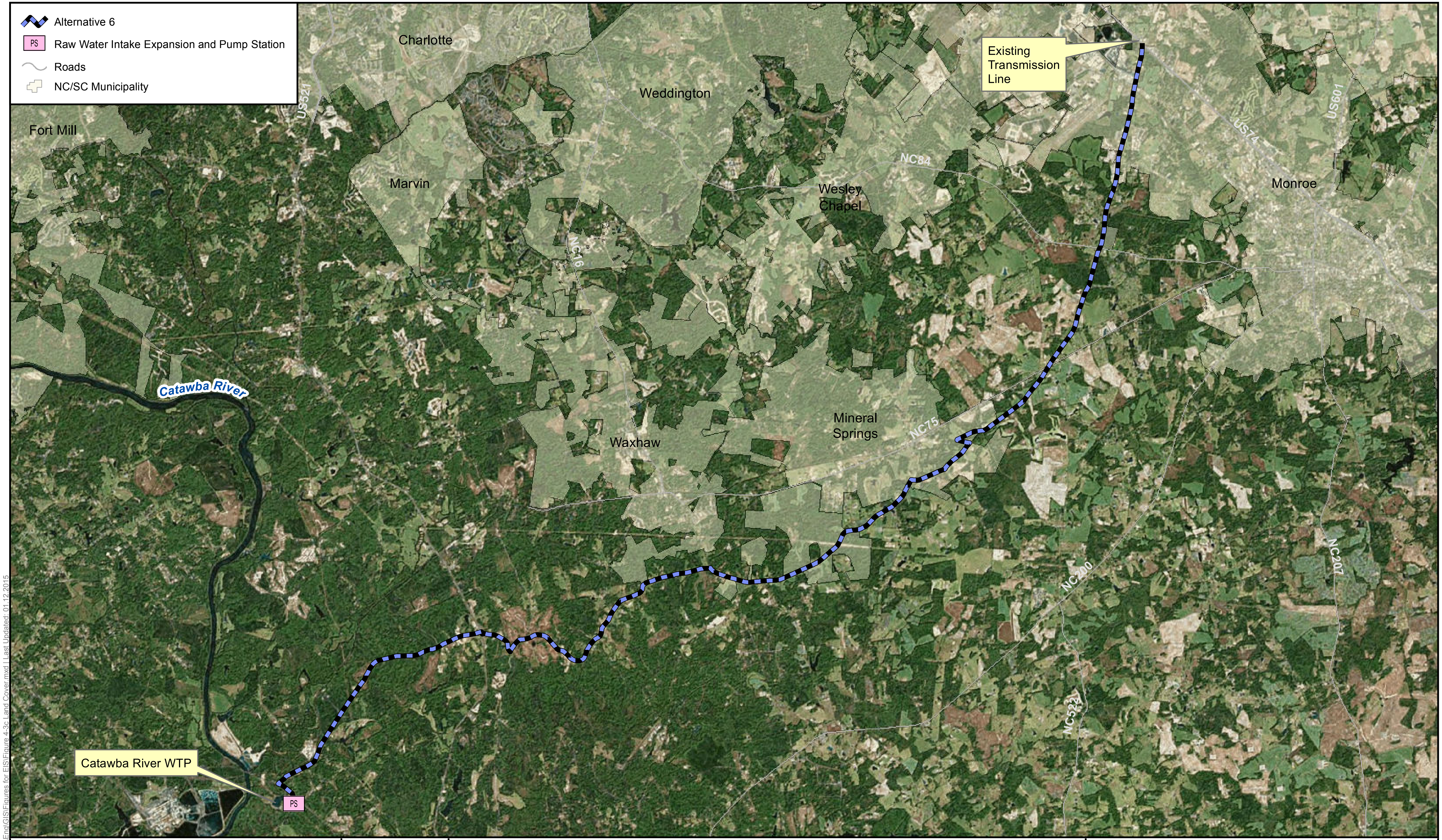
Figure 4-3b: Land Cover

Alternatives 3A, 3B, 4, 5, and WTP Alternatives B and C

Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 0.75 1.5 3 4.5

miles

1 inch = 1.5 miles

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Figure 4-3c: Land Cover

Alternative 6

Yadkin River Water Supply Project
Union County, North Carolina

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Figure 4-3d: Land Cover

Alternative 7

Yadkin River Water Supply Project
Union County, North Carolina

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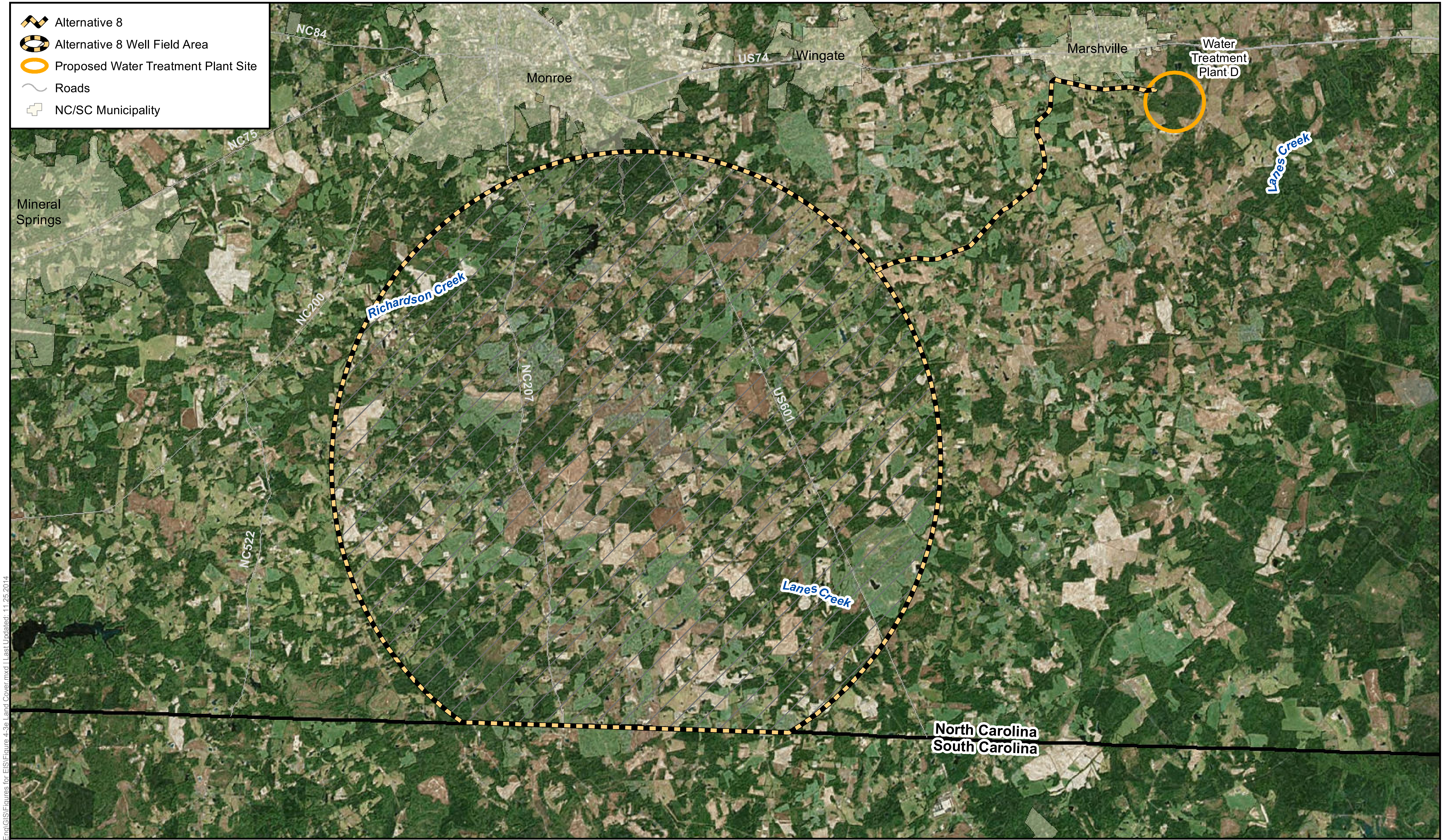

SCALE

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miles

1 inch = 1.5 miles

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Figure 4-3e: Land Cover

Alternative 8

Yadkin River Water Supply Project
Union County, North Carolina

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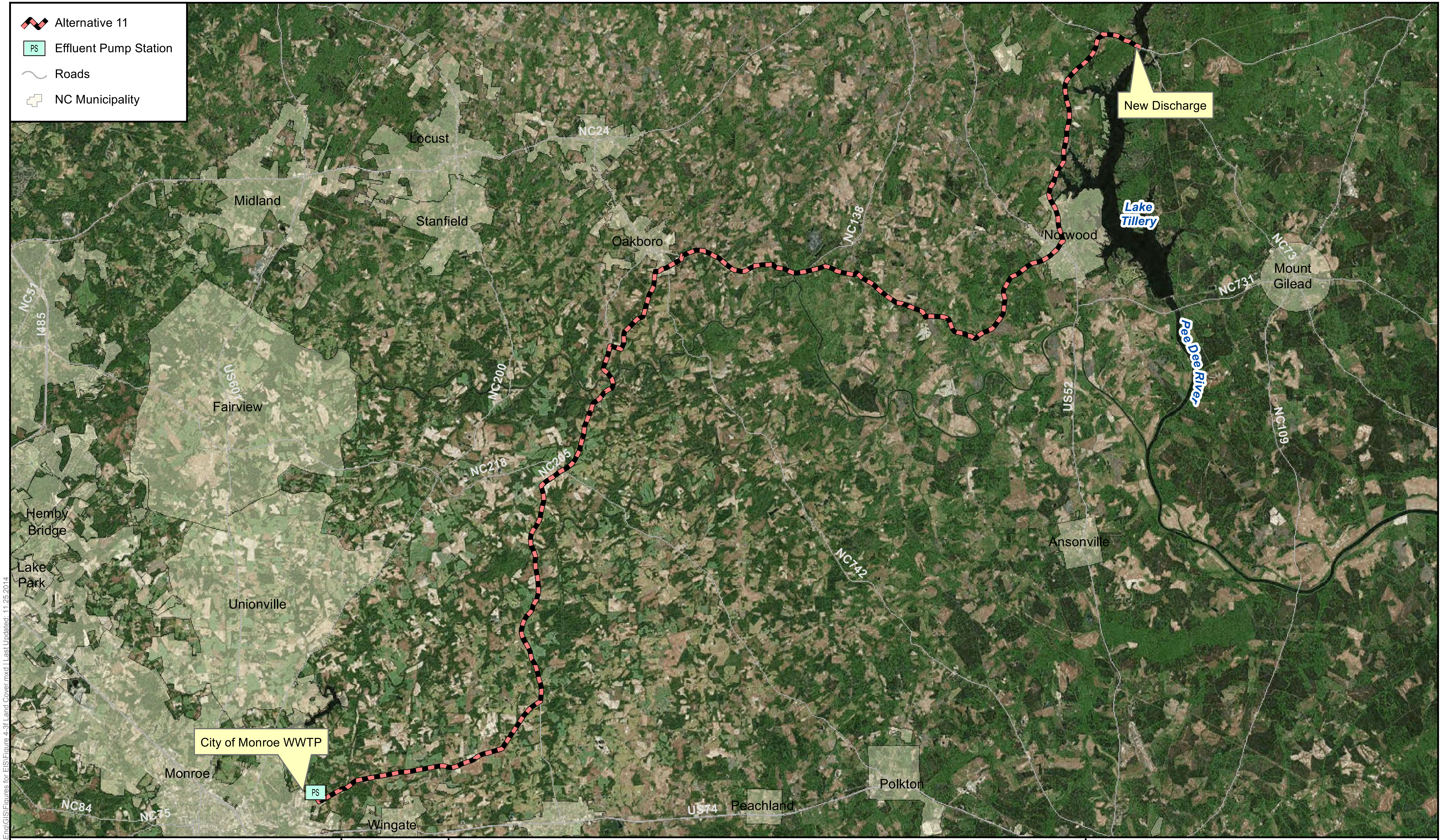

SCALE

0 1.5 3 6 9

miles

1 inch = 2.5 miles

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Figure 4-3f: Land Cover

Alternative 11

Yadkin River Water Supply Project
Union County, North Carolina

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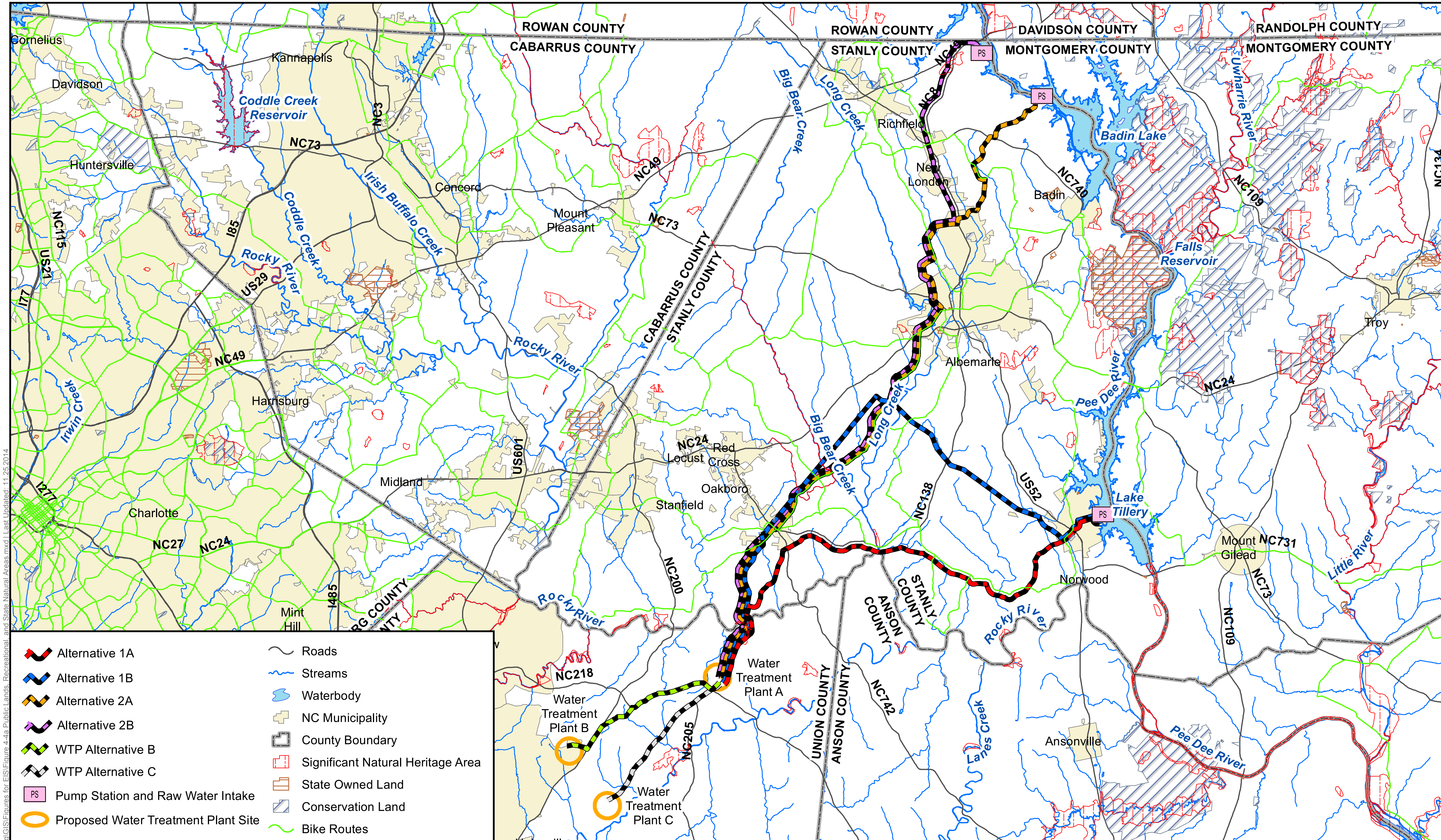

SCALE

0 1.75 3.5 7 10.5

miles

1 inch = 3.5 miles

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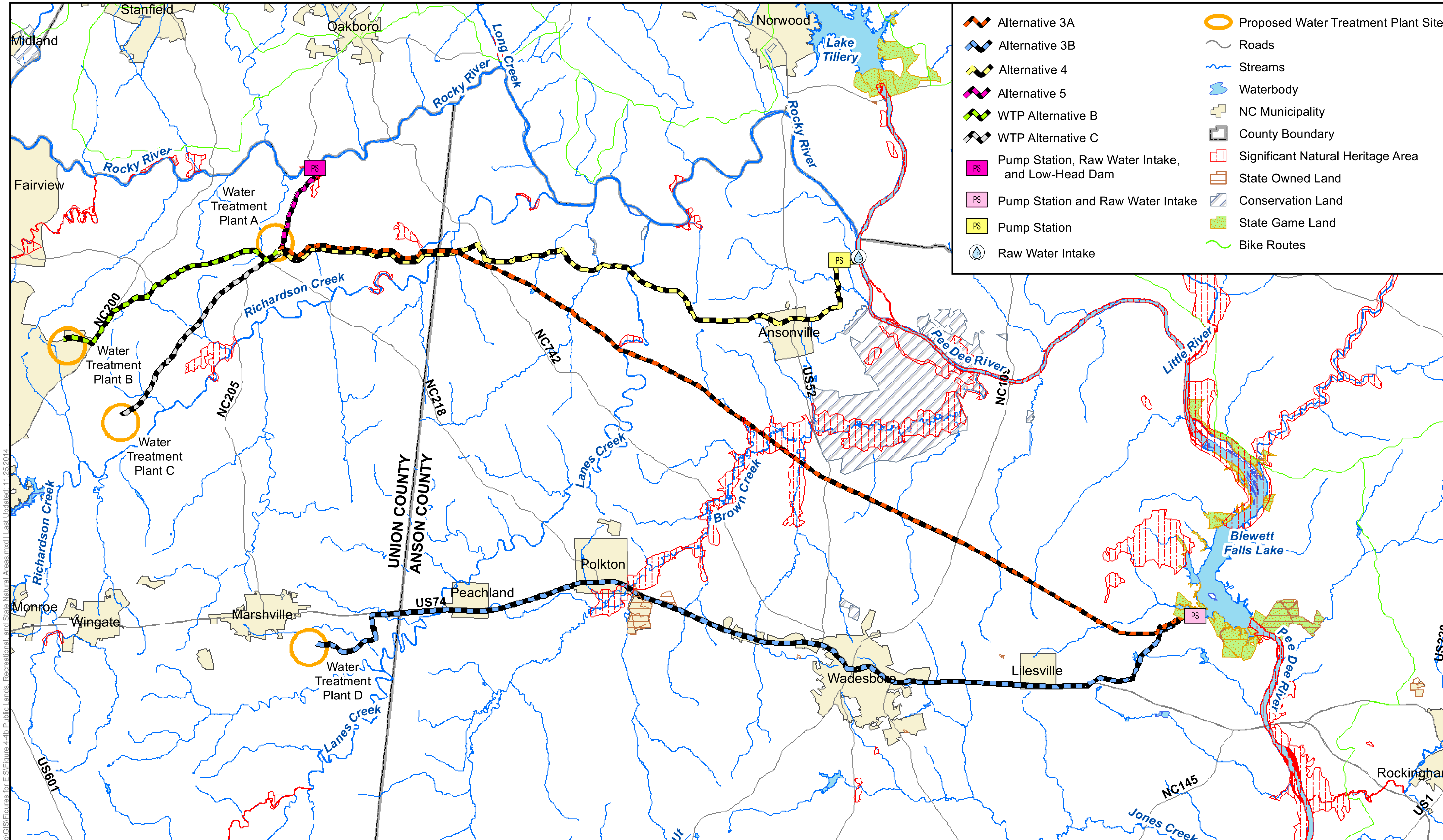
Figure 4-4a: Public Lands, Recreational, and State Natural Areas

Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives B and C

Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 1.5 3 6 9

miles

1 inch = 2.5 miles

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Figure 4-4b: Public Lands, Recreational, and State Natural Areas

Alternatives 3A, 3B, 4, 5, and WTP Alternatives B and C

Yadkin River Water Supply Project
Union County, North Carolina

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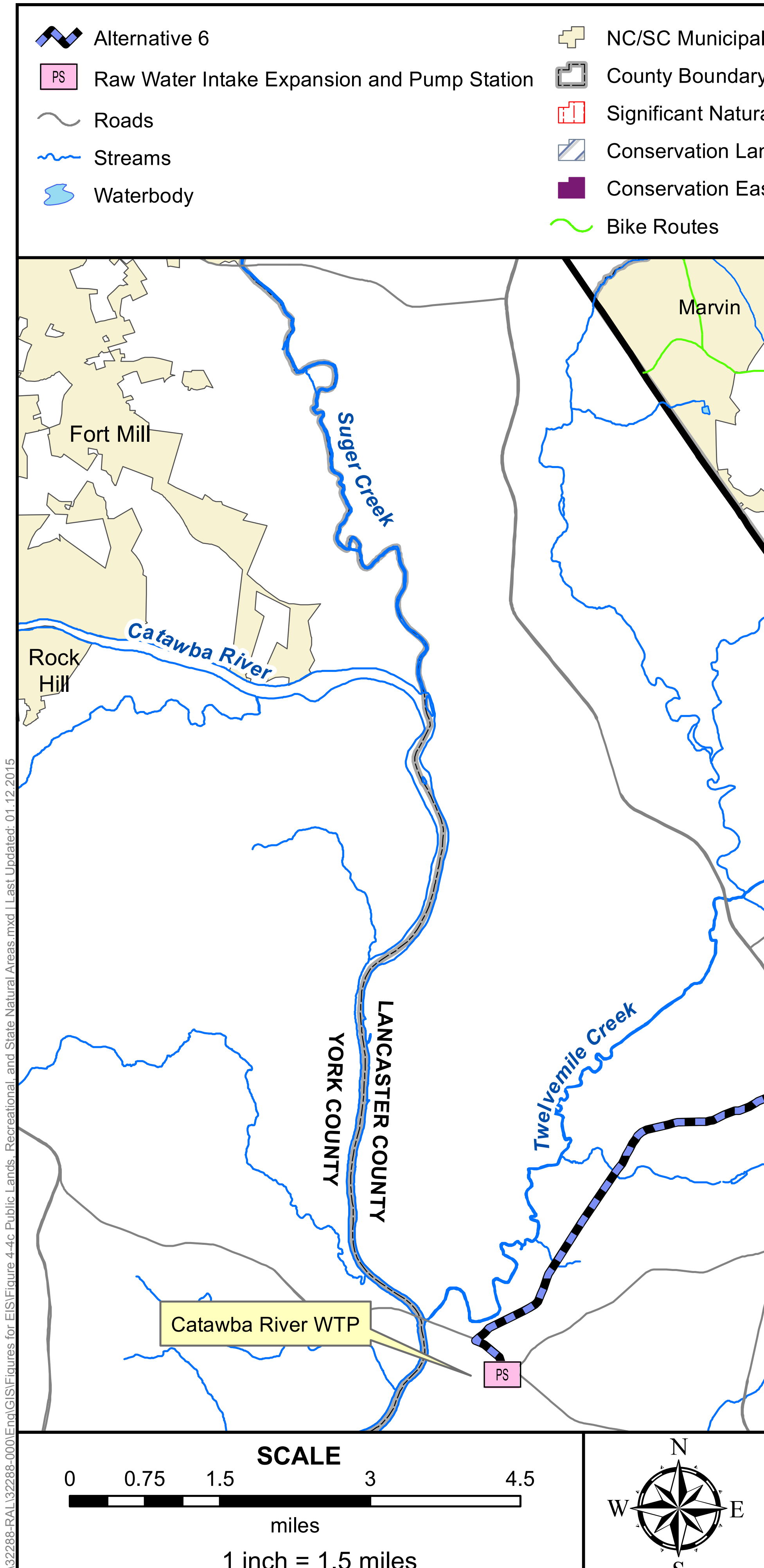

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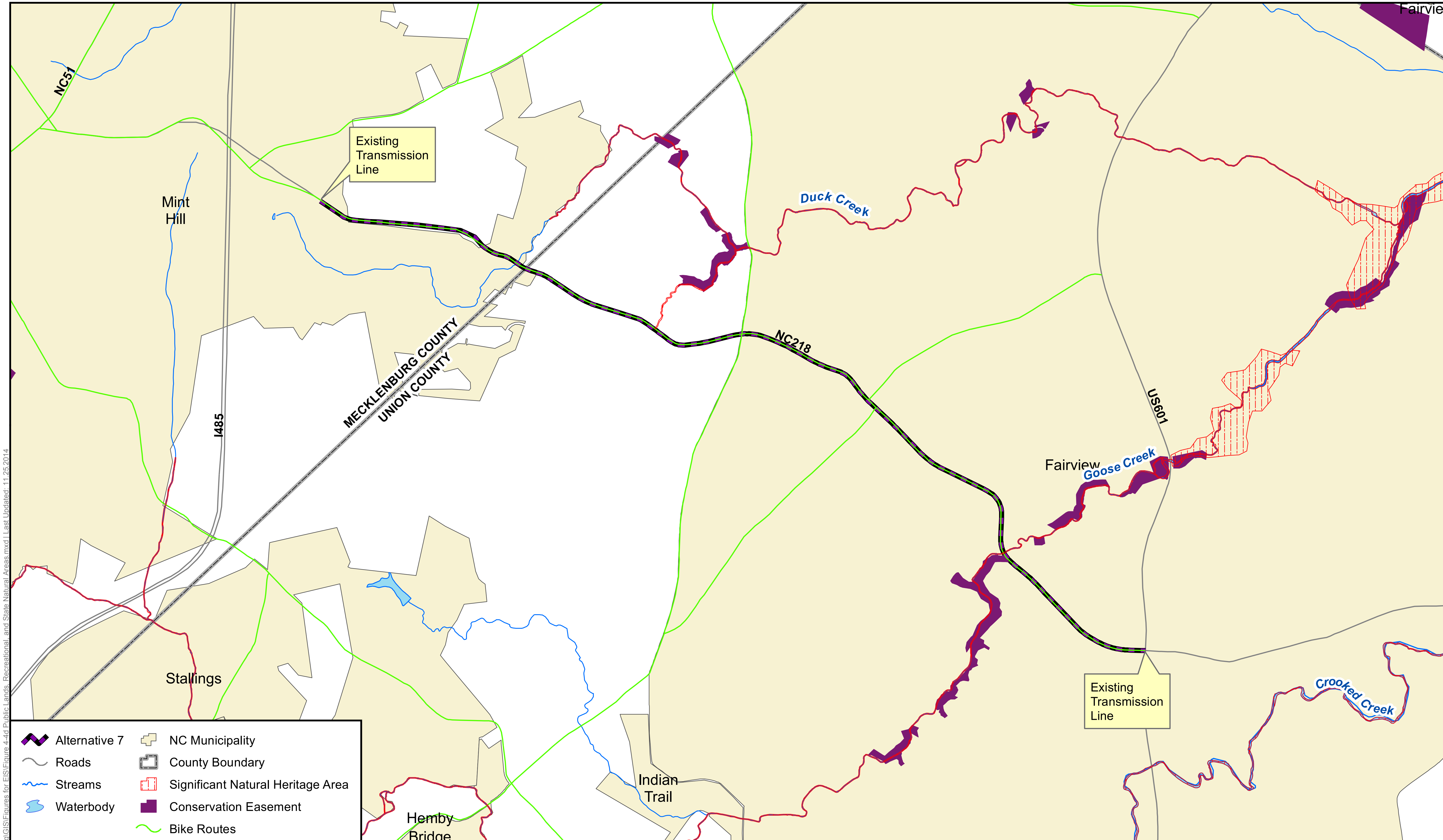
Figure 4-4c: Public Lands, Recreational, and State Natural Areas

Alternative 6

Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 0.275 0.55 1.1 1.65

miles

1 inch = 0.5 mile

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Figure 4-4d: Public Lands, Recreational, and State Natural Areas

Alternative 7

Yadkin River Water Supply Project
Union County, North Carolina

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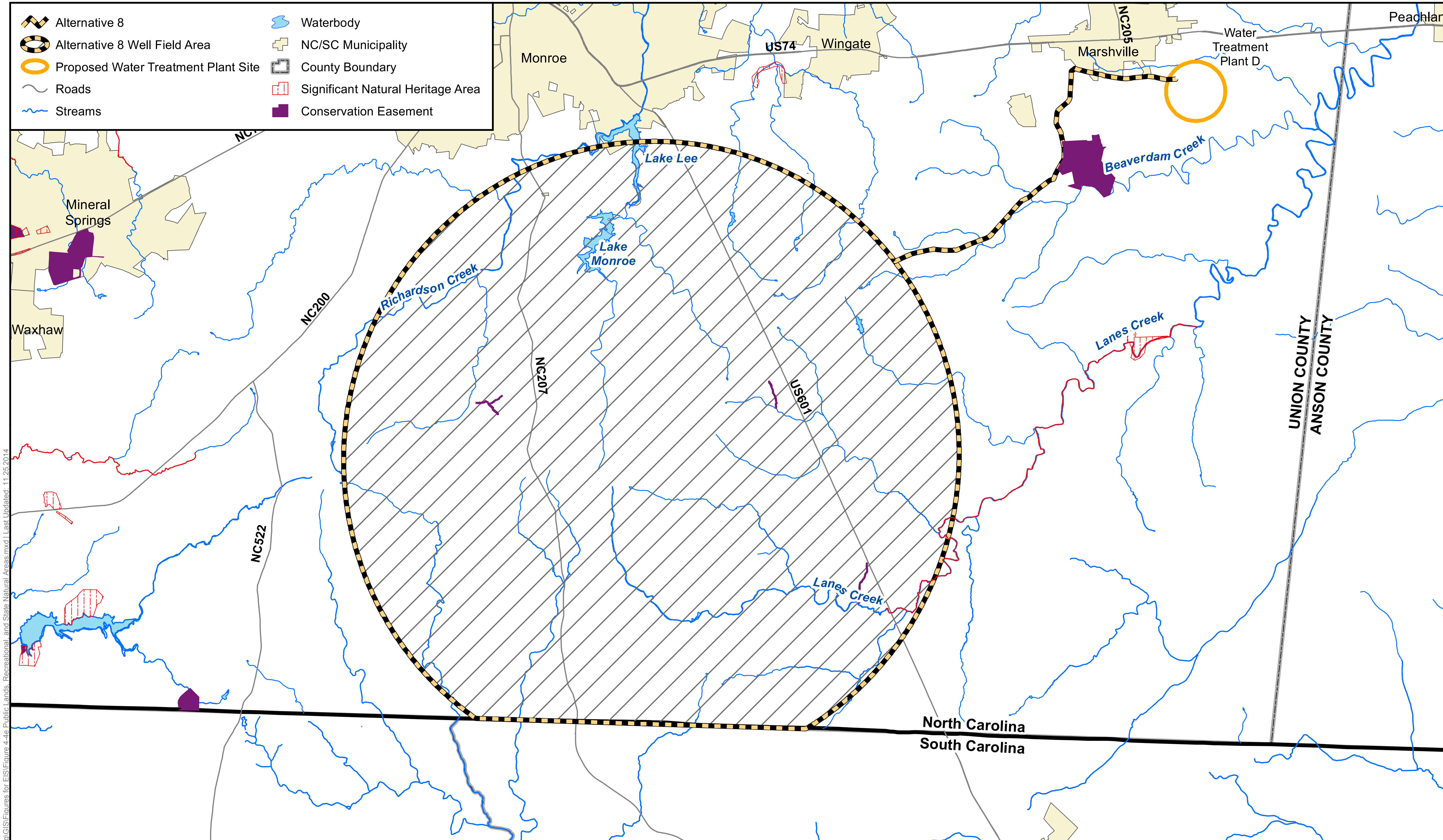

SCALE
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miles
1 inch = 1.5 miles

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Figure 4-4e: Public Lands, Recreational, and State Natural Areas
Alternative 8
Yadkin River Water Supply Project
Union County, North Carolina

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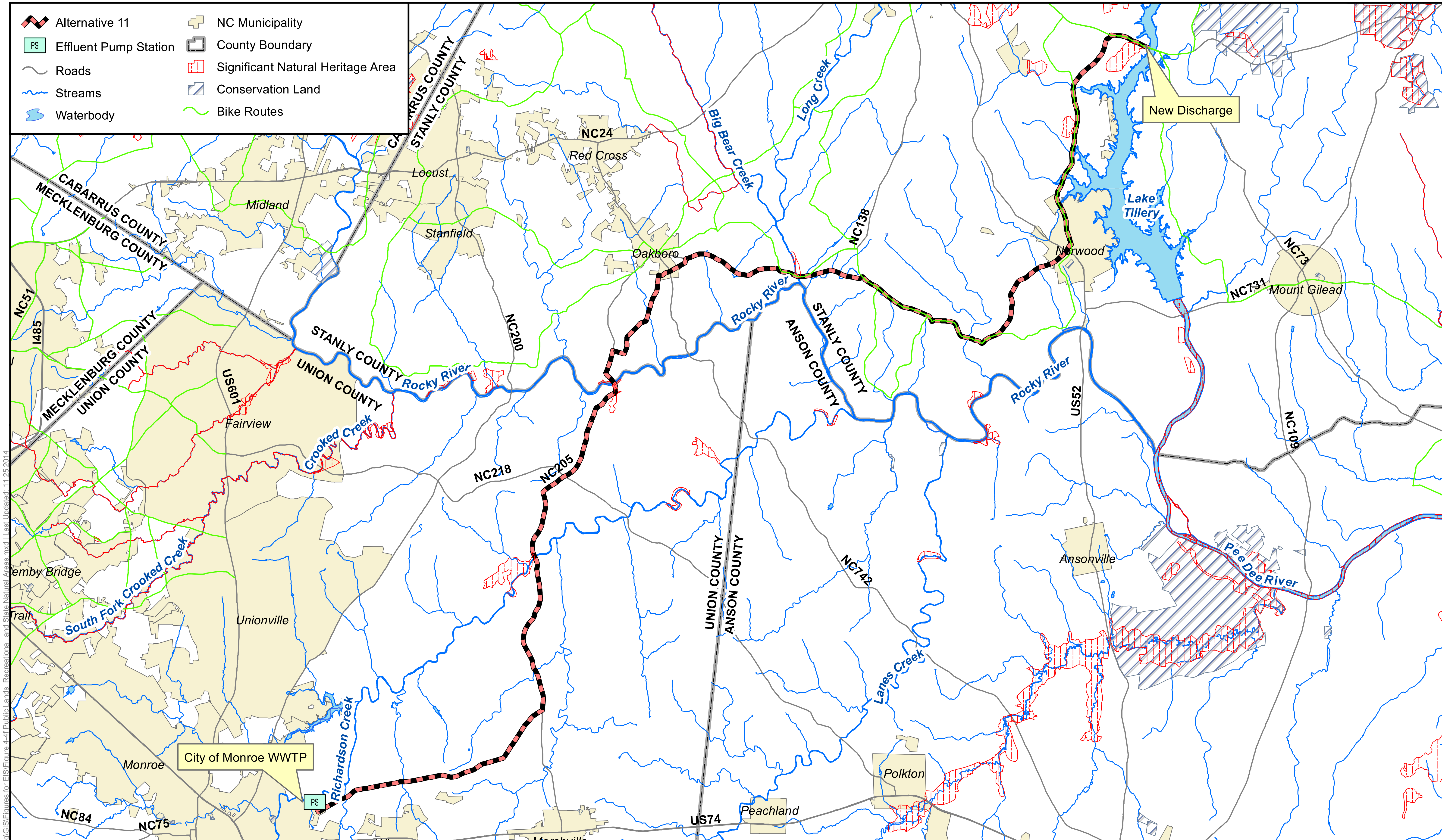

SCALE

0 1.5 3 6 9

miles

1 inch = 2.5 miles

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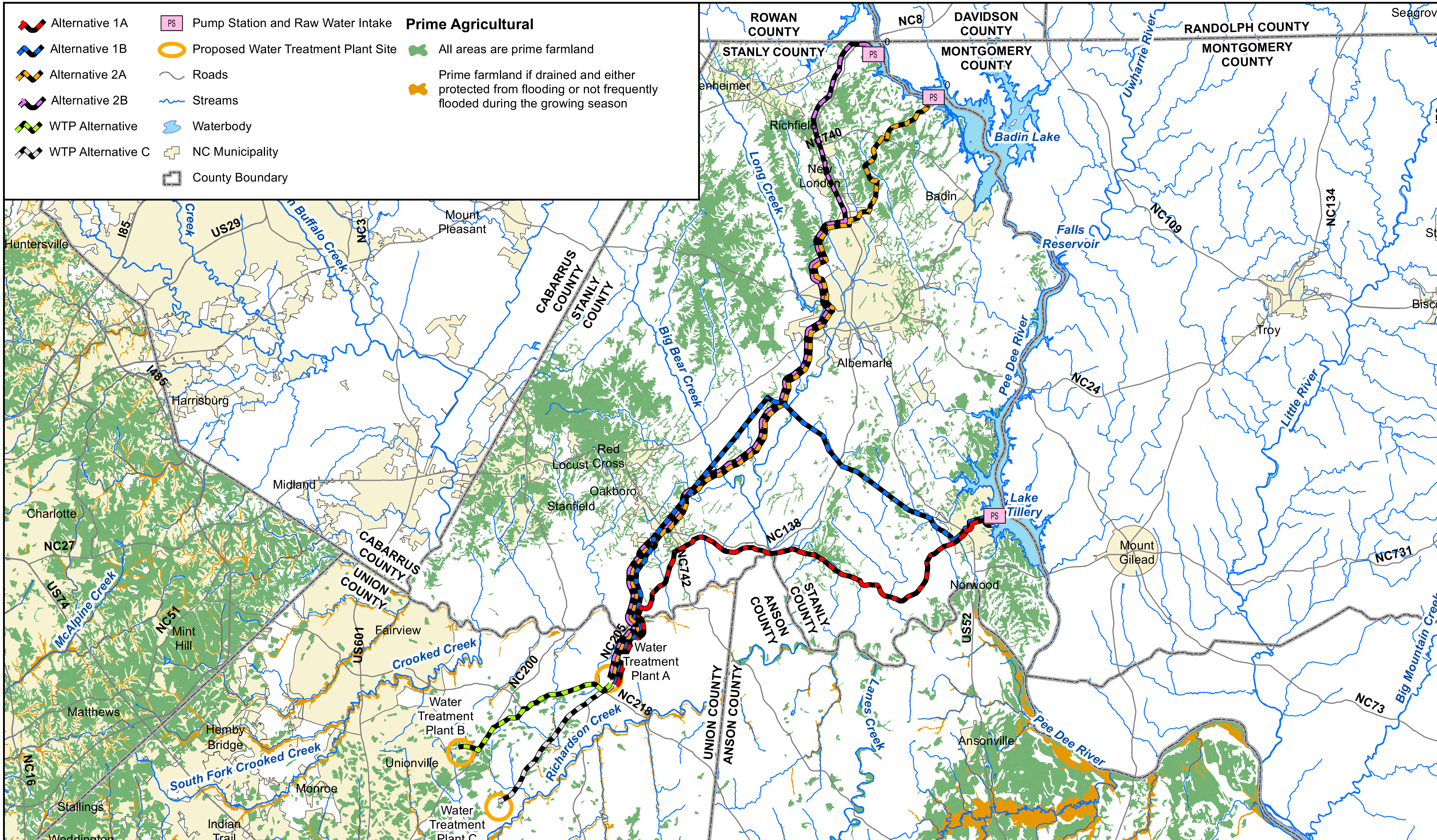
Figure 4-4f: Public Lands, Recreational, and State Natural Areas

Alternative 11

Yadkin River Water Supply Project

Union County, North Carolina



SCALE

0 1.75 3.5 7 10.5 Miles

1 inch = 3.5 miles

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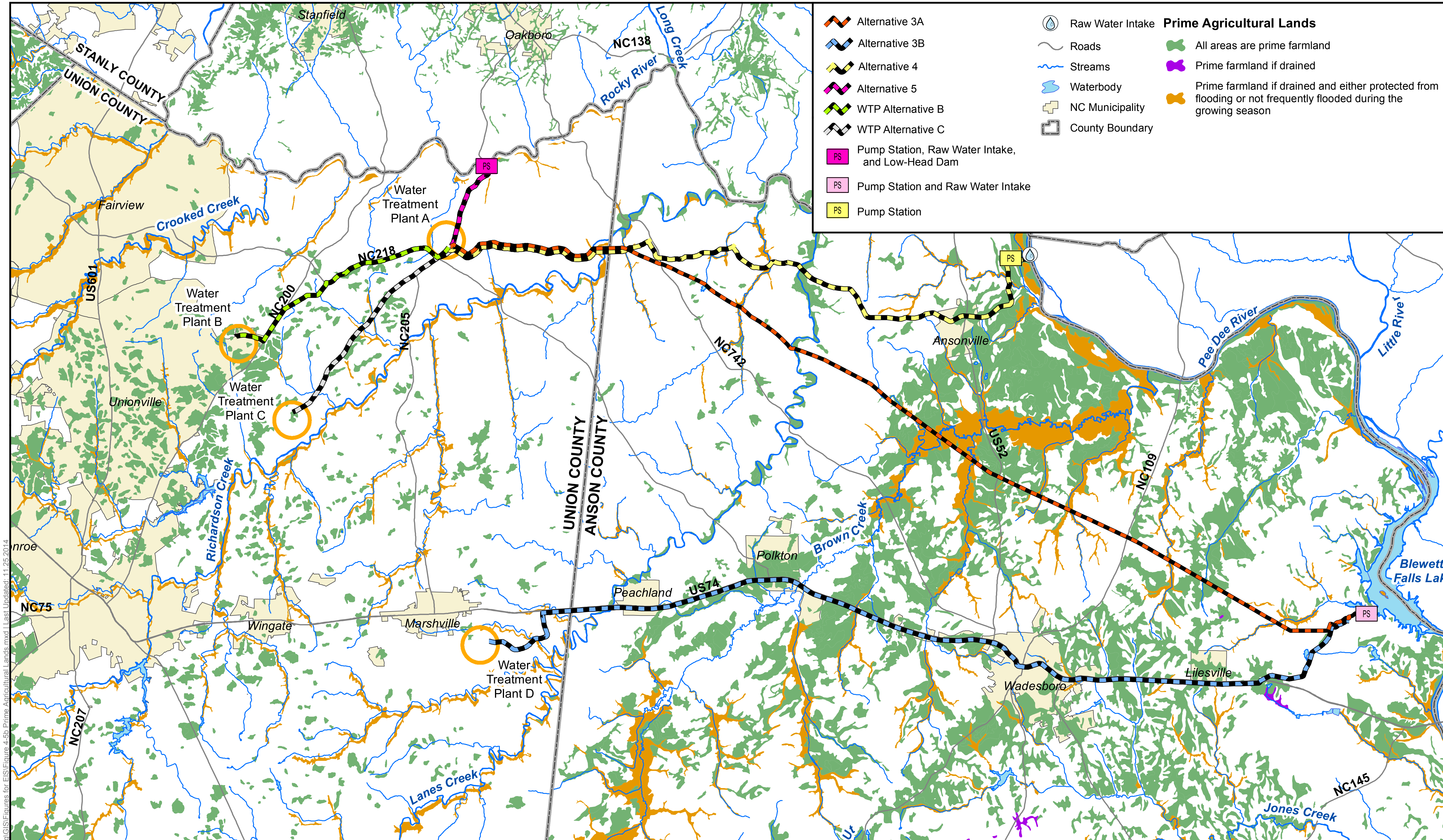
Figure 4-5a:
Prime Agricultural Lands
Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives B and C
Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 1.25 2.5 5 7.5

miles

1 inch = 2.5 miles

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Figure 4-5b:
Prime Agricultural Lands
Alternatives 3A, 3B, 4, 5, and WTP Alternatives B and C
Yadkin River Water Supply Project
Union County, North Carolina

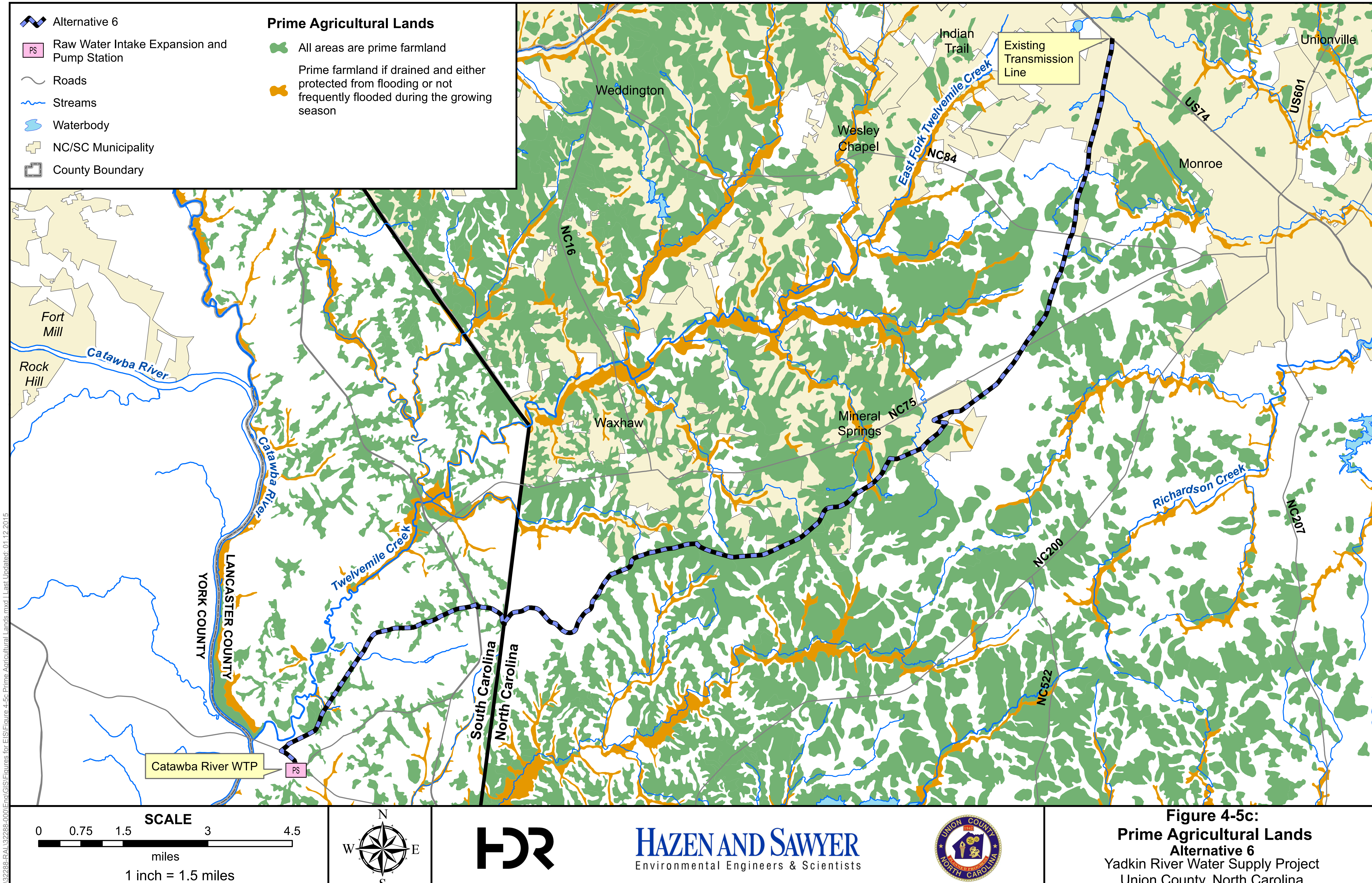

Figure 4-5c: Prime Agricultural Lands
Alternative 6
Yadkin River Water Supply Project
Union County, North Carolina

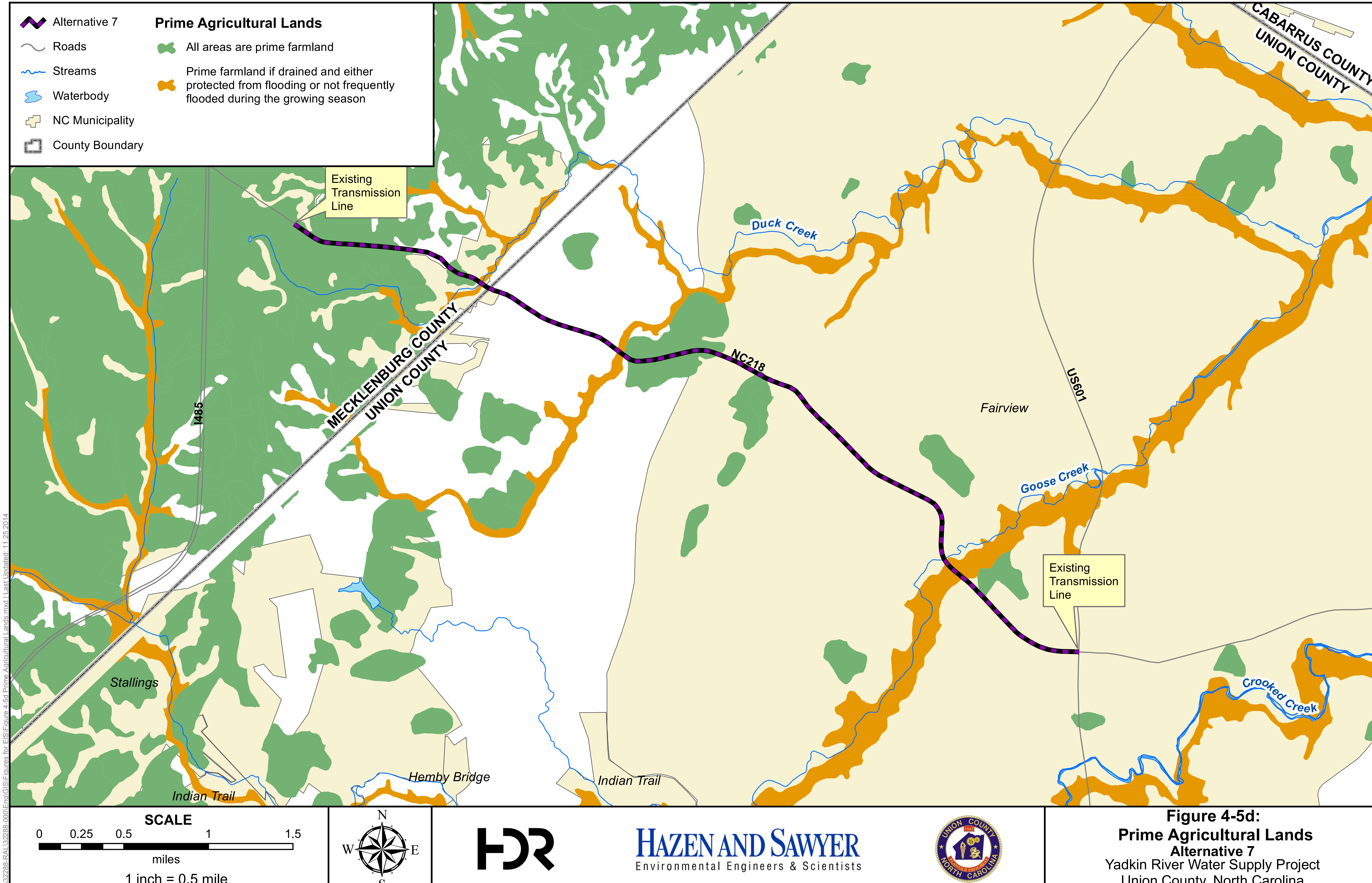

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Figure 4-5d:
Prime Agricultural Lands
Alternative 7
Yadkin River Water Supply Project
Union County, North Carolina

A-50

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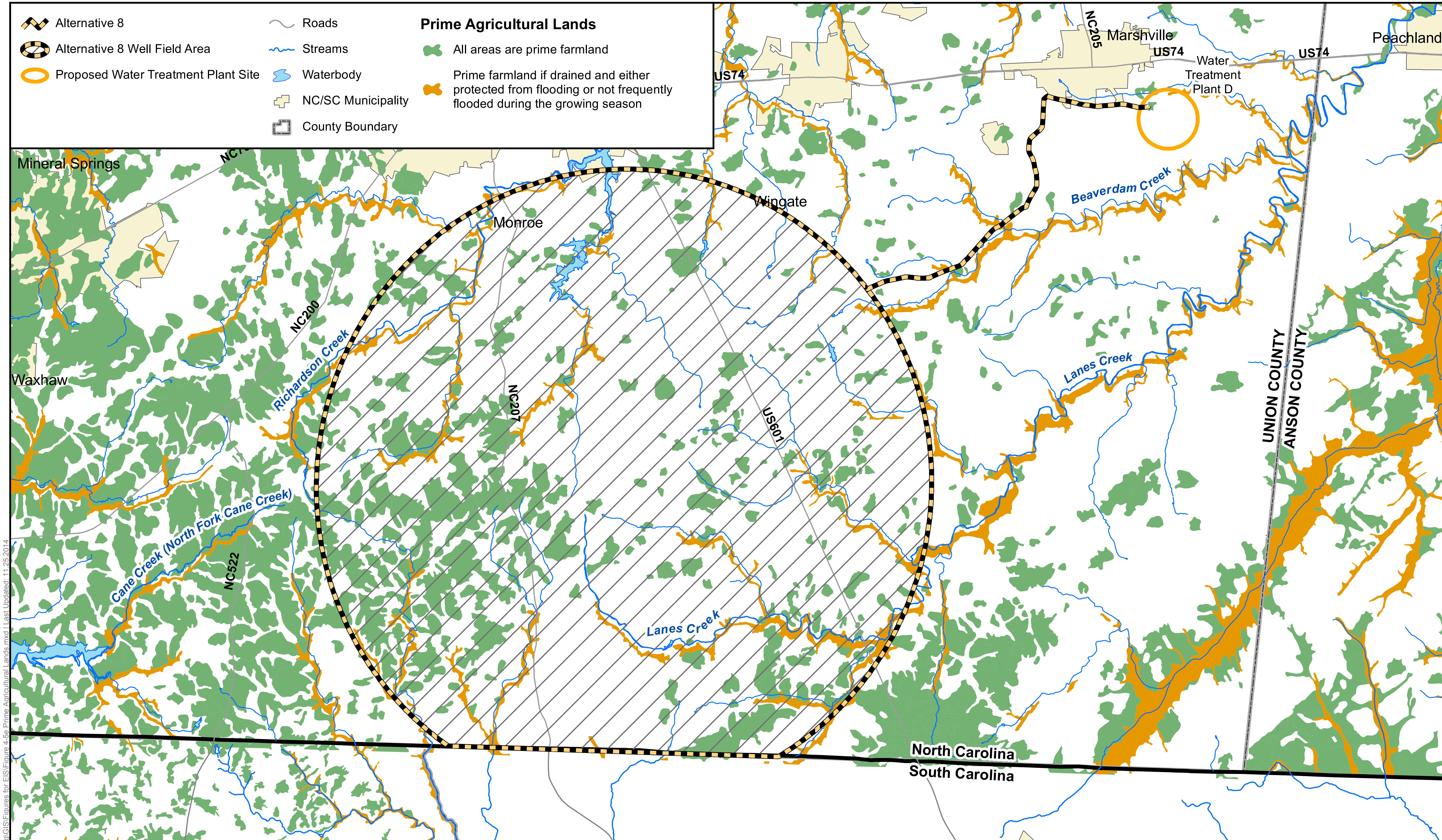

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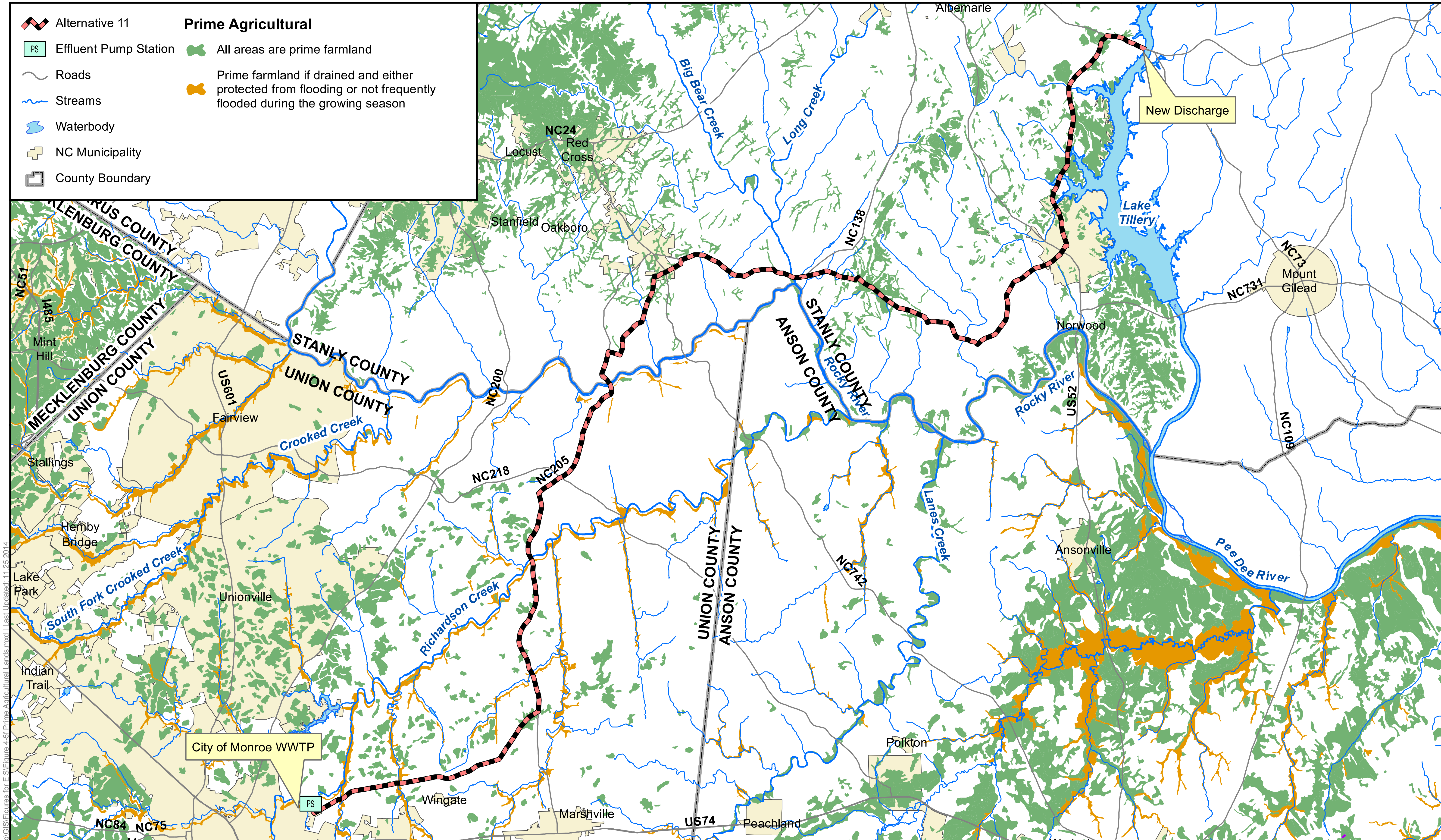
Figure 4-5e:
Prime Agricultural Lands
Alternative 8
Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 1.5 3 6 9

miles

1 inch = 2.5 miles

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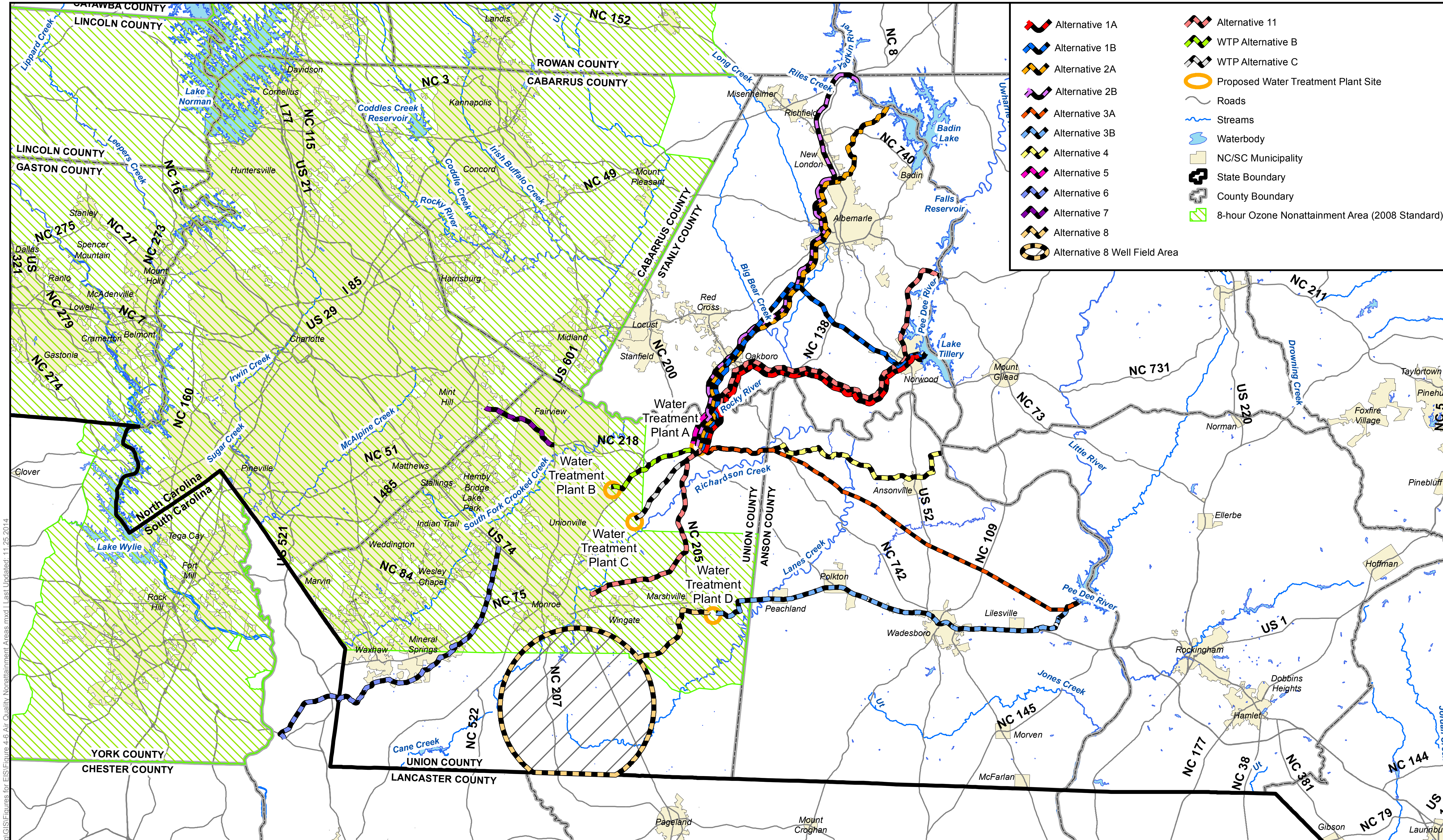
Figure 4-5f:
Prime Agricultural Lands
Alternative 11
Yadkin River Water Supply Project
Union County, North Carolina



SCALE

0 3 6 12 18

miles

1 inch = 6 miles

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Figure 4-6: Air Quality Nonattainment Areas

Yadkin River Water Supply Project
Union County, North Carolina

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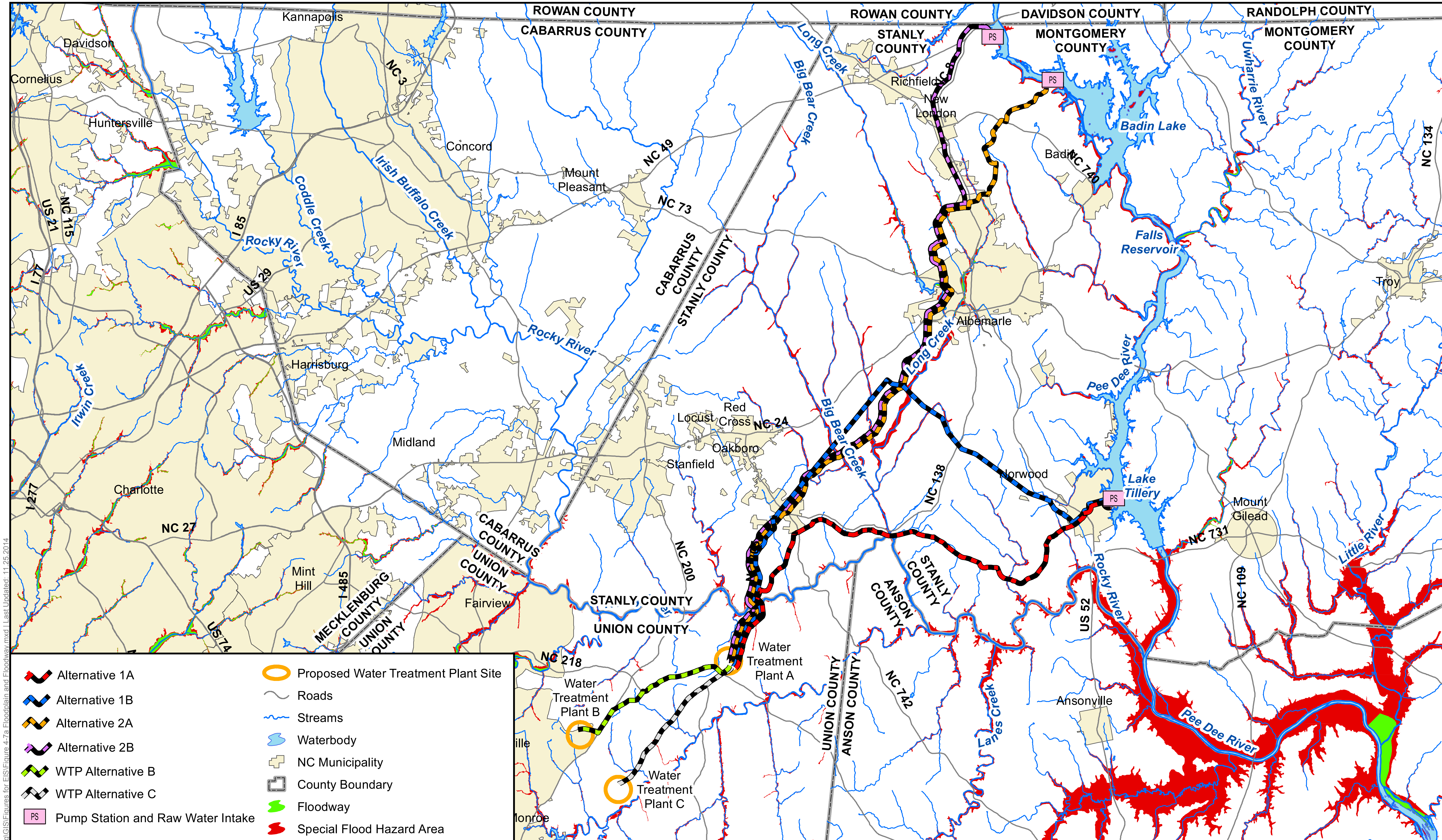

SCALE

0 2 4 8 12

miles

1 inch = 3.5 miles

N W E S

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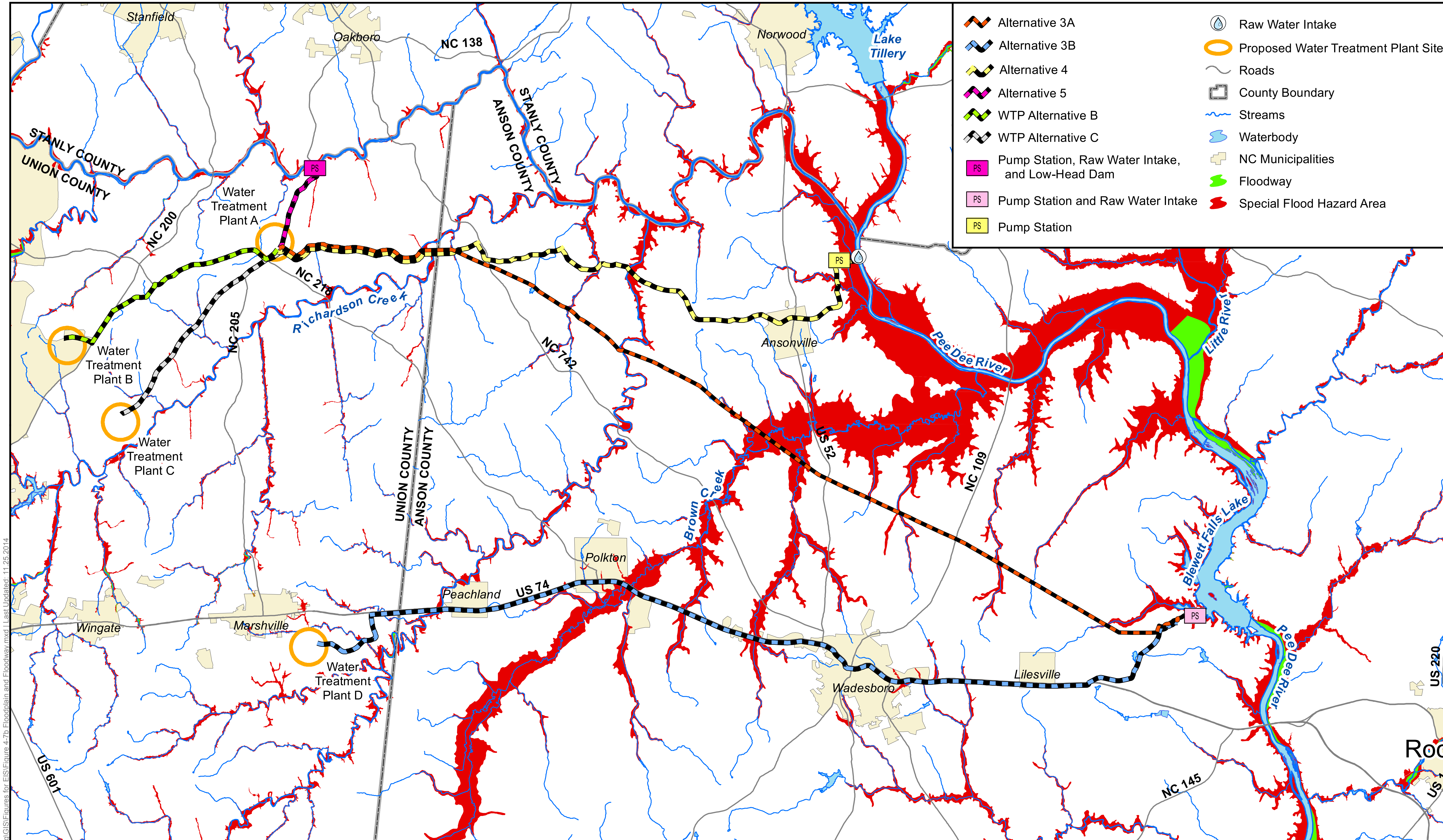
Figure 4-7a: Floodplain and Floodway

Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives B and C

Yadkin River Water Supply Project

Union County, North Carolina



SCALE

0 1.5 3 6 9

miles

1 inch = 2.5 miles

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Figure 4-7b: Floodplain and Floodway
Alternatives 3A, 3B, 4, 5, and WTP Alternatives B and C
Yadkin River Water Supply Project
Union County, North Carolina

O:\32288-RAL\32288-000\EngIGIS\Figures for EIS\Figure 4-7b Floodplain and Floodway.mxd | Last Updated: 11.25.2014

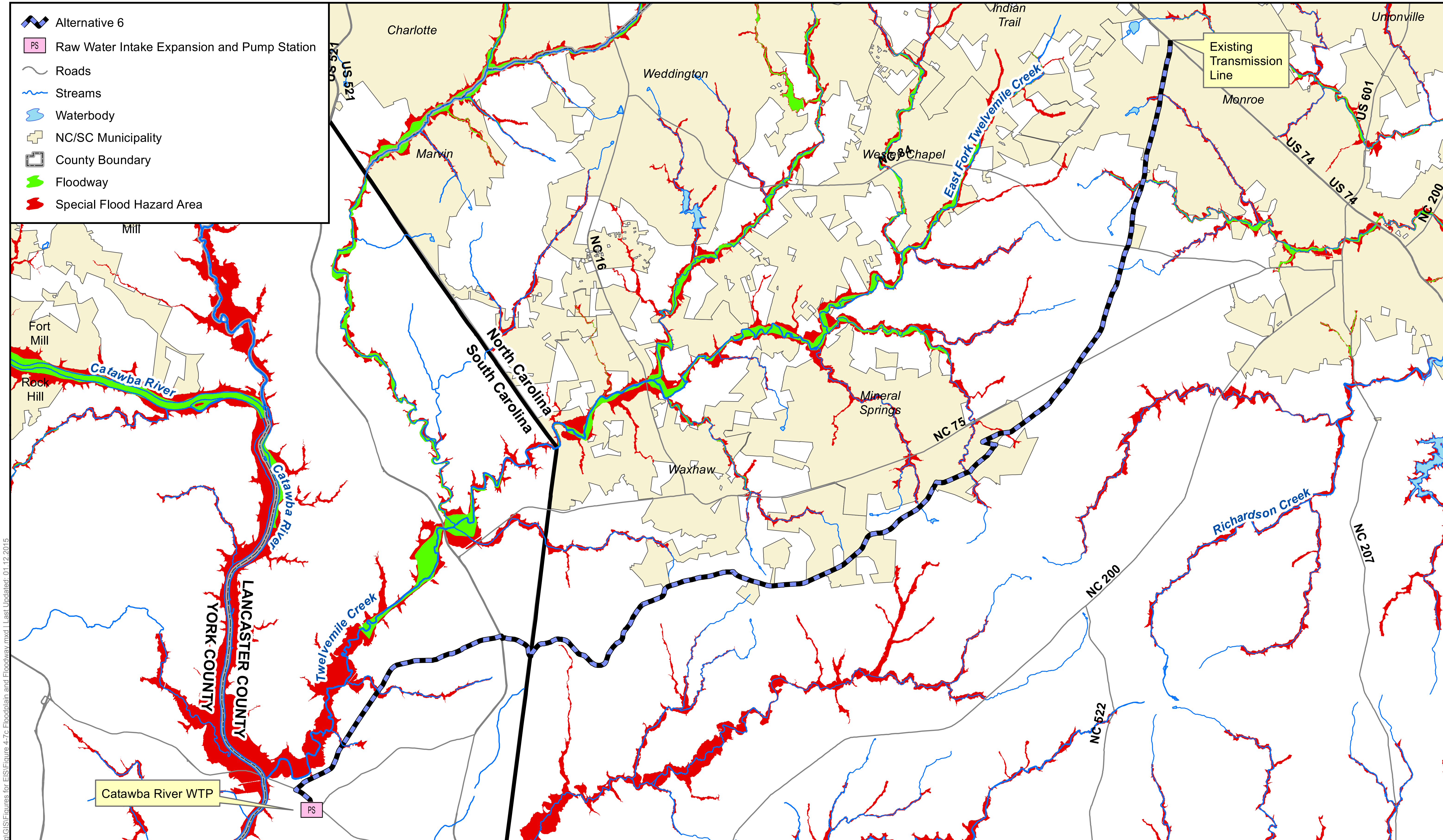

Figure 4-7c: Floodplain and Floodway

Alternative 6

Yadkin River Water Supply Project
Union County, North Carolina

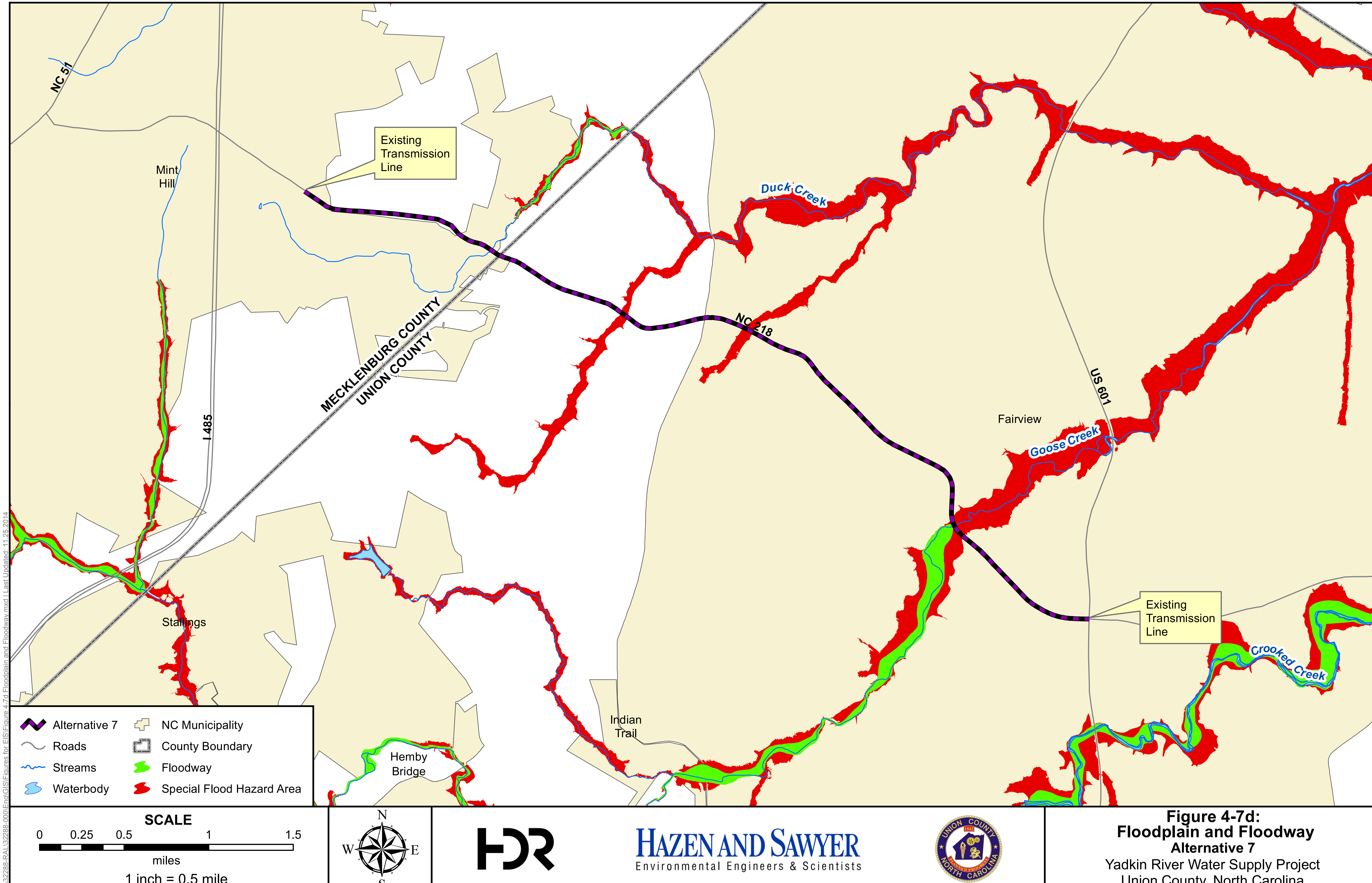

Figure 4-7d:
Floodplain and Floodway
Alternative 7
Yadkin River Water Supply Project
Union County, North Carolina

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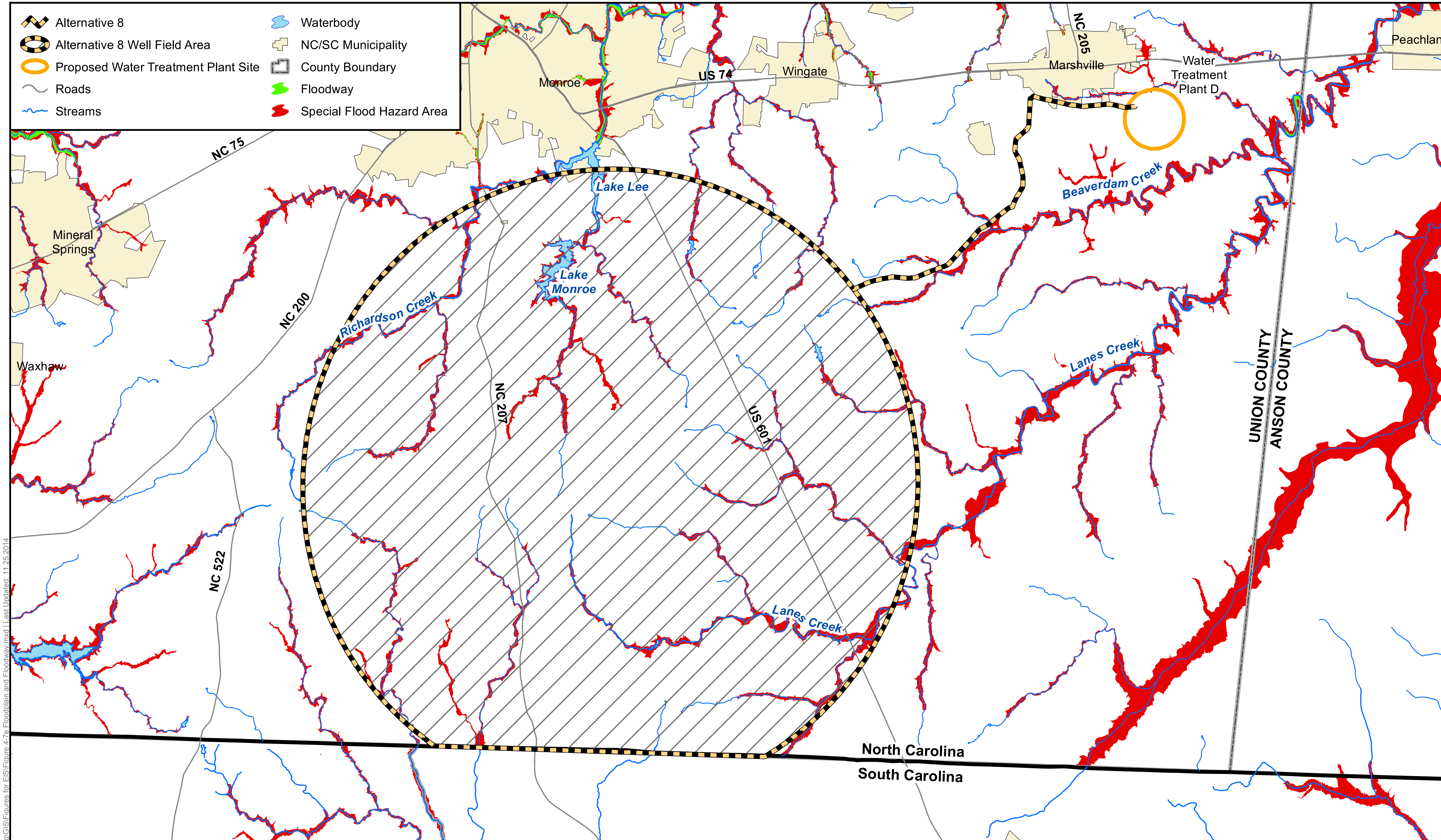

SCALE

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miles

1 inch = 1.5 miles

N W E S

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Figure 4-7e:
Floodplain and Floodway
Alternative 8
Yadkin River Water Supply Project
Union County, North Carolina

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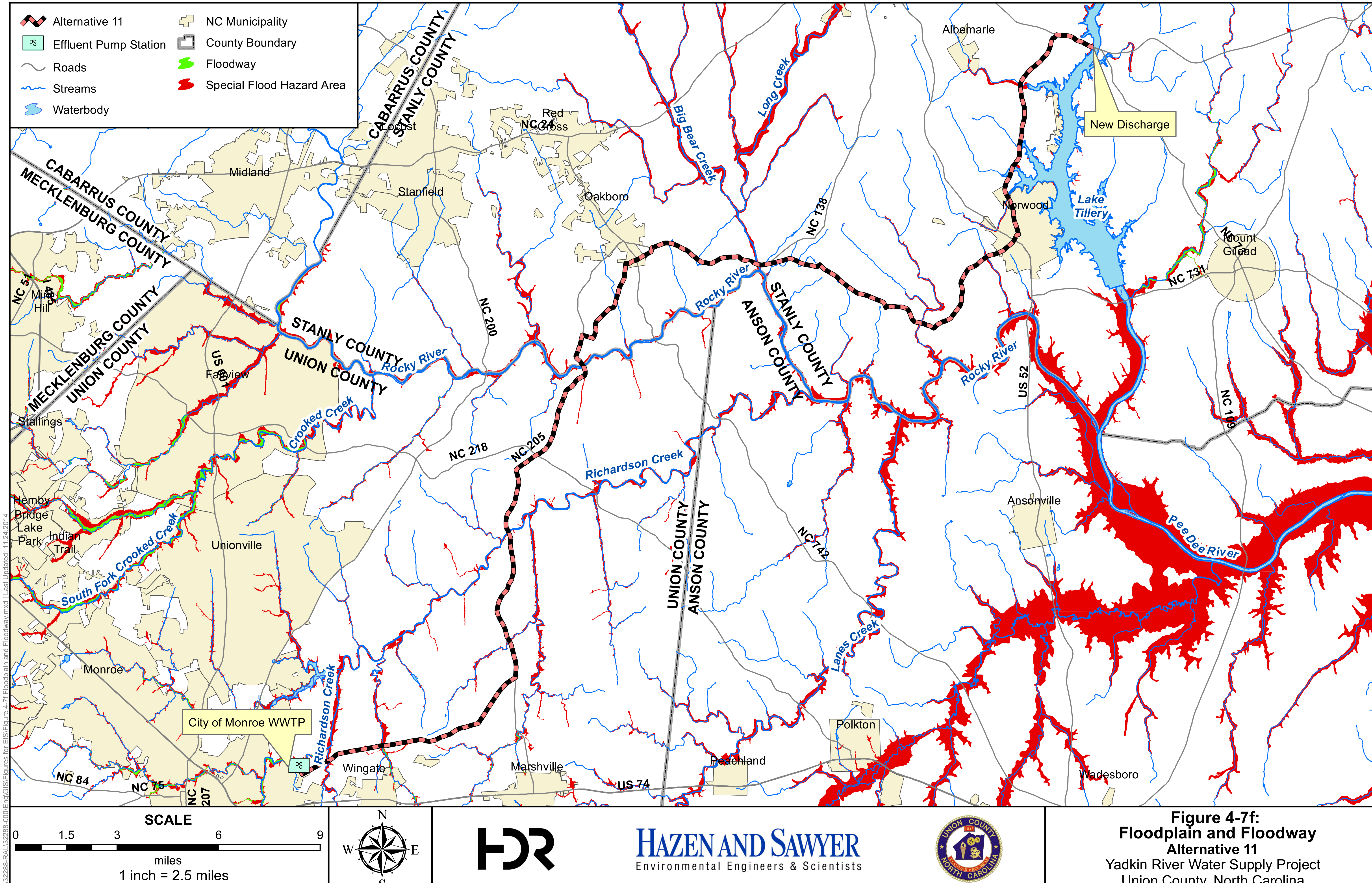

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UNION COUNTY NORTH CAROLINA

Figure 4-7f:
Floodplain and Floodway
Alternative 11
Yadkin River Water Supply Project
Union County, North Carolina

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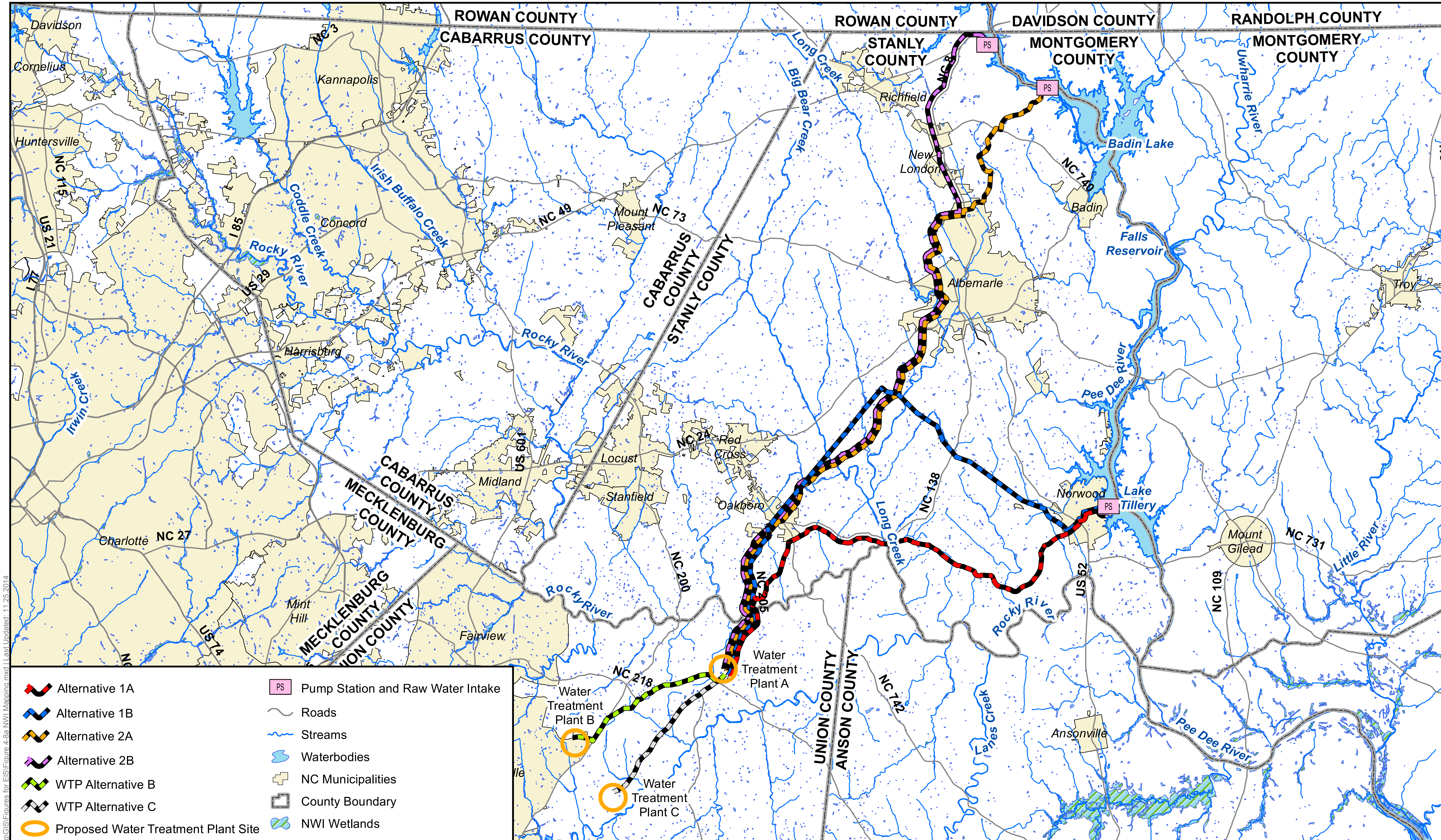

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miles

1 inch = 3.5 miles

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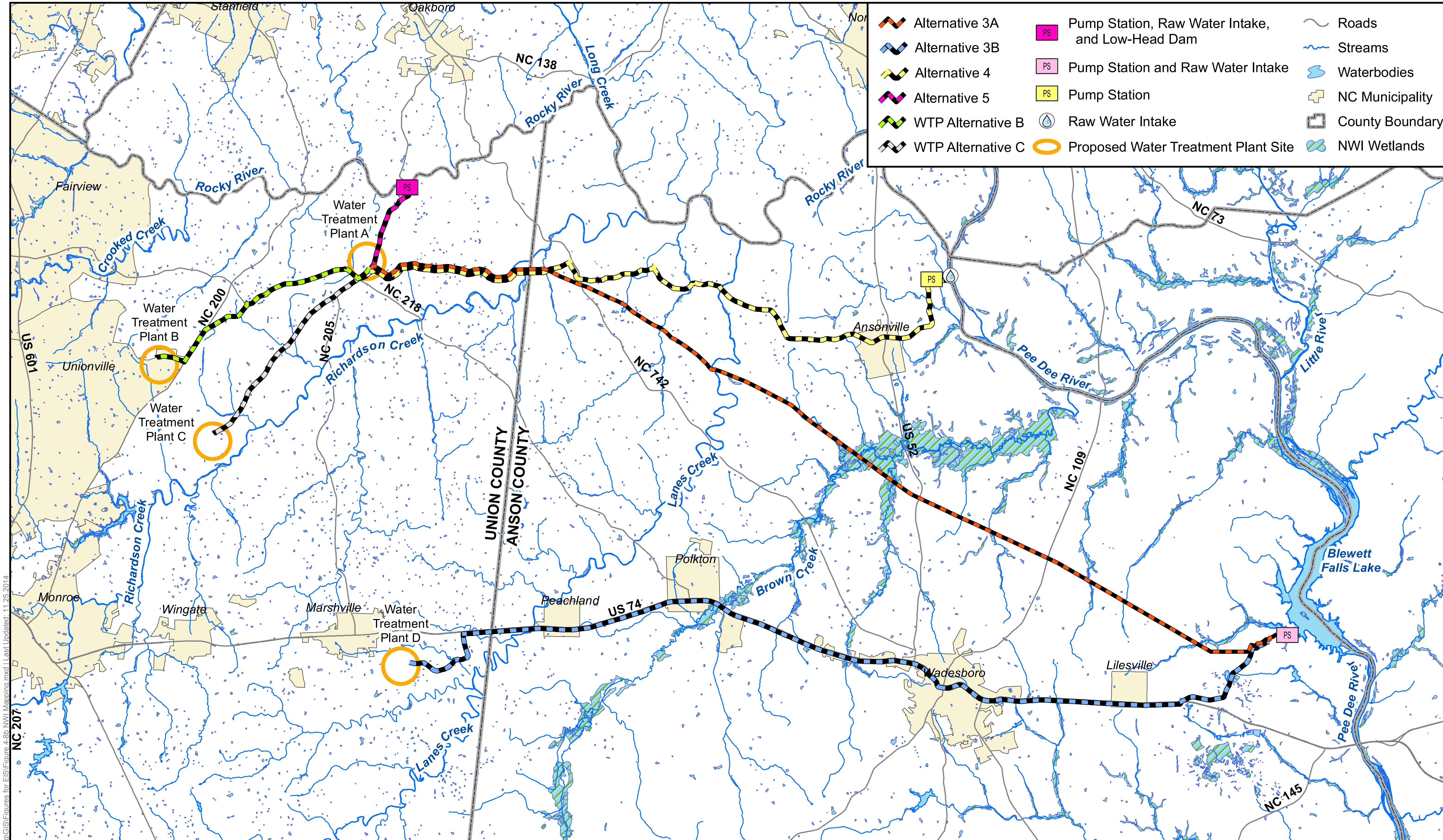
UNION COUNTY NORTH CAROLINA

Figure 4-8a: NWI Mapping

Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives

Yadkin River Water Supply Project
Union County, North Carolina

A-60



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miles

1 inch = 2.5 miles

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Figure 4-8b: NWI Mapping

Alternatives 3A, 3B, 4, 5, and WTP Alternatives

Yadkin River Water Supply Project
Union County, North Carolina

A-61

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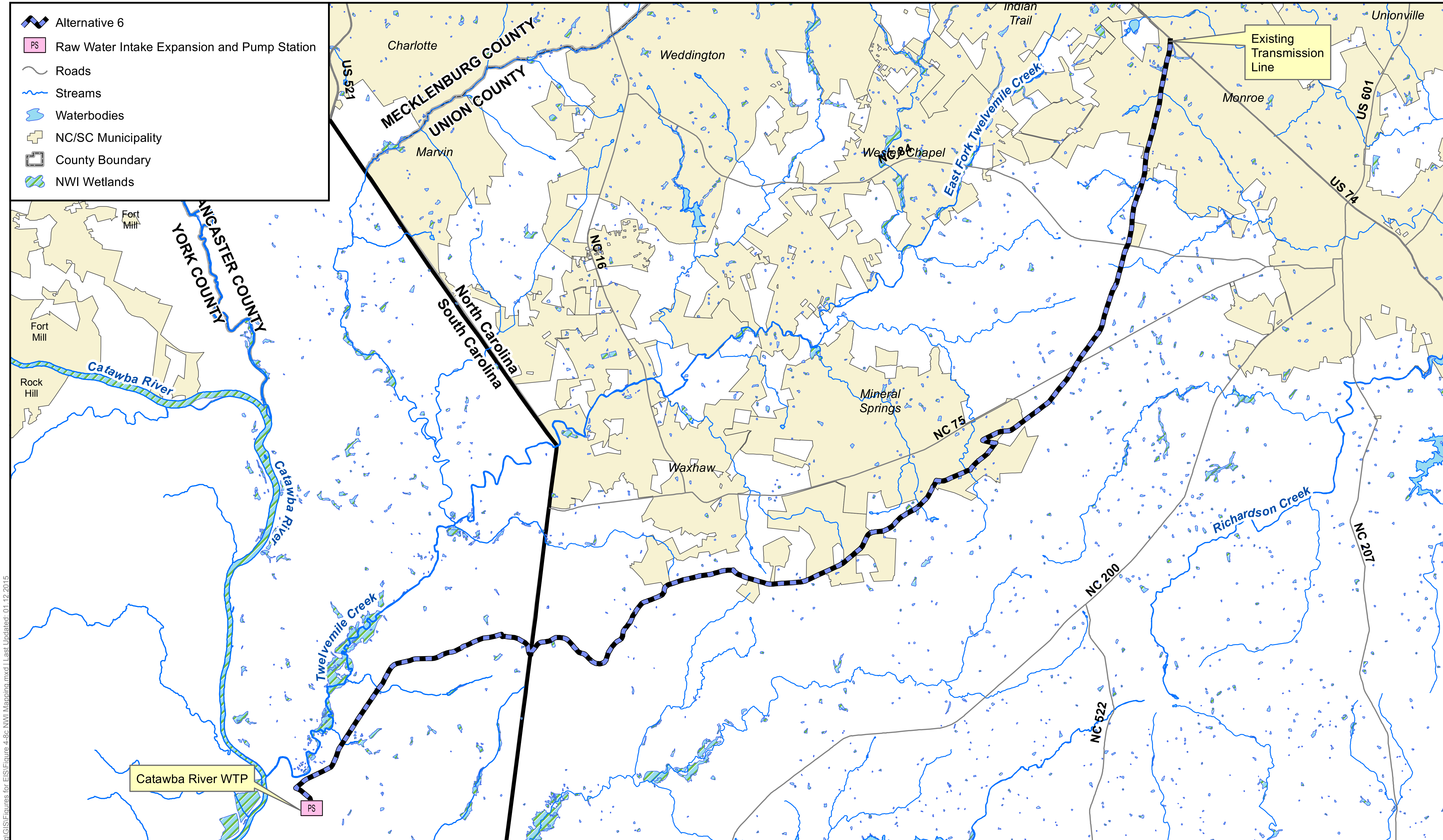

SCALE

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miles

1 inch = 1.5 miles

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Figure 4-8c: NWI Mapping

Alternative 6

Yadkin River Water Supply Project
Union County, North Carolina

A-02

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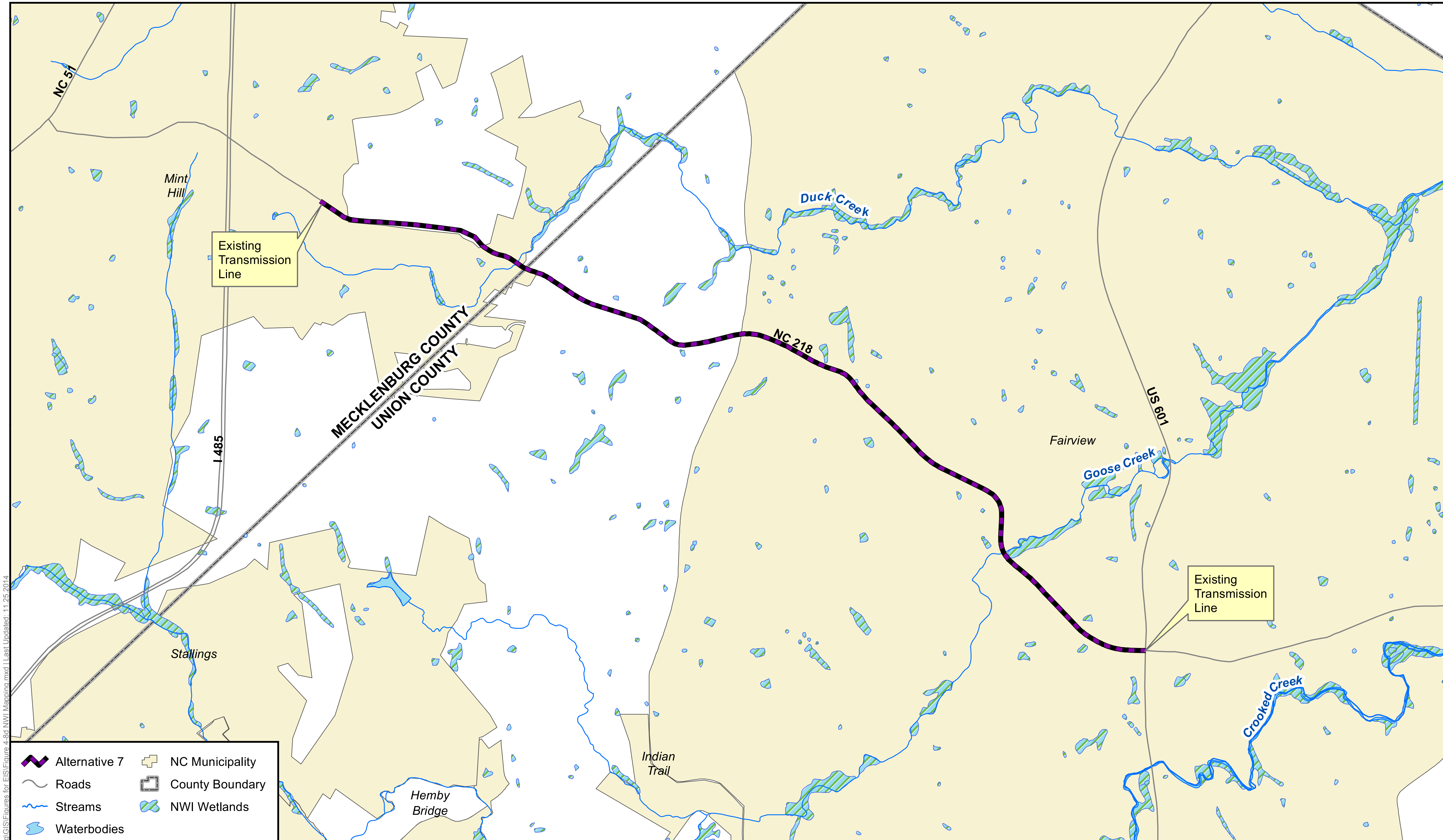

SCALE

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miles

1 inch = 0.5 mile

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Figure 4-8d: NWI Mapping

Alternative 7

Yadkin River Water Supply Project
Union County, North Carolina

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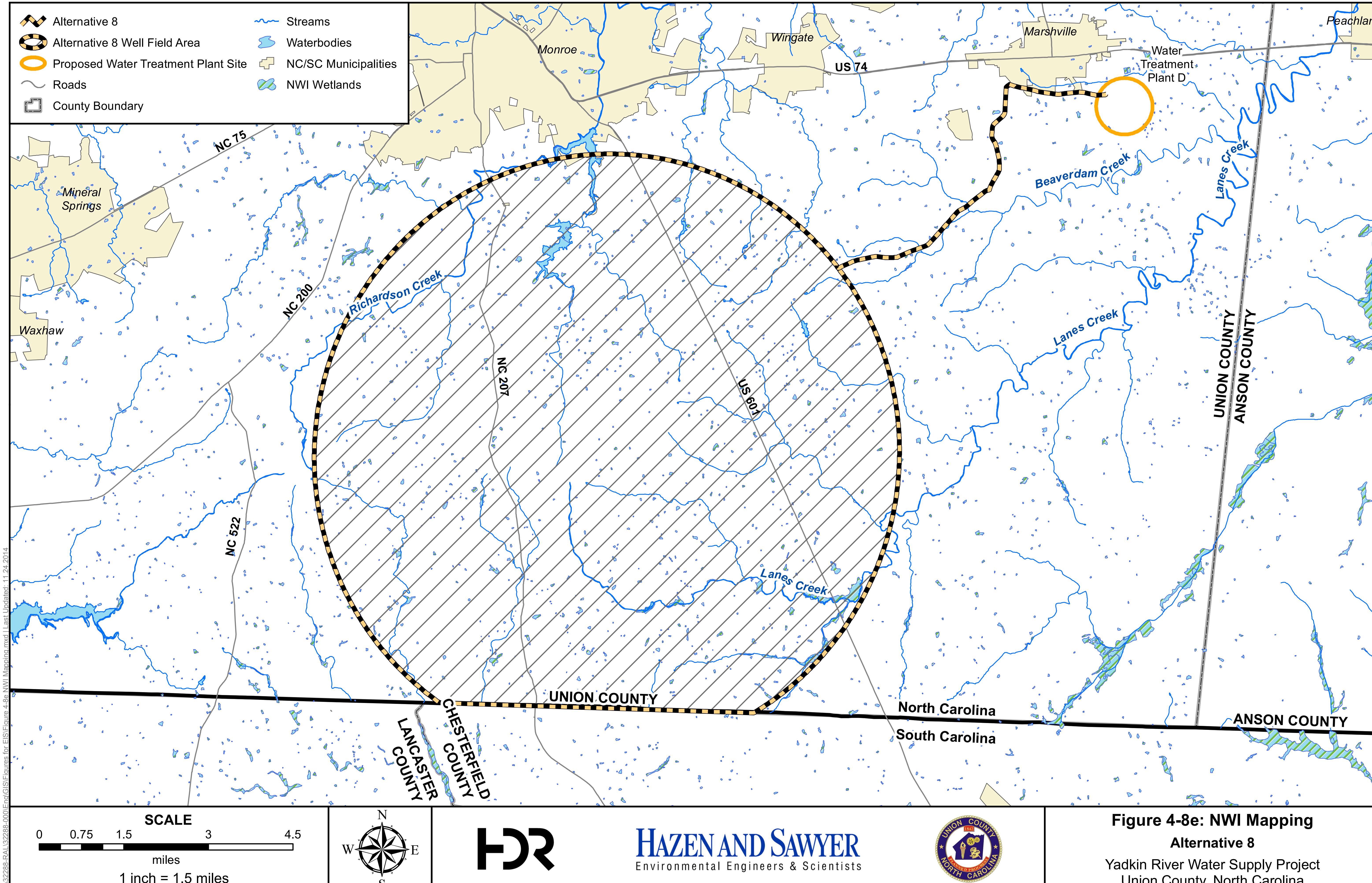

Figure 4-8e: NWI Mapping

Alternative 8

Yadkin River Water Supply Project
Union County, North Carolina

A-64

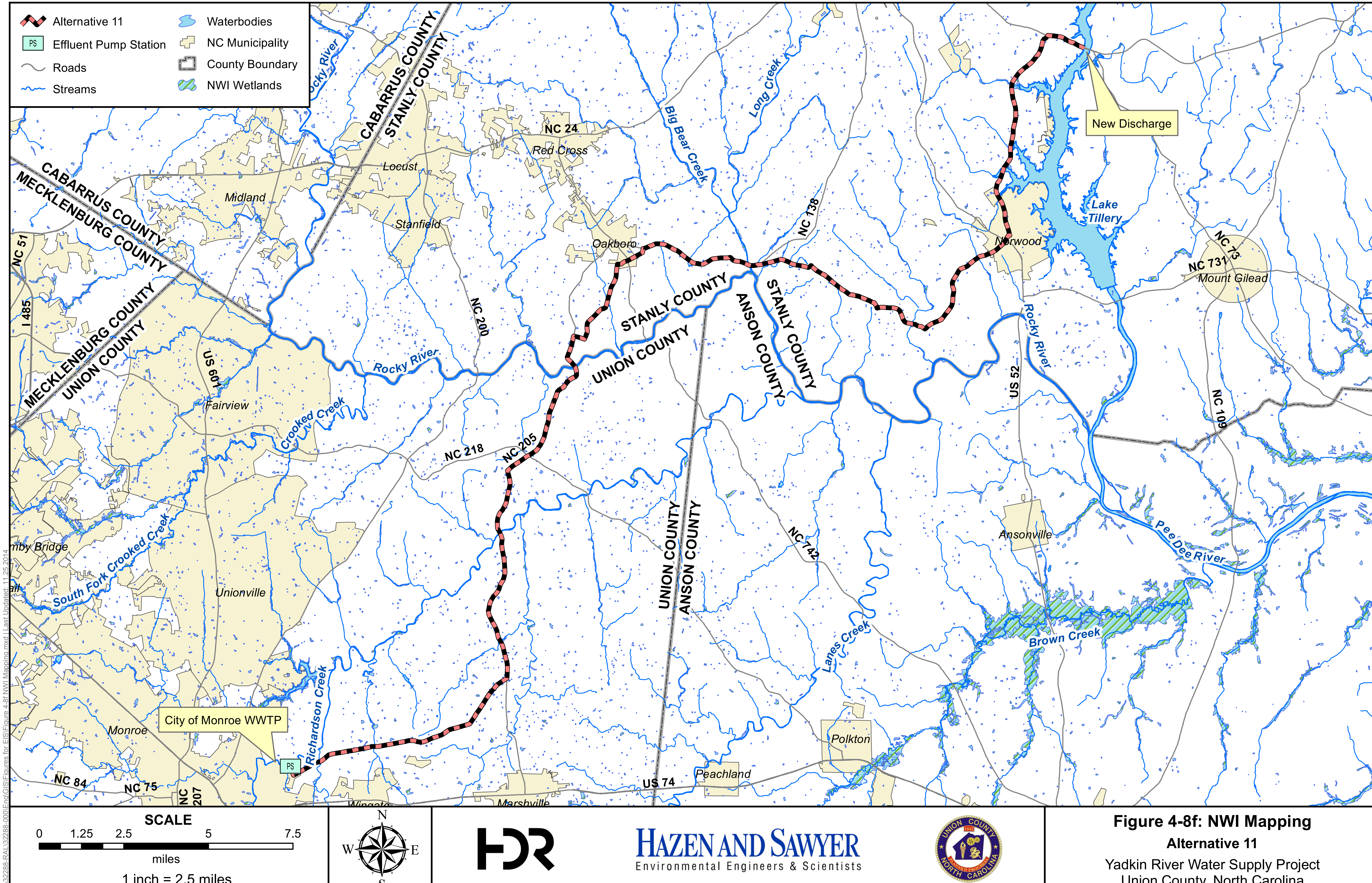

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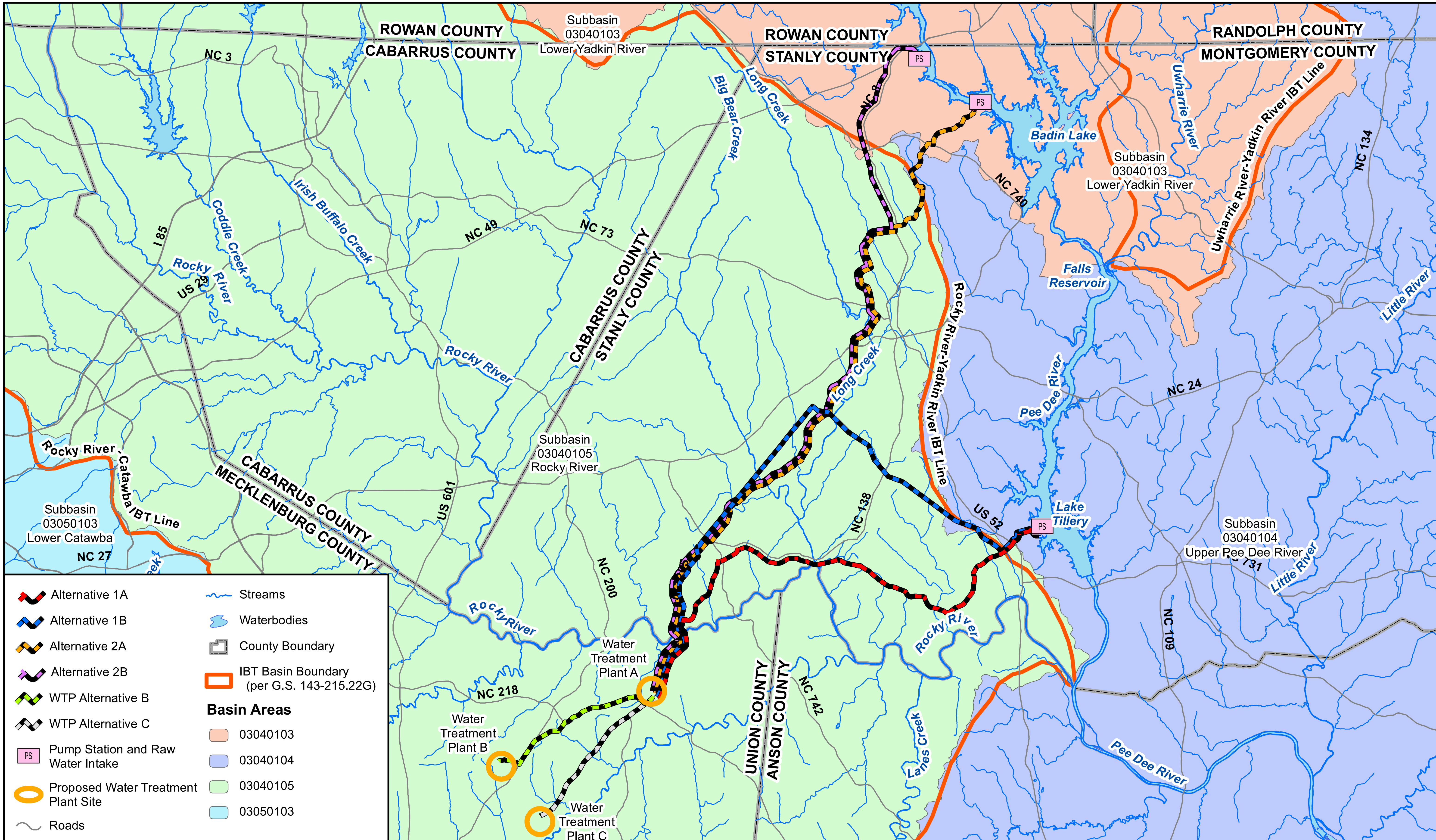
Figure 4-8f: NWI Mapping

Alternative 11

Yadkin River Water Supply Project
Union County, North Carolina



SCALE

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miles

1 inch = 3.5 miles

N W E S

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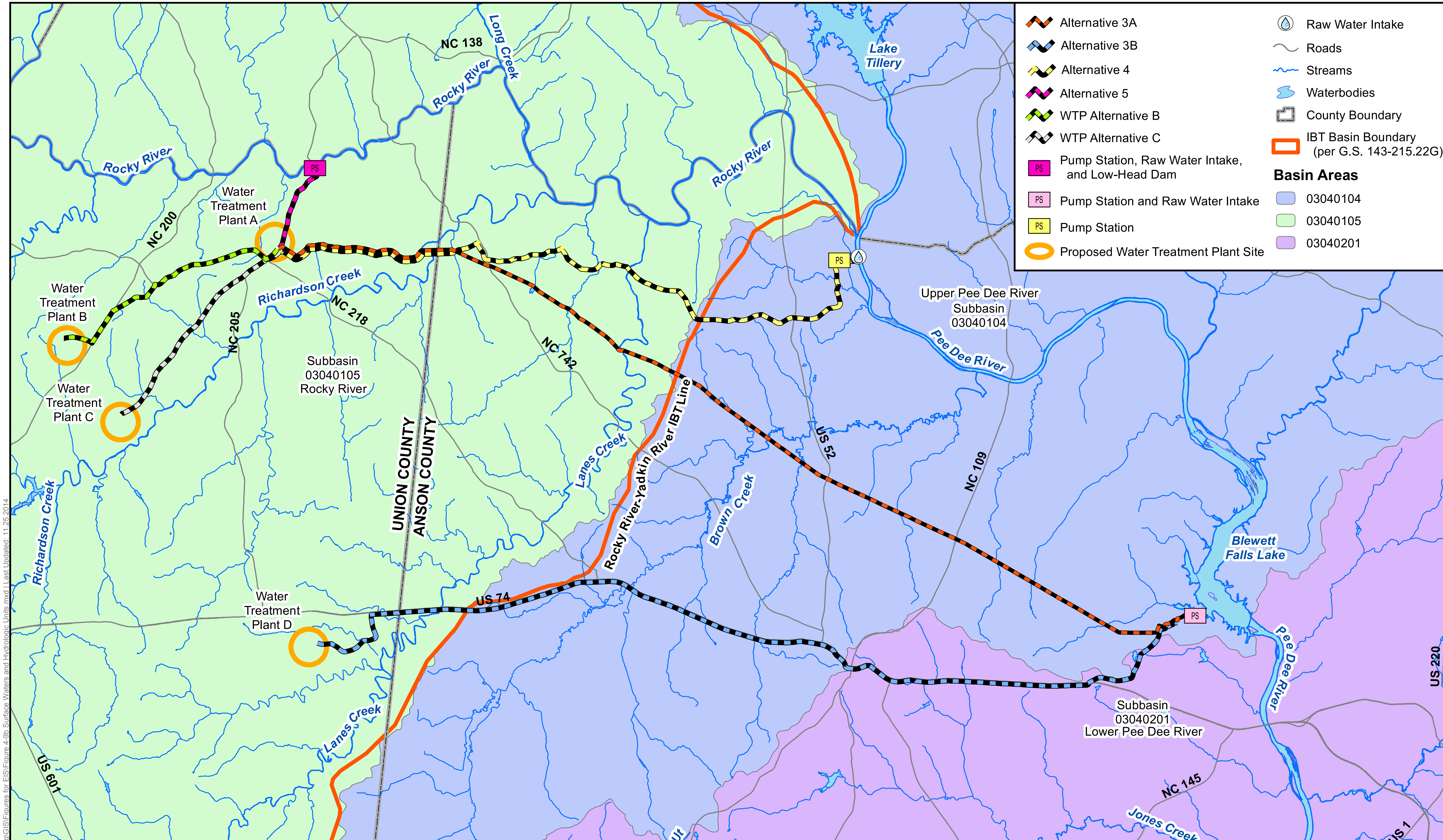
UNION COUNTY NORTH CAROLINA

Figure 4-9a:
Surface Waters and Hydrologic Units
Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives
Yadkin River Water Supply Project
Union County, North Carolina

A-66



SCALE
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miles
1 inch = 2.5 miles

N W E S

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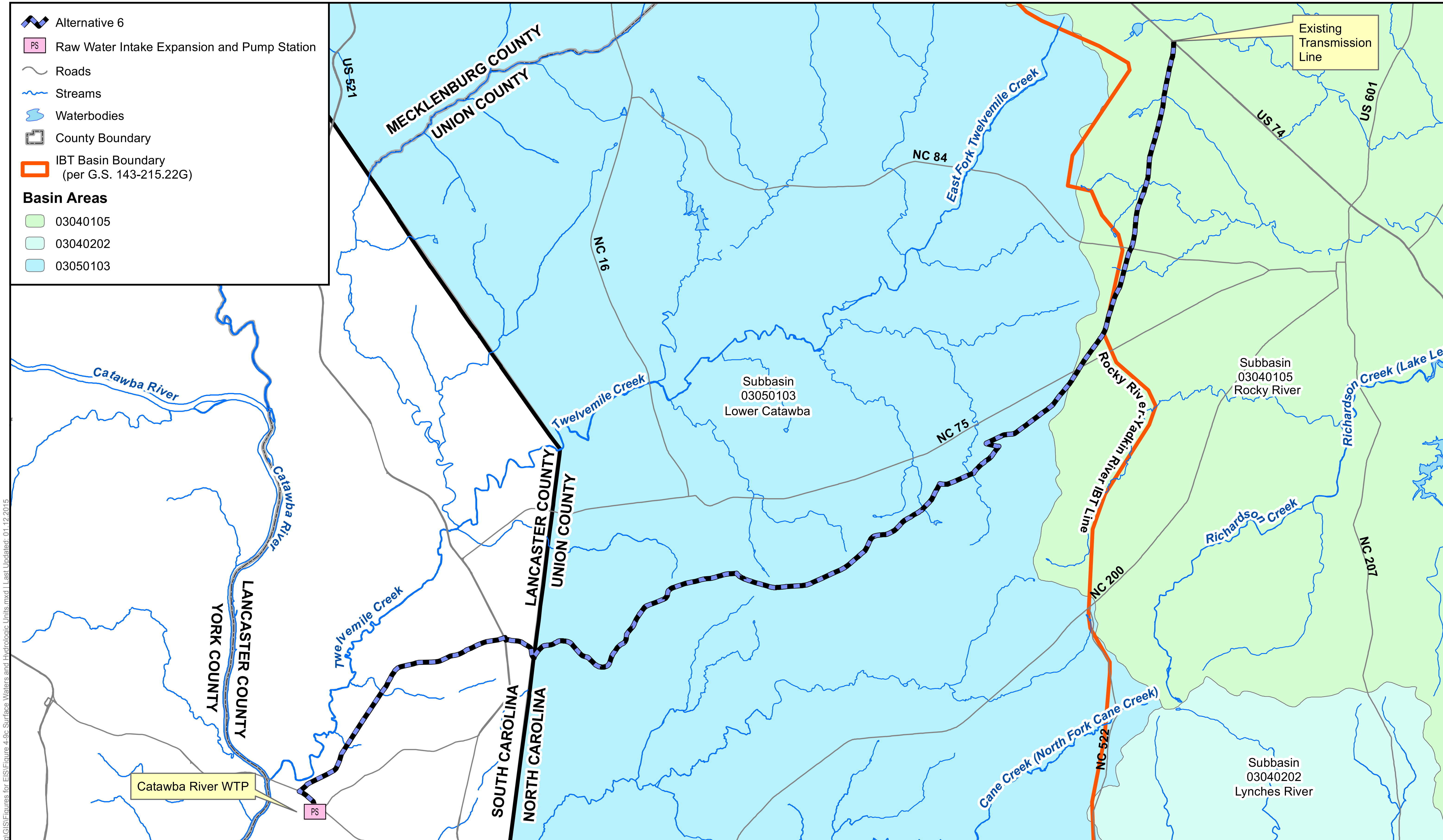
Figure 4-9b:
Surface Waters and Hydrologic Units
Alternatives 3A, 3B, 4, 5, and WTP Alternatives
Yadkin River Water Supply Project
Union County, North Carolina

A-67



SCALE

0 0.75 1.5 3 4.5

miles

1 inch = 1.5 miles

N W E S

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Figure 4-9c: Surface Waters and Hydrologic Units

Alternative 6

Yadkin River Water Supply Project

Union County, North Carolina

A-68

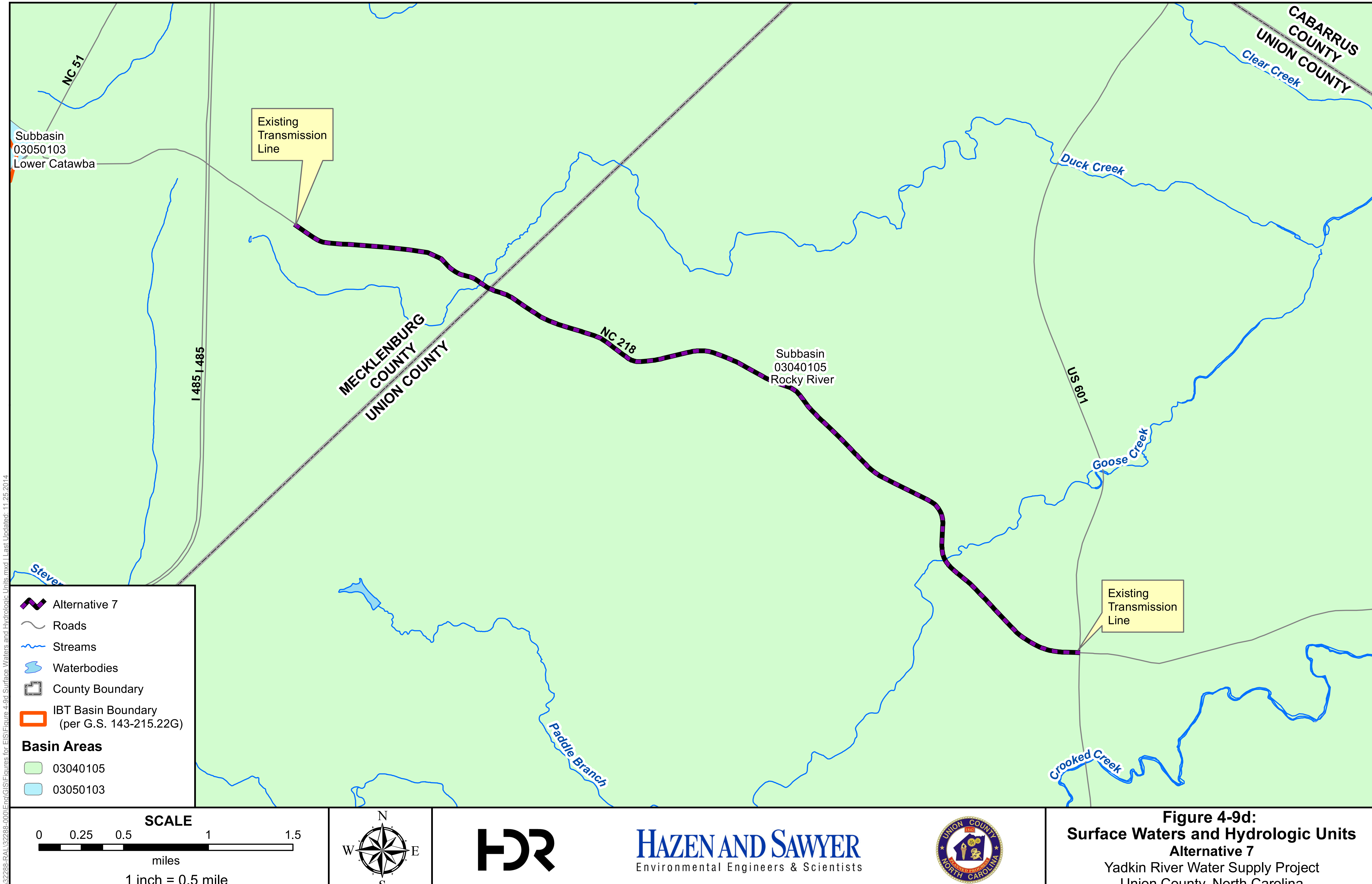

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Figure 4-9d:
Surface Waters and Hydrologic Units
Alternative 7
Yadkin River Water Supply Project
Union County, North Carolina

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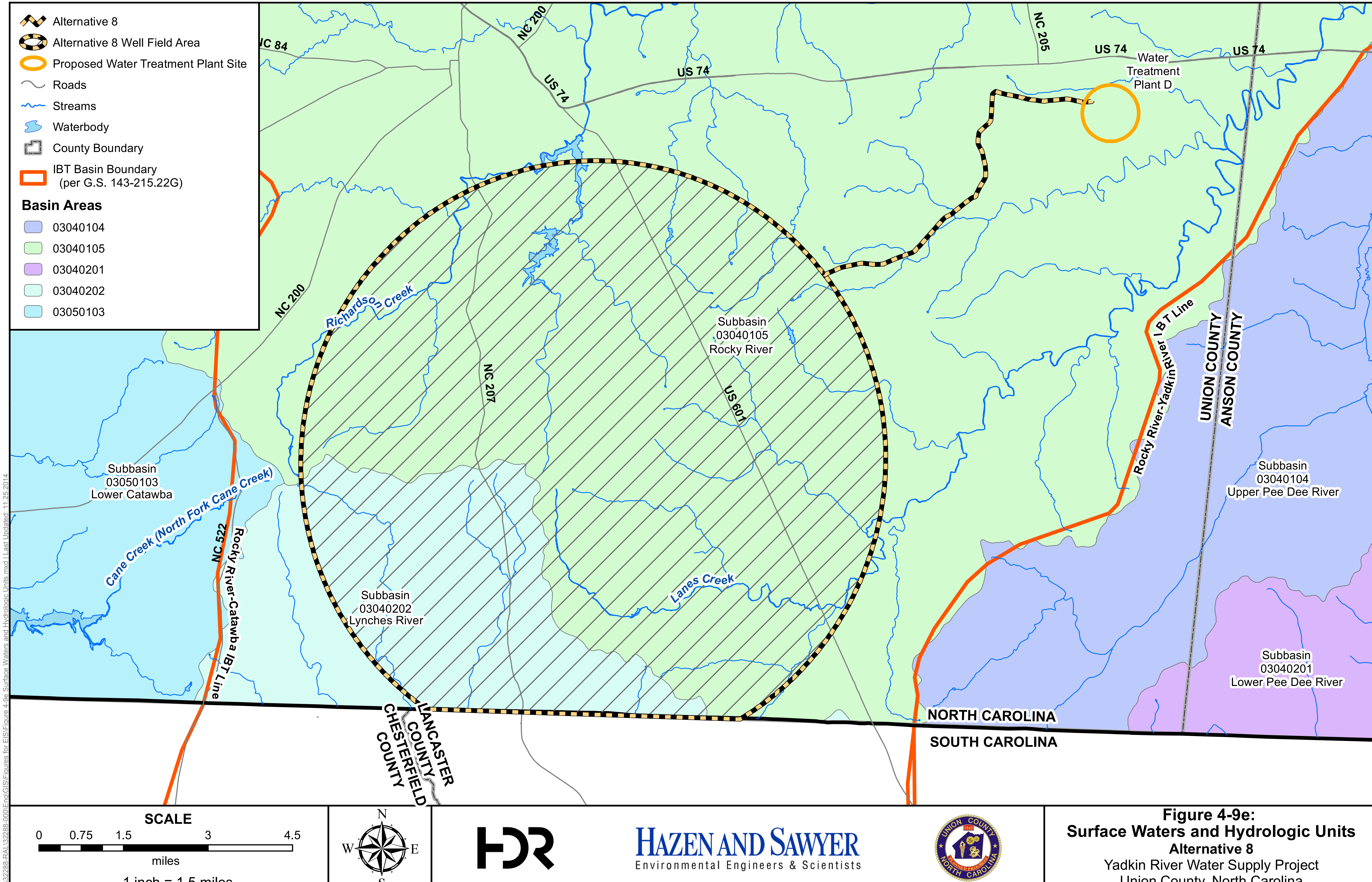

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Figure 4-9e:
Surface Waters and Hydrologic Units
Alternative 8
Yadkin River Water Supply Project
Union County, North Carolina

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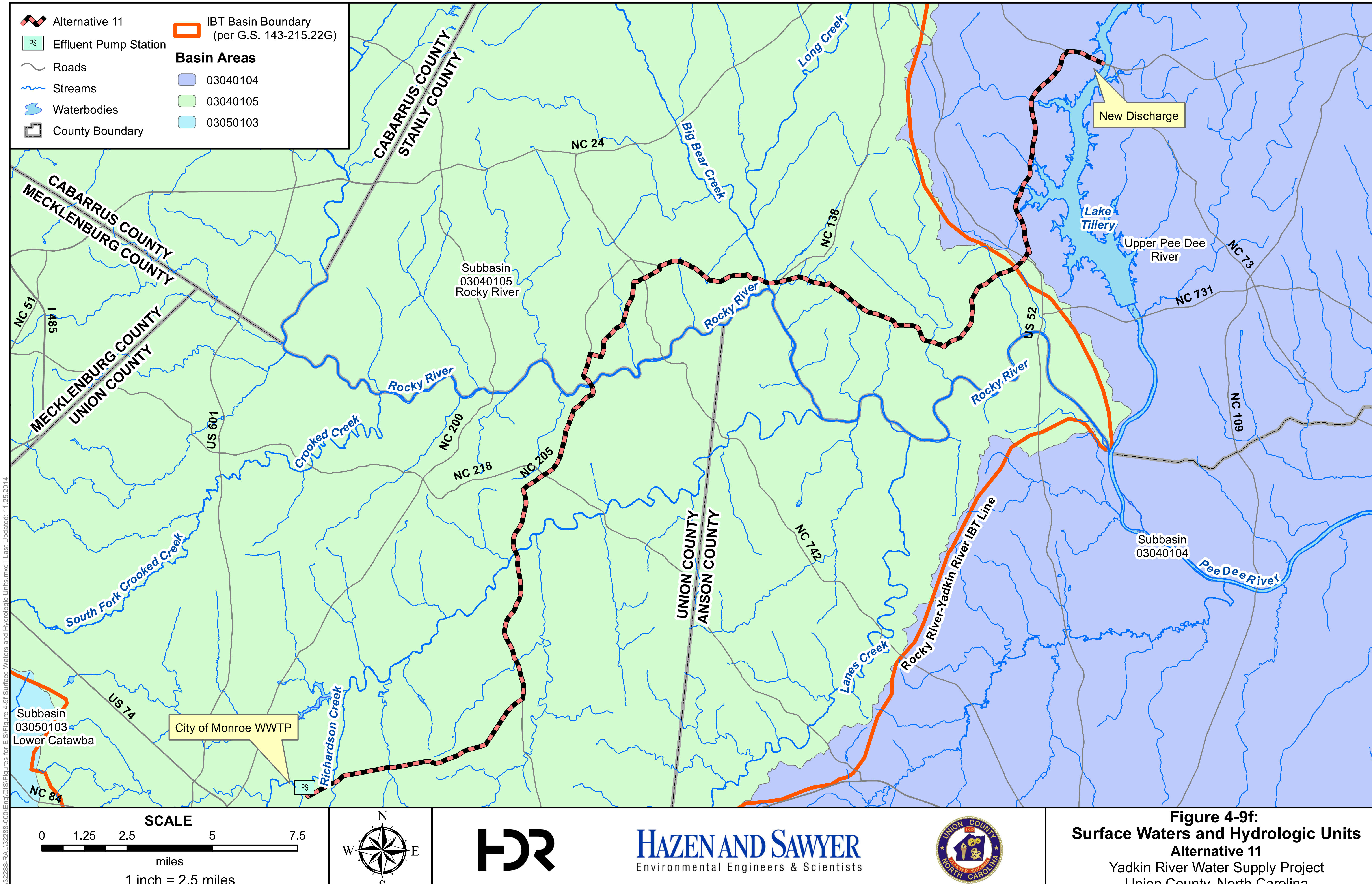

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Figure 4-9f:
Surface Waters and Hydrologic Units
Alternative 11
Yadkin River Water Supply Project
Union County, North Carolina

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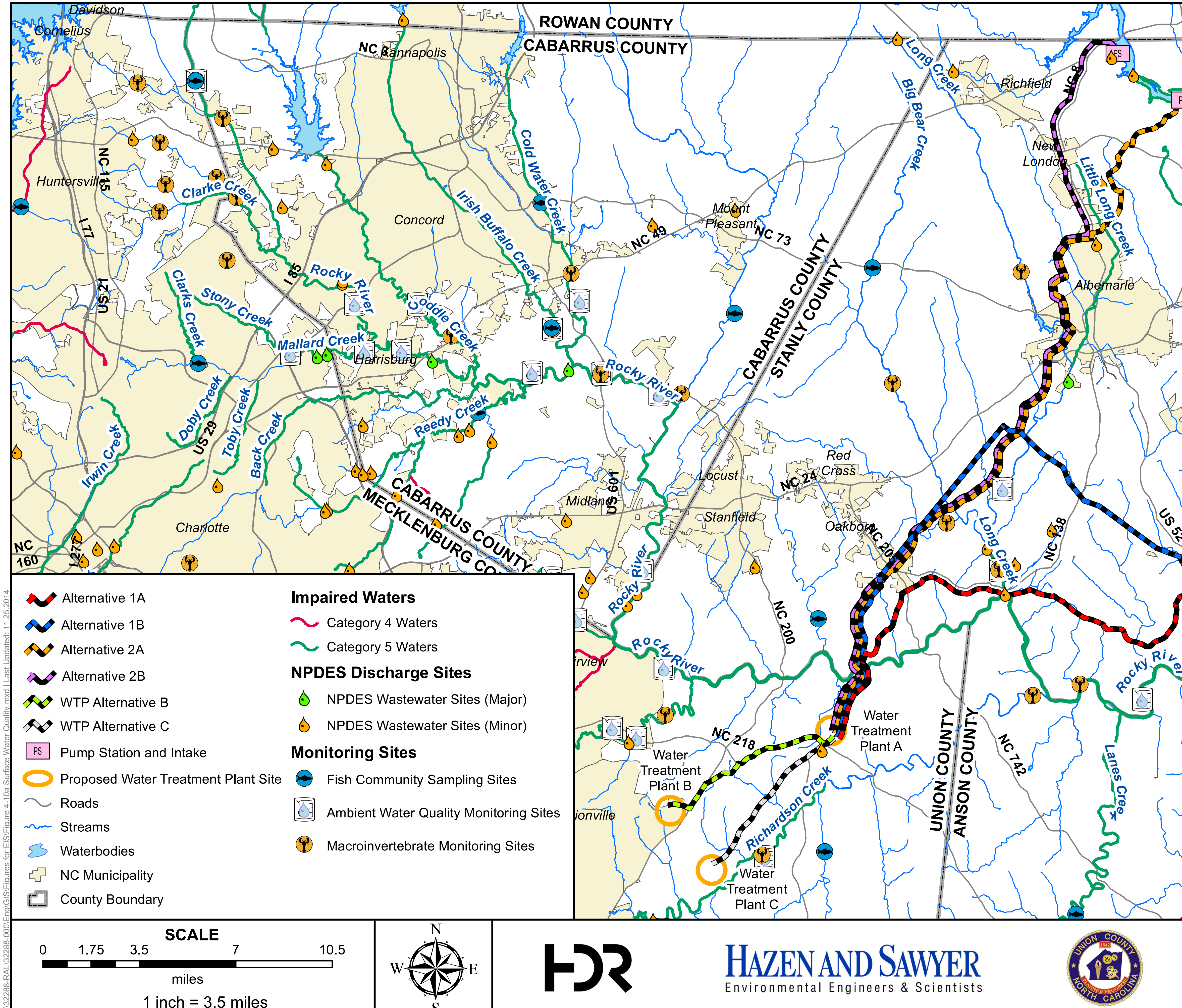
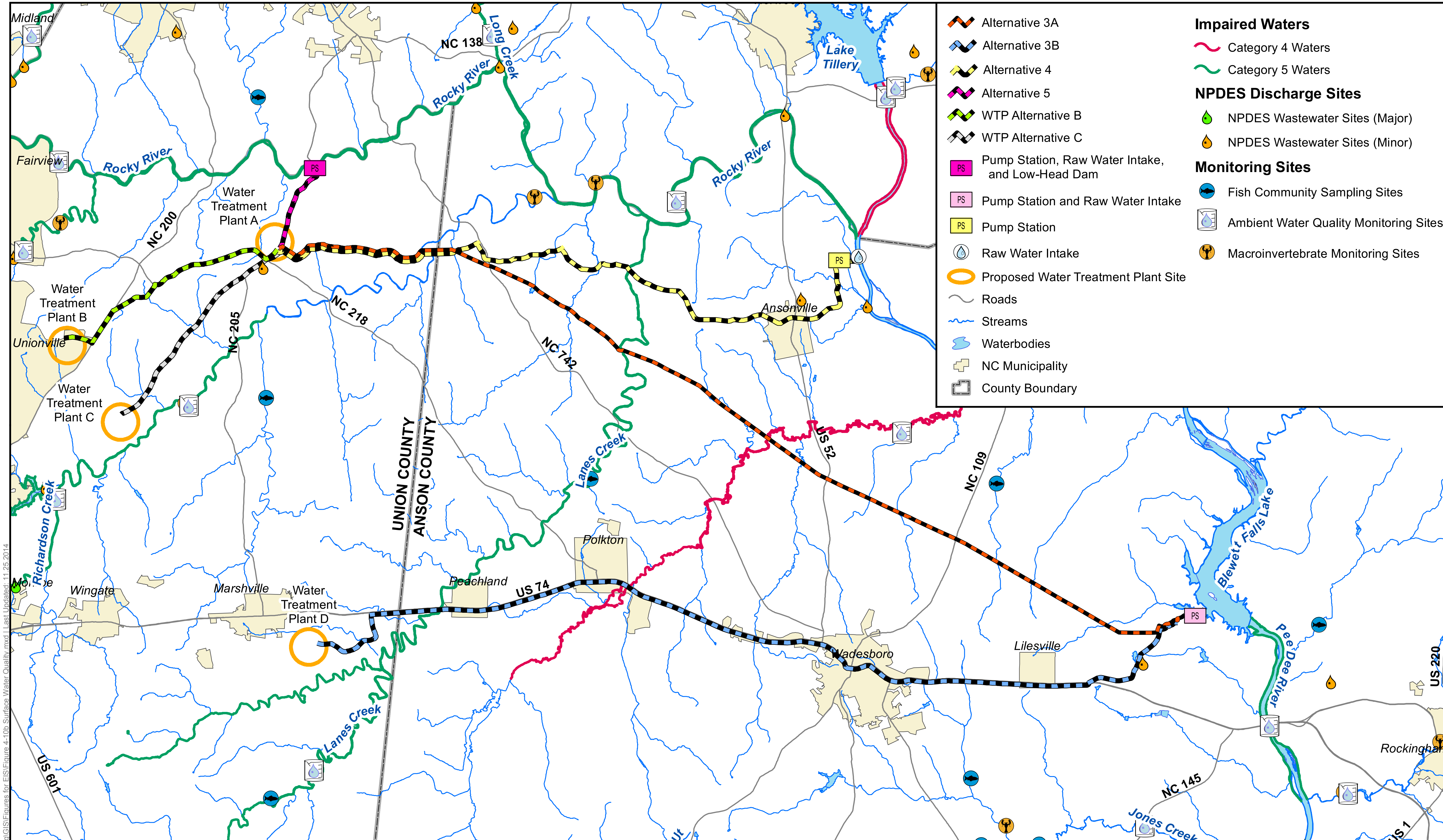


Figure 4-10a: Surface Water Quality

Alternatives 1A, 1B, 2A, 2B, and WTP Alternatives

Yadkin River Water Supply Project

Union County, North Carolina



SCALE

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miles

1 inch = 2.5 miles

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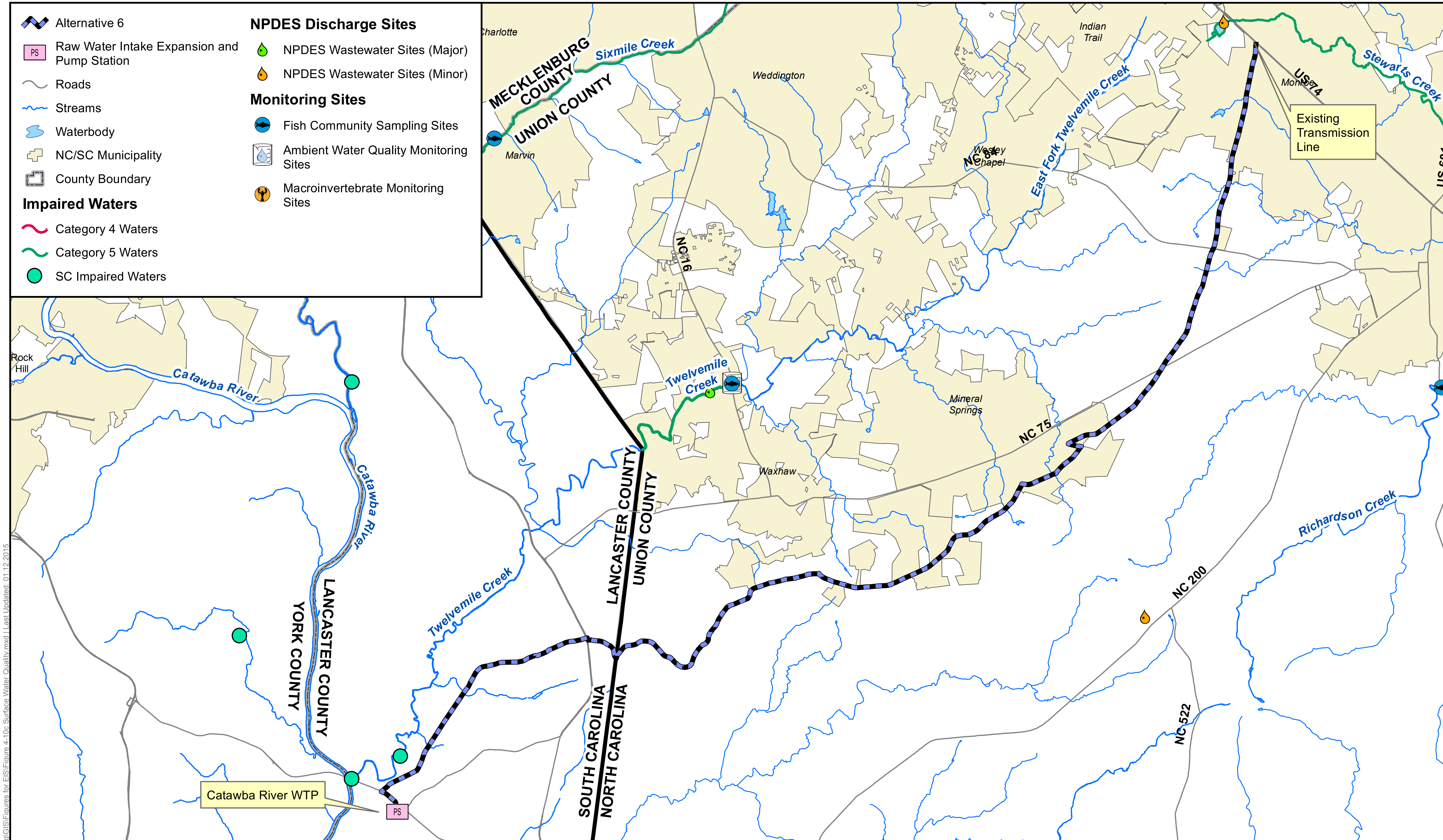
Figure 4-10b:
Surface Water Quality
Alternatives 3A, 3B, 4, 5, and WTP Alternatives
Yadkin River Water Supply Project
Union County, North Carolina

O:\32288-RAL\32288-000\EngGIS\Figures for EIS\Figure 4-10b Surface Water Quality.mxd | Last Updated: 11.25.2014



SCALE

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miles

1 inch = 1.5 miles

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UNION COUNTY NORTH CAROLINA

Figure 4-10c:
Surface Water Quality
Alternative 6
Yadkin River Water Supply Project
Union County, North Carolina

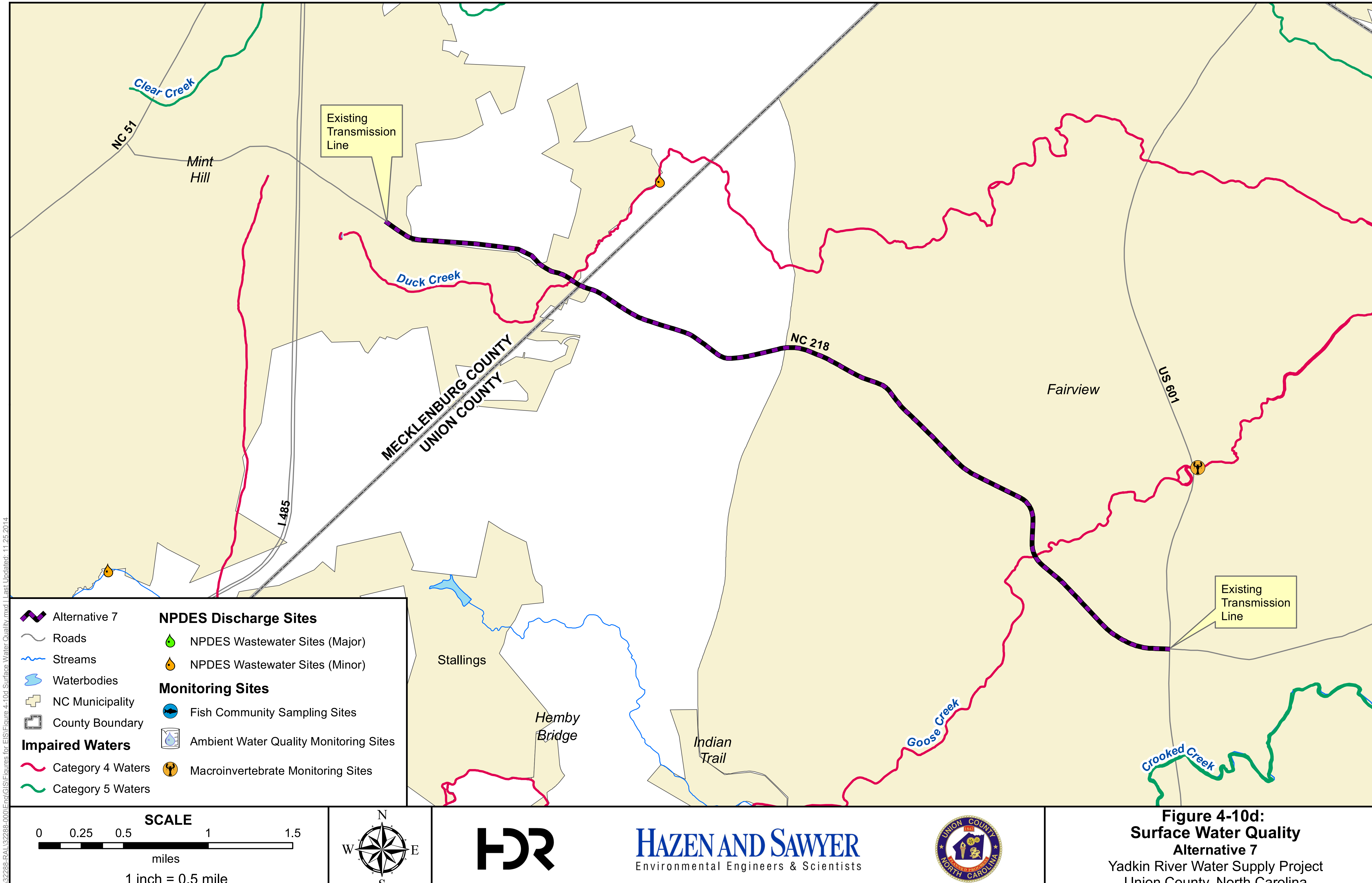

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Figure 4-10d:
Surface Water Quality
Alternative 7
Yadkin River Water Supply Project
Union County, North Carolina

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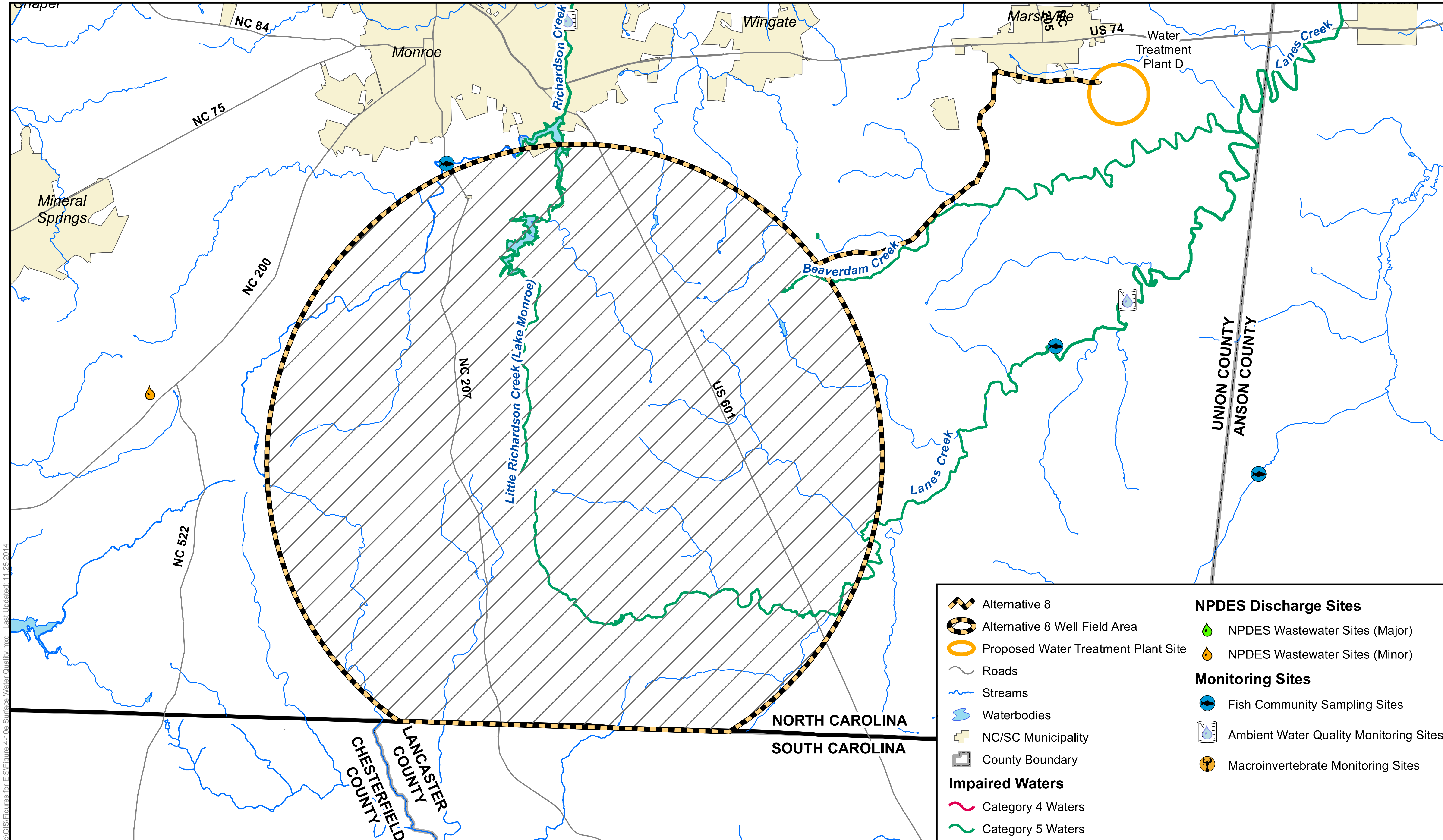

SCALE
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miles
1 inch = 1.5 miles

N W E S

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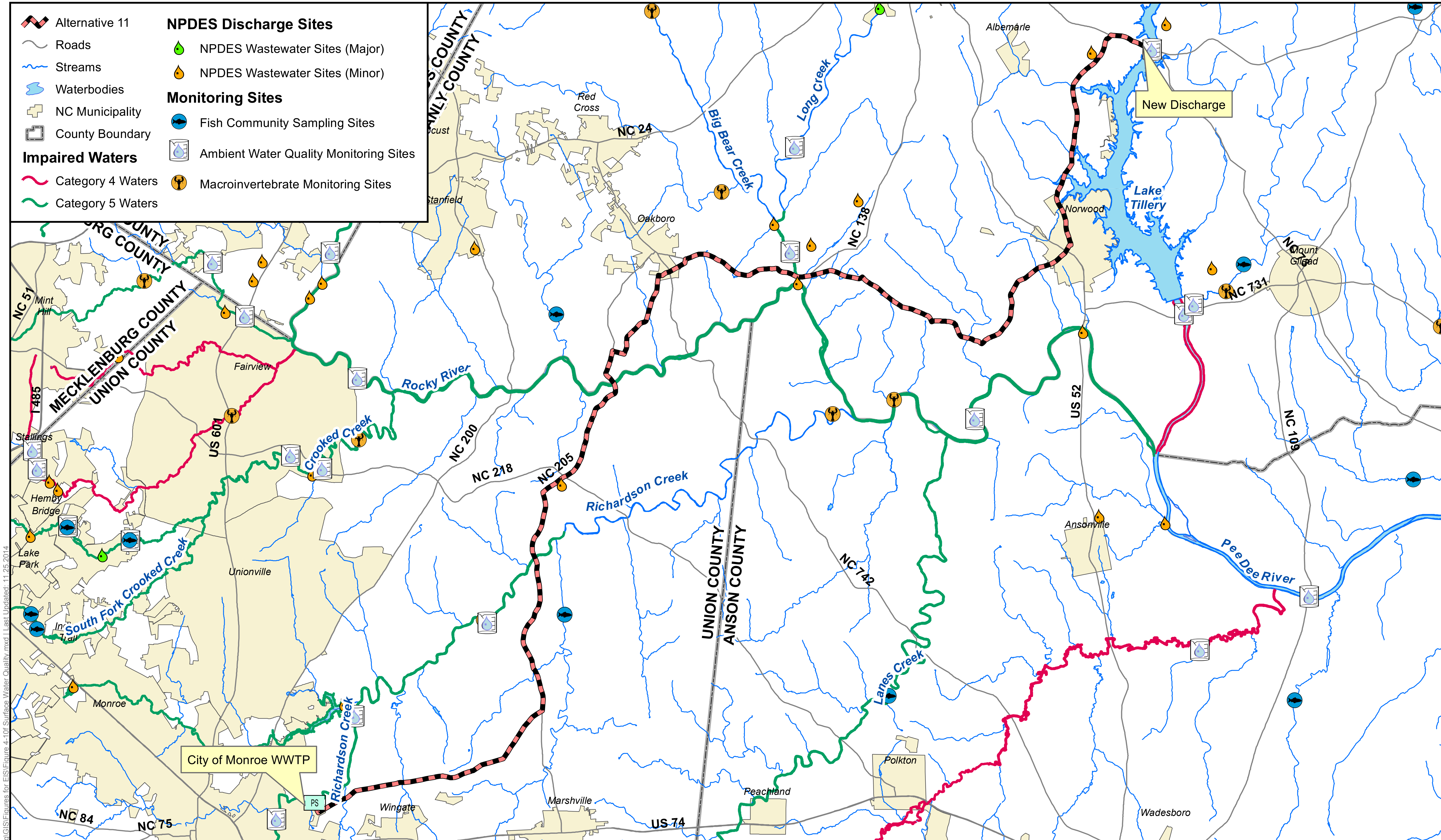
UNION COUNTY NORTH CAROLINA

Figure 4-10e: Surface Water Quality
Alternative 8
Yadkin River Water Supply Project
Union County, North Carolina



SCALE

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miles

1 inch = 2.5 miles

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Figure 4-10f:
Surface Water Quality
Alternative 11
Yadkin River Water Supply Project
Union County, North Carolina

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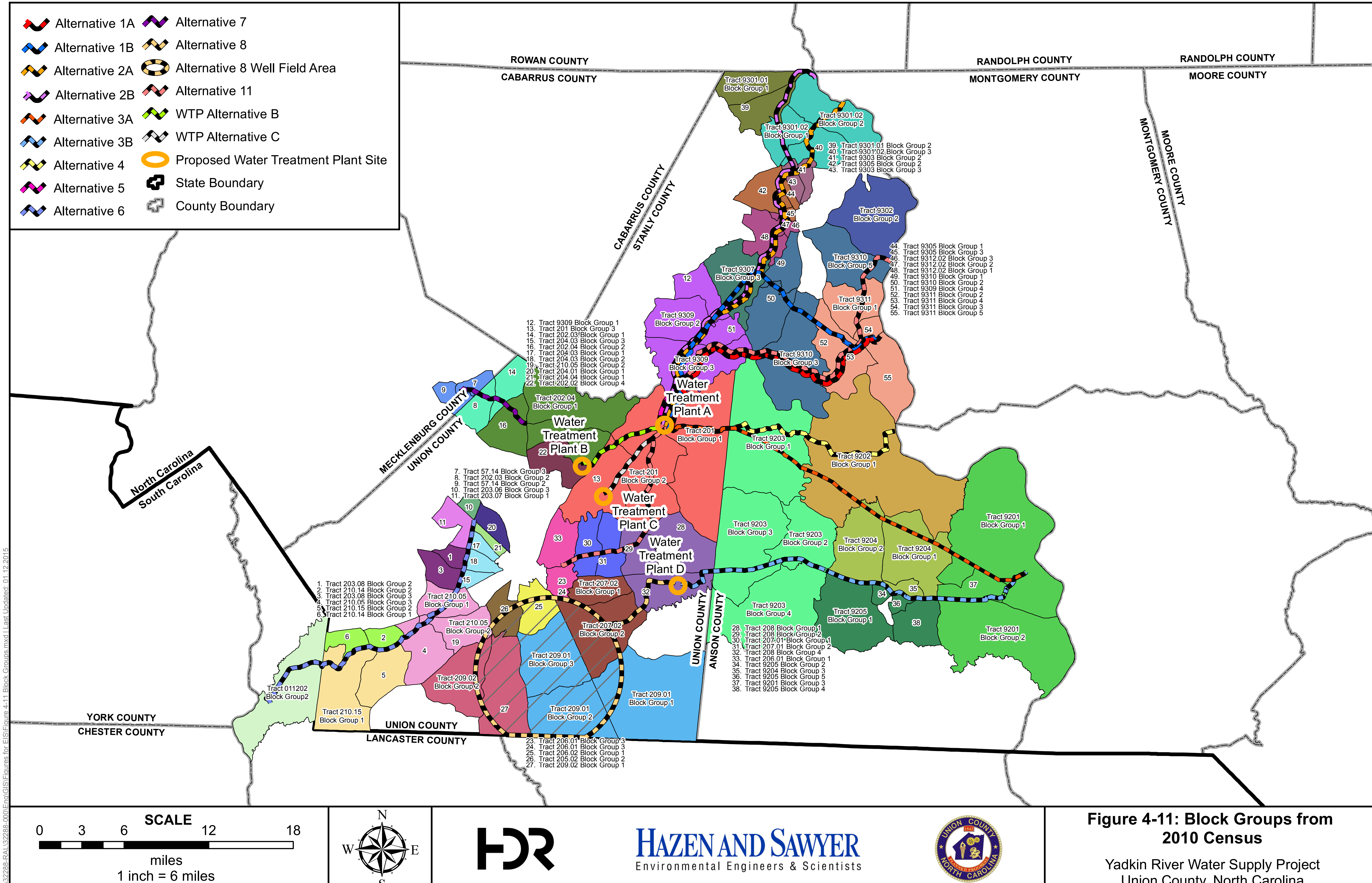

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UNION COUNTY NORTH CAROLINA

Figure 4-11: Block Groups from 2010 Census

Yadkin River Water Supply Project
Union County, North Carolina

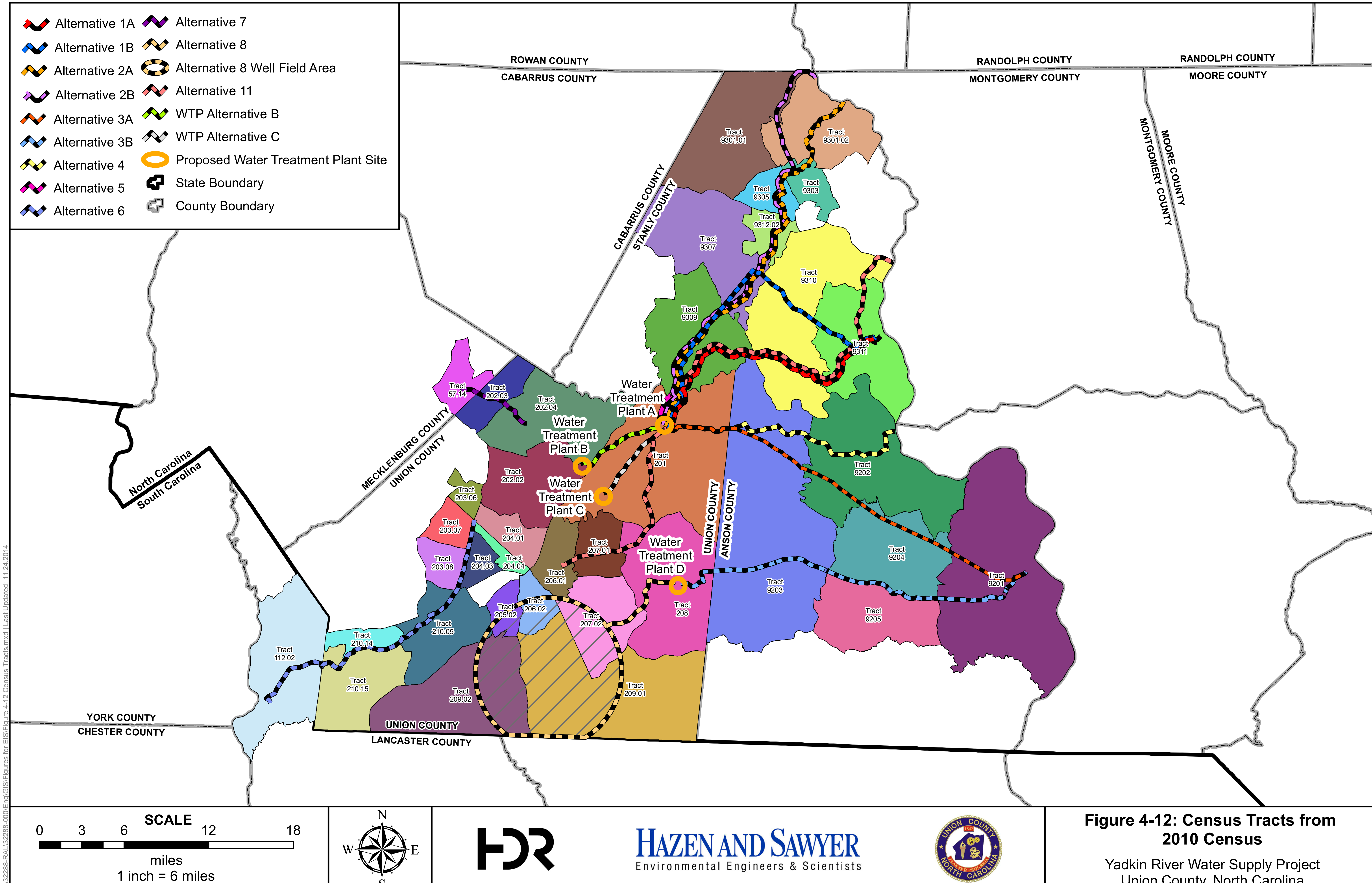

Figure 4-12: Census Tracts from 2010 Census

Yadkin River Water Supply Project
Union County, North Carolina

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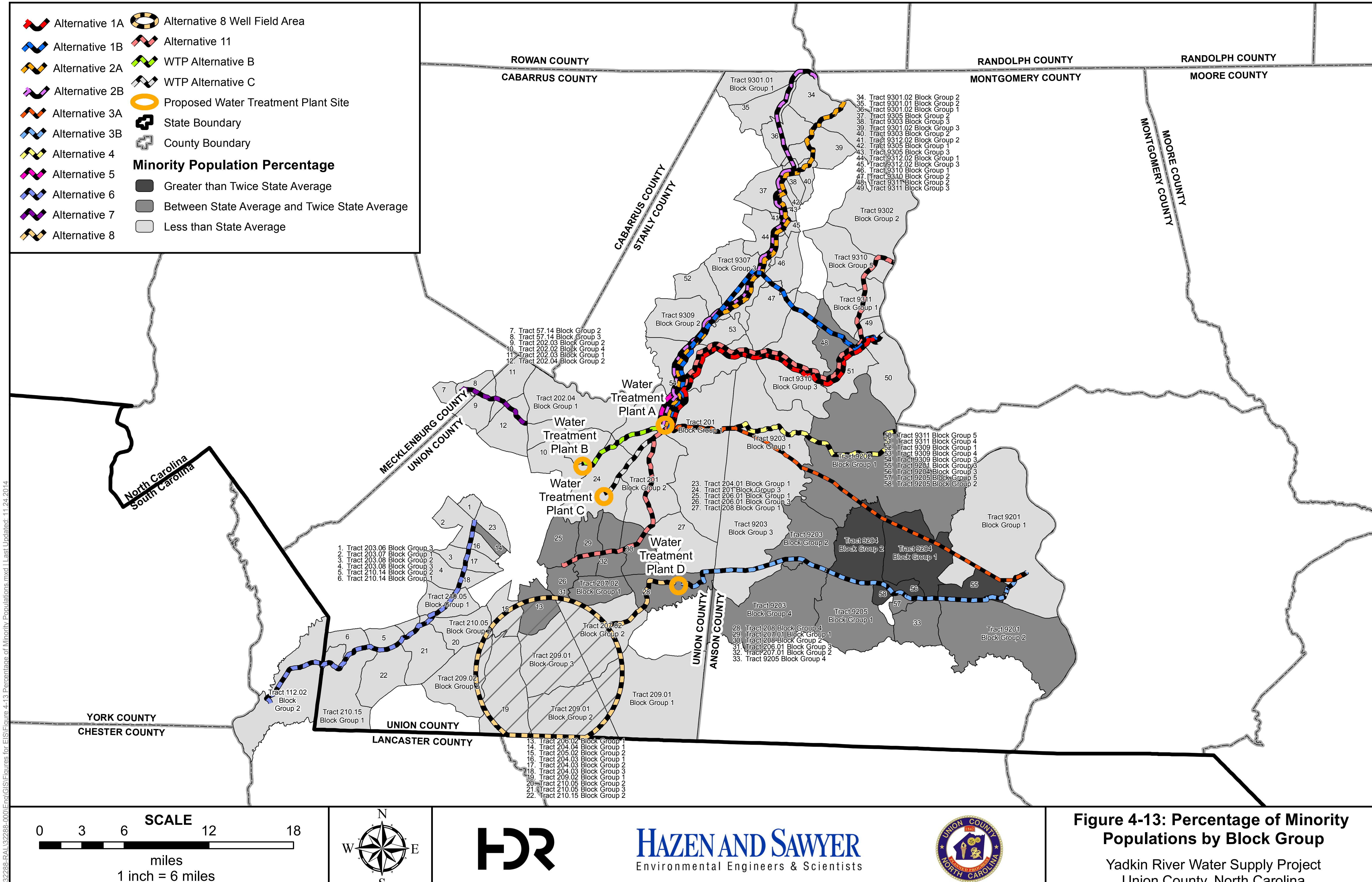

Figure 4-13: Percentage of Minority Populations by Block Group

Yadkin River Water Supply Project
Union County, North Carolina

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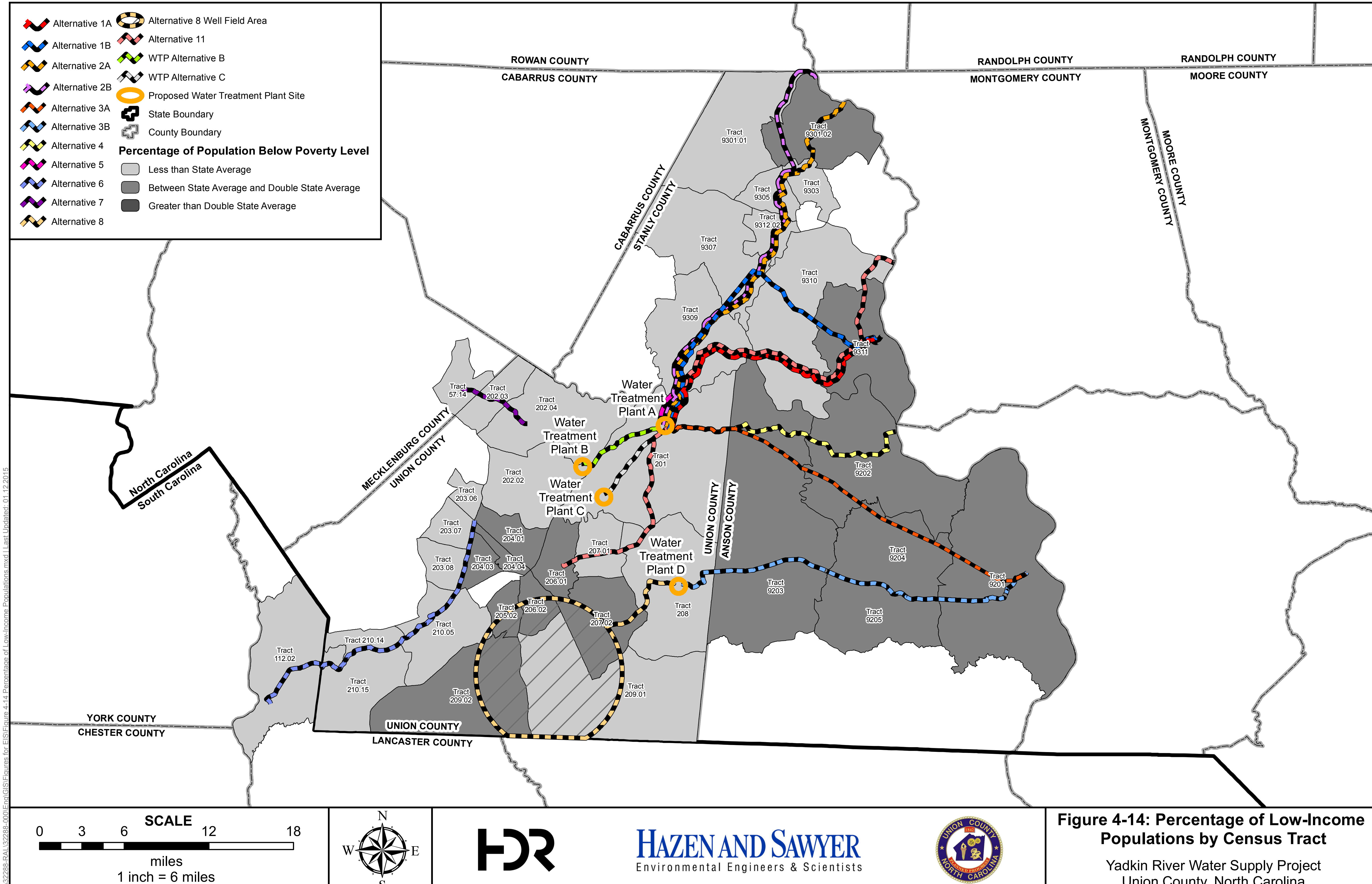

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Figure 4-14: Percentage of Low-Income Populations by Census Tract

Yadkin River Water Supply Project
Union County, North Carolina

O:\32288-RAL\32288-000\Eng\GIS\Figures for EIS\Figure 4-14 Percentage of Low-Income Populations.mxd | Last Updated: 01.12.2015

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B

APPENDIX B – Water Demand Projections and Data Evaluation

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B.1

APPENDIX B.1

Yadkin River Water Supply Project - Water Demand Projections

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INTERBASIN TRANSFER WATER BALANCE TABLE

-AVERAGE DAILY TRANSFER ESTIMATES-

Water System: Union County (PWSID 01-90-413)
Source Basin: Yadkin River (18-1)
Receiving Basin(s): Rocky River (18-4)

Date: 12/14/2015
Prepared By: HDR

Year[3] (A)	Water System (B)	Withdrawal fron Source[1] (MGD) (C)	Consumptive Loss[1] Source Basin (MGD) (D)	Consumptive Loss[1] Receiving Basin[4] (MGD) (E)	Wastewater Discharge[1] Source Basin (MGD) (F)	Wastewater Discharge[1] Receiving Basin (MGD) (G)	Total Return to Source Basin[1] (MGD) (H)=(D)+(F)	Total Surface Water Transfer[1] (MGD) (I)=(C)-(H)	Comments
2010	Union County[2]	1.79	0.00	0.00	0.00	2.40	0.00	1.79	Cork Rule Exception applies[5]
2013 (BASE YEAR)	Union County[2]	1.79	0.00	0.00	0.00	2.75	0.00	1.79	Cork Rule Exception applies[5]
2015	Union County[2]	2.37	0.00	0.00	0.00	2.98	0.00	2.37	Cork Rule Exception applies[5]
2020	Union County[2]	2.37	0.00	0.00	0.00	4.07	0.00	2.37	Cork Rule Exception applies[5]
2030	Union County[2]	7.03	0.00	1.53	0.00	5.50	0.00	7.03	Assumes YRWSP operational
2040	Union County[2]	11.76	0.00	4.86	0.00	6.90	0.00	11.76	Assumes YRWSP operational
2050	Union County[2]	16.50	0.00	7.70	0.00	8.80	0.00	16.50	Assumes YRWSP operational

Notes:
1. All numbers are expressed in million gallons per day (MGD) rounded to two decimal places.
2. Union County water system includes wholesale water supply to the Town of Wingate.
3. Water use values shown for 2010-2015 are estimated values, based on Union County Master Plan and subsequent projections developed for this EIS document.
4. Consumptive loss values indicated in the receiving basin through 2020 reflect low values as a portion of wastewater returns to the receiving basin may include returns of supplemental water supplied to the receiving basin through Union County's existing grandfathered Catawba River IBT.
5. Cork Rule Exception applies for Anson County water sales to Union County as the withdrawal is below Rocky River confluence with the Pee Dee River.

INTERBASIN TRANSFER WATER BALANCE TABLE

-MAXIMUM MONTH AVERAGE DAILY TRANSFER ESTIMATES-

Water System: Union County (PWSID 01-90-413)
Source Basin: Yadkin River (18-1)
Receiving Basin(s): Rocky River (18-4)

Date: 12/14/2015
Prepared By: HDR

Year[4] (A)	Water System (B)	Withdrawal fron Source[1] (MGD) (C)	Consumptive Loss[1] Source Basin (MGD) (D)	Consumptive Loss[1] Receiving Basin[5] (MGD) (E)	Wastewater Discharge[1,3] Source Basin (MGD) (F)	Wastewater Discharge[1,3] Receiving Basin (MGD) (G)	Total Return to Source Basin[1] (MGD) (H)=(D)+(F)	Total Surface Water Transfer[1] (MGD) (I)=(C)-(H)	Comments
2010	Union County[2]	2.50	0.00	0.10	0.00	2.40	0.00	2.50	Cork Rule Exception applies[6]
2013 (BASE YEAR)	Union County[2]	2.50	0.00	0.00	0.00	2.75	0.00	2.50	Cork Rule Exception applies[6]
2015	Union County[2]	3.30	0.00	0.32	0.00	2.98	0.00	3.30	Cork Rule Exception applies[6]
2020	Union County[2]	3.30	0.00	0.00	0.00	4.07	0.00	3.30	Cork Rule Exception applies[6]
2030	Union County[2]	9.80	0.00	4.30	0.00	5.50	0.00	9.80	Assumes YRWSP operational
2040	Union County[2]	16.40	0.00	9.50	0.00	6.90	0.00	16.40	Assumes YRWSP operational
2050	Union County[2]	23.00	0.00	14.20	0.00	8.80	0.00	23.00	Assumes YRWSP operational

Notes:

1. All numbers are expressed in million gallons per day (MGD) rounded to two decimal places.
2. Union County water system includes wholesale water supply to the Town of Wingate.
3. Wastewater discharge shown based on average annual daily values to more accurately reflect full magnitude of water transfer.
4. Water use values shown for 2010-2015 are estimated values, based on Union County Master Plan and subsequent projections developed for this EIS document.
5. Consumptive loss values indicated in the receiving basin through 2020 reflect low values as a portion of wastewater returns to the receiving basin may include returns of supplemental water supplied to the receiving basin through Union County's existing grandfathered Catawba River IBT.
6. Cork Rule Exception applies for Anson County water sales to Union County as the withdrawal is below Rocky River confluence with the Pee Dee River.

Union County Water Supply Projections for the Yadkin River Water Supply Project

Catawba Inputs		Yadkin Inputs	
Population Growth 2010-2020	2.4%	Population Growth 2010-2020	2.7%
Population Growth 2021-2030	1.8%	Population Growth 2021-2030	2.7%
Population Growth 2031-2040	1.8%	Population Growth 2031-2040	2.4%
Population Growth 2041-2050	1.8%	Population Growth 2041-2050	1.8%
Service Area Growth	0.20%	Service Area Growth	1.00%
Per Capita Use	120	Per Capita Use	120
Peaking Factor	1.7	Peaking Factor	1.7
IBT Limit (mgd)	5.0	Add'l Anson Supply (mgd)	0
CRWTP 2018 Add'l Capacity (mgd)	9	YRWSP 2022 Capacity (mgd)	12
CRWTP 2039 Add'l Capacity (mgd)	18	YRWSP 2032 Capacity (mgd)	20
		YRWSP 2044 Capacity (mgd)	28

Legend

User input/selection required
Value referenced from user input/selection
Dependent calculation value
Calculation Result of Importance

Planning Year	Average Day Water Demands (ADD)			MDD:ADD Peaking Factor - Catawba	MDD:ADD Peaking Factor - Yadkin	Maximum Month Daily Water Demands (MMDD)			Maximum Day Water Demands (MDD)			Water Supply (MMDD)								Total Supply (mgd)	Supply Adequacy		IBT					
	Catawba (mgd)	Yadkin (mgd)	Total (mgd)			Catawba (mgd)	Yadkin (mgd)	Total (mgd)	Catawba (mgd)	Yadkin (mgd)	Total (mgd)	Catawba (mgd) CRWTP Existing	CRWTP New	Total	Yadkin (mgd) Anson Existing	Anson New	Anson Total	YRWSP	Total		Demand % of Supply	Sufficient Supply?	Catawba Supply Surplus/Deficit (mgd)	Yadkin Supply Surplus/Deficit (mgd)	Water Transfer Amount (mgd)	WW Transfer (mgd)	Net IBT - Max Month Daily Avg (mgd)	Transfer Direction
A	B	C	D	E	F	G	H	I	G	H	I	J	K	L	M	N		O	P	Q	R	S	T	U	V	W	Z	AA
2010	5.6	4.9	10.5			8.0	6.9	14.8	9.7	8.4	18.1	14.8	0.0	14.8	2.5	0.0	2.5	0.0	2.5	17.2	86.2%	YES	6.8	-4.4	4.4	0.7	3.7	Catawba to Yadkin
2011	5.9	5.1	11.0	1.70	1.70	8.2	7.1	15.3	10.0	8.7	18.7	14.8	2.5	17.2	2.5	0.0	2.5	0.0	2.5	19.7	77.8%	YES	9.0	-4.6	4.6	0.8	3.9	Catawba to Yadkin
2012	6.2	5.3	11.5	1.70	1.70	8.6	7.4	16.0	10.5	9.0	19.5	14.8	2.5	17.2	2.5	0.0	2.5	0.0	2.5	19.7	81.2%	YES	8.6	-4.9	4.9	0.8	4.1	Catawba to Yadkin
2013	6.4	5.5	11.9	1.70	1.70	8.9	7.7	16.6	10.8	9.4	20.2	14.8	2.5	17.2	2.5	0.0	2.5	0.0	2.5	19.7	84.2%	YES	8.4	-5.2	5.2	0.9	4.3	Catawba to Yadkin
2014	6.6	5.8	12.3	1.70	1.70	10.7	8.0	18.7	13.0	9.8	22.8	14.8	2.5	17.2	2.5	0.8	3.3	0.0	3.3	20.5	91.4%	YES	6.5	-4.7	4.7	1.0	3.7	Catawba to Yadkin
2015	6.8	6.0	12.8	1.70	1.70	11.0	8.4	19.4	13.4	10.2	23.6	14.8	2.5	17.2	2.5	0.8	3.3	0.0	3.3	20.5	94.4%	YES	6.2	-5.1	5.1	1.1	4.0	Catawba to Yadkin
2016	7.0	6.3	13.2	1.70	1.70	11.3	8.7	20.0	13.8	10.6	24.4	14.8	2.5	17.2	2.5	0.8	3.3	0.0	3.3	20.5	97.6%	YES	5.9	-5.4	5.4	1.2	4.3	Catawba to Yadkin
2017	7.2	6.5	13.7	1.70	1.70	11.6	9.1	20.7	14.1	11.1	25.2	14.8	2.5	17.2	2.5	0.8	3.3	0.0	3.3	20.5	100.8%	NO	5.6	-5.8	5.8	1.3	4.5	Catawba to Yadkin
2018	7.4	6.8	14.2	1.70	1.70	11.9	9.5	21.4	14.5	11.5	26.0	14.8	7.4	22.1	2.5	0.8	3.3	0.0	3.3	25.4	84.0%	YES	10.2	-6.2	6.2	1.6	4.6	Catawba to Yadkin
2019	7.6	7.1	14.7	1.70	1.70	12.2	9.8	22.1	14.9	12.0	26.9	14.8	7.4	22.1	2.5	0.8	3.3	0.0	3.3	25.4	86.8%	YES	9.9	-6.6	6.6	1.7	4.9	Catawba to Yadkin
2020	7.9	7.4	15.2	1.70	1.70	12.6	10.2	22.8	15.3	12.5	27.8	14.8	7.4	22.1	2.5	0.8	3.3	0.0	3.3	25.4	89.7%	YES	9.6	-7.0	7.0	1.8	5.2	Catawba to Yadkin
2021	8.1	7.7	15.7	1.70	1.70	12.8	10.7	23.5	15.6	13.0	28.6	14.8	7.4	22.1	2.5	0.8	3.3	0.0	3.3	25.4	92.4%	YES	9.3	-7.4	7.4	1.8	5.6	Catawba to Yadkin
2022	8.3	8.0	16.2	1.70	1.70	13.1	11.1	24.2	15.9	13.5	29.5	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	75.6%	YES	9.1	-1.3	1.3	1.9	0.0	
2023	8.5	8.3	16.7	1.70	1.70	13.3	11.6	24.9	16.3	14.1	30.4	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	77.8%	YES	8.8	-1.7	1.7	2.0	0.0	
2024	8.7	8.6	17.3	1.70	1.70	13.6	12.0	25.6	16.6	14.7	31.3	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	80.2%	YES	8.5	-2.2	2.2	2.1	0.1	Catawba to Yadkin
2025	8.9	9.0	17.8	1.70	1.70	13.9	12.5	26.4	17.0	15.3	32.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	82.6%	YES	8.2	-2.7	2.7	2.1	0.5	Catawba to Yadkin
2026	9.1	9.3	18.4	1.70	1.70	14.2	13.0	27.2	17.3	15.9	33.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	85.0%	YES	8.0	-3.2	3.2	2.2	1.0	Catawba to Yadkin
2027	9.3	9.7	19.0	1.70	1.70	14.5	13.5	28.0	17.7	16.5	34.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	87.6%	YES	7.7	-3.7	3.7	2.3	1.4	Catawba to Yadkin
2028	9.5	10.1	19.6	1.70	1.70	14.8	14.1	28.8	18.0	17.2	35.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	90.2%	YES	7.4	-4.2	4.2	2.4	1.9	Catawba to Yadkin
2029	9.7	10.5	20.2	1.70	1.70	15.1	14.6	29.7	18.4	17.8	36.2	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	92.9%	YES	7.1	-4.8	4.8	2.4	2.4	Catawba to Yadkin
2030	9.9	10.9	20.8	1.70	1.70	15.4	15.2	30.6	18.8	18.6	37.3	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	95.7%	YES	6.8	-5.4	5.4	2.5	2.9	Catawba to Yadkin
2031	10.1	11.3	21.5	1.70	1.70	15.7	15.8	31.5	19.2	19.2	38.4	14.8	7.4	22.1	0.0	0.0	0.0	9.8	9.8	32.0	98.4%	YES	6.4	-5.9	5.9	2.6	3.4	Catawba to Yadkin
2032	10.4	11.7	22.1	1.70	1.70	16.0	16.3	32.4	19.5	19.9	39.5	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	84.0%	YES	6.1	0.1	0.0	2.6	0.0	
2033	10.6	12.1	22.8	1.70	1.70	16.4	16.9	33.3	19.9	20.7	40.6	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	86.4%	YES	5.8	-0.5	0.5	2.7	0.0	
2034	10.9	12.6	23.4	1.70	1.70	16.7	17.5	34.2	20.4	21.4	41.8	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	88.8%	YES	5.4	-1.1	1.1	2.8	0.0	
2035	11.1	13.0	24.1	1.70	1.70	17.0	18.2	35.2	20.8	22.2	42.9	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	91.4%	YES	5.1	-1.8	1.8	2.8	0.0	
2036	11.4	13.5	24.9	1.70	1.70	17.4	18.8	36.2	21.2	23.0	44.2	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	94.0%	YES	4.8	-2.4	2.4	2.9	0.0	
2037	11.6	14.0	25.6	1.70	1.70	17.7	19.5	37.2	21.6	23.8	45.4	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	96.7%	YES	4.4	-3.1	3.1	2.9	0.2	Catawba to Yadkin
2038	11.9	14.5	26.4	1.70	1.70	18.1	20.2	38.3	22.1	24.7	46.7	14.8	7.4	22.1	0.0	0.0	0.0	16.4	16.4	38.5	99.4%	YES	4.0	-3.8	3.8	3.0	0.8	Catawba to Yadkin
2039	12.1	15.0	27.2	1.70	1.70	18.5	20.9	39.4	22.5	25.5	48.1	14.8	14.8	29.5	0.0	0.0	0.0	16.4	16.4	45.9	85.8%	YES	11.1	-4.5	4.5	3.0	1.5	Catawba to Yadkin
2040	12.4	15.6	28.0	1.70	1.70	18.8	21.7	40.5	23.0	26.4	49.4	14.8	14.8	29.5	0.0	0.0	0.0	16.4	16.4	45.9	88.3%	YES	10.7	-5.3	5.3	3.1	2.2	Catawba to Yadkin
2041	12.7	16.0	28.7	1.70	1.70	19.2	22.3	41.6	23.5	27.2	50.7	14.8	14.8	29.5	0.0	0.0	0.0	16.4	16.4	45.9	90.5%	YES	10.3	-5.9	5.9	3.2	2.8	Catawba to Yadkin
2042	13.0	16.5	29.4	1.70	1.70	19.6	23.0	42.6	23.9	28.0	52.0	14.8	14.8	29.5	0.0	0.0	0.0	16.4	16.4	45.9	92.8%	YES	9.9	-6.6	6.6	3.2	3.4	Catawba to Yadkin
2043	13.2	17.0	30.2	1.70	1.70	20.0	23.7	43.7	24.4	28.8	53.3	14.8	14.8	29.5	0.0	0.0	0.0	16.4	16.4	45.9	95.1%	YES	9.5	-7.3	7.3	3.3	4.0	Catawba to Yadkin
2044	13.5	17.5	31.0	1.70	1.70	20.4	24.3	44.8	24.9	29.7	54.6	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	85.3%	YES	9.1	-1.4	1.4	3.3	0.0	
2045	13.8	18.0	31.8	1.70	1.70	20.9	25.1	45.9	25.4	30.6	56.0	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	87.5%	YES	8.7	-2.1	2.1	3.4	0.0	
2046	14.1	18.5	32.6	1.70	1.70	21.3	25.8	47.1	25.9	31.5	57.4	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	89.7%	YES	8.2	-2.8	2.8	3.5	0.0	
2047	14.5	19.0	33.5	1.70	1.70	21.7	26.5	48.3	26.5	32.4	58.8	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	91.9%	YES	7.8	-3.6	3.6	3.5	0.1	Catawba to Yadkin
2048	14.8	19.6	34.4	1.70	1.70	22.2	27.3	49.5	27.0	33.3	60.3	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	94.3%	YES	7.4	-4.4	4.4	3.6	0.8	Catawba to Yadkin
2049	15.1	20.2	35.3	1.70	1.70	22.6	28.1	50.7	27.6	34.3	61.8	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	96.6%	YES	6.9	-5.2	5.2	3.6	1.5	Catawba to Yadkin
2050	15.4	20.8	36.2	1.70	1.70	23.1	28.9	52.0	28.1	35.3	63.4	14.8	14.8	29.5	0.0	0.0	0.0	23.0	23.0	52.5	99.1%	YES	6.5	-6.0	6.0	3.7	2.3	Catawba to Yadkin
2013-2050 AGR	2.43%	3.64%	3.06%			2.62%	3.64%	3.14%	2.62%	3.64%	3.14%																	
2030-2050 AGR	2.23%	3.27%	2.80%			2.04%	3.27%	2.69%	2.04%	3.27%	2.69%																	

Planning Year	Water Supply (MDD)								Total Supply (mgd)	Supply Adequacy		IBT								
	Catawba (mgd) CRWTP Existing	CRWTP New	Total	Yadkin (mgd) Anson Existing	Anson New	Anson Total	YRWSP	Total		Demand % of Supply	Sufficient Supply?	Catawba Supply Surplus/Deficit (mgd)	Yadkin Supply Surplus/Deficit (mgd)	Water Transfer Amount (mgd)	WW Transfer (mgd)	Net IBT Max Daily (mgd)	IBT Max Month Avg / Max Day Factor	Net IBT - Max Month Daily Avg (mgd)	Transfer Direction
A	J	K	L	M	N		O	P	Q	R	S	T	U	V	W	X	y	z	AA
2010	18.0	0.0	18.0	3.0	0.0	3.0	0.0	3.0	21.0	86.2%	YES	8.3	-5.4	5.4	0.9	4.5	0.82	3.7	Catawba to Yadkin
2011	18.0	3.0	21.0	3.0	0.0	3.0	0.0	3.0	24.0	77.8%	YES	11.0	-5.7	5.7	0.9	4.8	0.82	3.9	Catawba to Yadkin
2012	18.0	3.0	21.0	3.0	0.0	3.0	0.0	3.0	24.0	81.2%	YES	10.5	-6.0	6.0	1.0	5.0	0.82	4.1	Catawba to Yadkin
2013	18.0	3.0	21.0	3.0	0.0	3.0	0.0	3.0	24.0	84.2%	YES	10.2	-6.4	6.4	1.1	5.3	0.82	4.3	Catawba to Yadkin
2014	18.0	3.0	21.0	3.0	1.0	4.0	0.0	4.0	25.0	91.4%	YES	8.0	-5.8	5.8	1.2	4.6	0.82	3.7	Catawba to Yadkin
2015	18.0	3.0	21.0	3.0	1.0	4.0	0.0	4.0	25.0	94.4%	YES	7.6	-6.2	6.2	1.3	4.9	0.82	4.0	Catawba to Yadkin
2016	18.0	3.0	21.0	3.0	1.0	4.0	0.0	4.0	25.0	97.6%	YES	7.2	-6.6	6.6	1.4	5.2	0.82	4.3	Catawba to Yadkin
2017	18.0	3.0	21.0	3.0	1.0	4.0	0.0	4.0	25.0	100.8%	NO	6.9	-7.1	7.1	1.5	5.5	0.82	4.5	Catawba to Yadkin
2018	18.0	9.0	27.0	3.0	1.0	4.0	0.0	4.0	31.0	84.0%	YES	12.5	-7.5	7.5	1.9	5.6	0.82	4.6	Catawba to Yadkin
2019	18.0	9.0	27.0	3.0	1.0	4.0	0.0	4.0	31.0	86.8%	YES	12.1	-8.0	8.0	2.0	6.0	0.82	4.9	Catawba to Yadkin
2020	18.0	9.0	27.0	3.0	1.0	4.0	0.0	4.0	31.0	89.7%	YES	11.7	-8.5	8.5	2.2	6.3	0.82	5.2	Catawba to Yadkin
2021	18.0	9.0	27.0	3.0	1.0	4.0	0.0	4.0	31.0	92.4%	YES	11.4	-9.0	9.0	2.2	6.8	0.82	5.6	Catawba to Yadkin
2022	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	75.6%	YES	11.1	-1.5	1.5	2.3	0.0	0.82	0.0	
2023	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	77.8%	YES	10.7	-2.1	2.1	2.4	0.0	0.82	0.0	
2024	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	80.2%	YES	10.4	-2.7	2.7	2.5	0.2	0.82	0.1	Catawba to Yadkin
2025	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	82.6%	YES	10.0	-3.3	3.3	2.6	0.7	0.82	0.5	Catawba to Yadkin
2026	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	85.0%	YES	9.7	-3.9	3.9	2.7	1.2	0.82	1.0	Catawba to Yadkin
2027	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	87.6%	YES	9.3	-4.5	4.5	2.8	1.7	0.82	1.4	Catawba to Yadkin
2028	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	90.2%	YES	9.0	-5.2	5.2	2.9	2.3	0.82	1.9	Catawba to Yadkin
2029	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	92.9%	YES	8.6	-5.8	5.8	3.0	2.9	0.82	2.4	Catawba to Yadkin
2030	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	95.7%	YES	8.2	-6.6	6.6	3.1	3.5	0.82	2.9	Catawba to Yadkin
2031	18.0	9.0	27.0	0.0	0.0	0.0	12.0	12.0	39.0	98.4%	YES	7.8	-7.2	7.2	3.1	4.1	0.82	3.4	Catawba to Yadkin
2032	18.0	9.0	27.0	0.0	0.0	0.0	20.0	20.0	47.0	84.0%	YES	7.5	0.1	0.0	3.2	0.0	0.82	0.0	
2033	18.0	9.0	27.0	0.0	0.0	0.0	20.0	20.0	47.0	86.4%	YES	7.1	-0.7	0.7	3.3	0.0	0.82	0.0	
2034	18.0	9.0	27.0	0.0	0.0	0.0	20.0	20.0	47.0	88.8%	YES	6.6	-1.4	1.4	3.4	0.0	0.82	0.0	
2035	18.0	9.0	27.0	0.0	0.0	0.0	20.0	20.0	47.0	91.4%	YES	6.2	-2.2	2.2	3.4	0.0	0.82	0.0	
2036	18.0	9.0	27.0	0.0	0.0	0.0	20.0	20.0	47.0	94.0%	YES	5.8	-3.0	3.0	3.5	0.0	0.82	0.0	
2037	18.0	9.0	27.0	0.0	0.0	0.0	20.0	20.0	47.0	96.7%	YES	5.4	-3.8	3.8	3.6	0.2	0.82	0.2	Catawba to Yadkin
2038	18.0	9.0	27.0	0.0	0.0	0.0	20.0	20.0	47.0	99.4%	YES	4.9	-4.7	4.7	3.6	1.0	0.82	0.8	Catawba to Yadkin
2039	18.0	18.0	36.0	0.0	0.0	0.0	20.0	20.0	56.0	85.8%	YES	13.5	-5.5	5.5	3.7	1.8	0.82	1.5	Catawba to Yadkin
2040	18.0	18.0	36.0	0.0	0.0	0.0	20.0	20.0	56.0	88.3%	YES	13.0	-6.4	6.4	3.8	2.7	0.82	2.2	Catawba to Yadkin
2041	18.0	18.0	36.0	0.0	0.0	0.0	20.0	20.0	56.0	90.5%	YES	12.5	-7.2	7.2	3.9	3.4	0.82	2.8	Catawba to Yadkin
2042	18.0	18.0	36.0	0.0	0.0	0.0	20.0	20.0	56.0	92.8%	YES	12.1	-8.0	8.0	3.9	4.1	0.82	3.4	Catawba to Yadkin
2043	18.0	18.0	36.0	0.0	0.0	0.0	20.0	20.0	56.0	95.1%	YES	11.6	-8.8	8.8	4.0	4.8	0.82	4.0	Catawba to Yadkin
2044	18.0	18.0	36.0	0.0	0.0	0.0	28.0	28.0	64.0	85.3%	YES	11.1	-1.7	1.7	4.1	0.0	0.82	0.0	
2045	18.0	18.0	36.0	0.0	0.0	0.0	28.0	28.0	64.0	87.5%	YES	10.6	-2.6	2.6	4.1	0.0	0.82	0.0	
2046	18.0	18.0	36.0	0.0	0.0	0.0	28.0	28.0	64.0	89.7%	YES	10.1	-3.5	3.5	4.2	0.0	0.82	0.0	
2047	18.0	18.0	36.0	0.0	0.0	0.0	28.0	28.0	64.0	91.9%	YES	9.5	-4.4	4.4	4.3	0.1	0.82	0.1	Catawba to Yadkin
2048	18.0	18.0	36.0	0.0	0.0	0.0	28.0	28.0	64.0	94.3%	YES	9.0	-5.3	5.3	4.4	1.0	0.82	0.8	Catawba to Yadkin
2049	18.0	18.0	36.0	0.0	0.0	0.0	28.0	28.0	64.0	96.6%	YES	8.4	-6.3	6.3	4.4	1.9	0.82	1.5	Catawba to Yadkin
2050	18.0	18.0	36.0	0.0	0.0	0.0	28.0	28.0	64.0	99.1%	YES	7.9	-7.3	7.3	4.5	2.8	0.82	2.3	Catawba to Yadkin

amyers
Sticky Note
Size is 51.52 x 33.33

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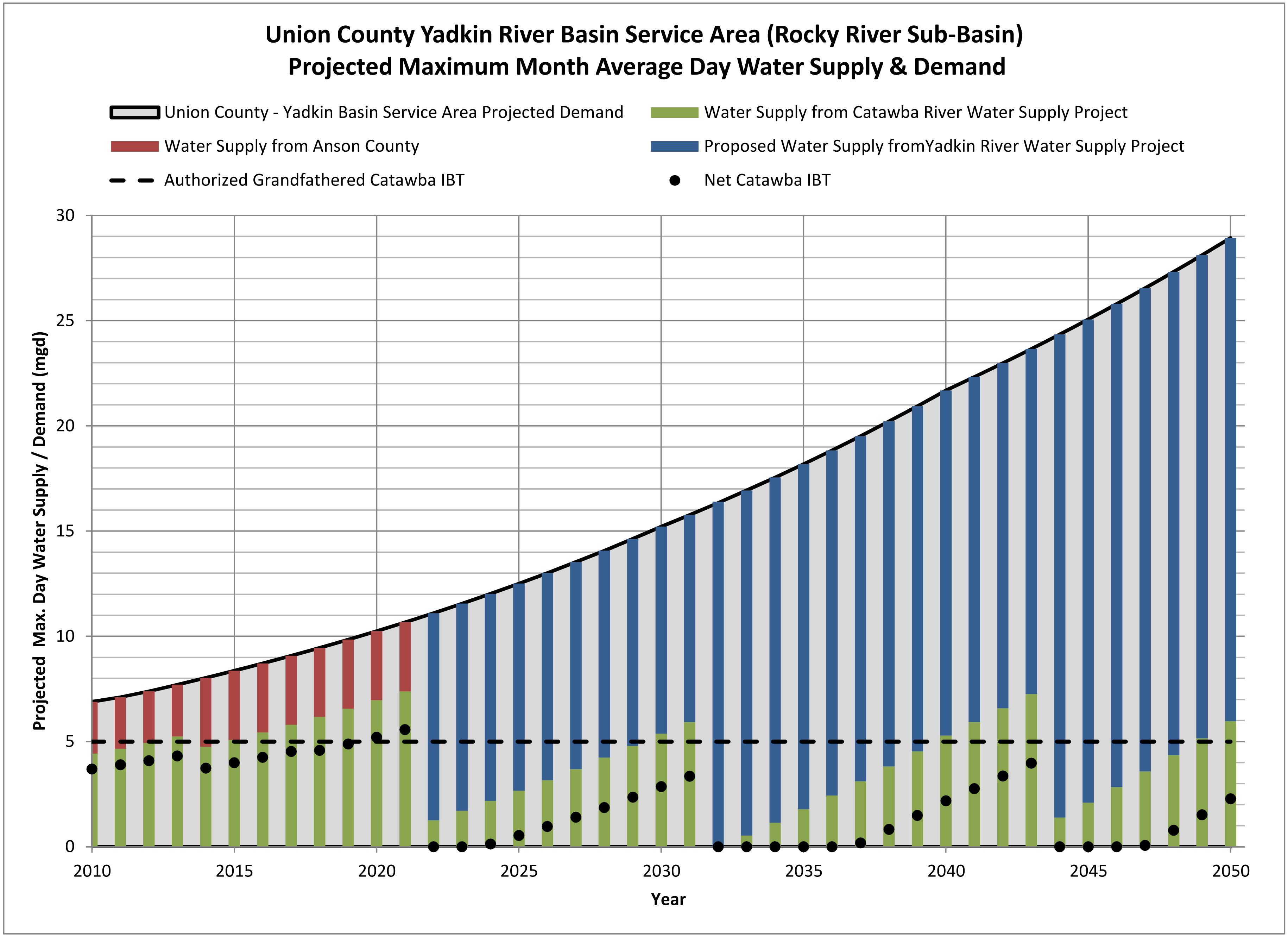
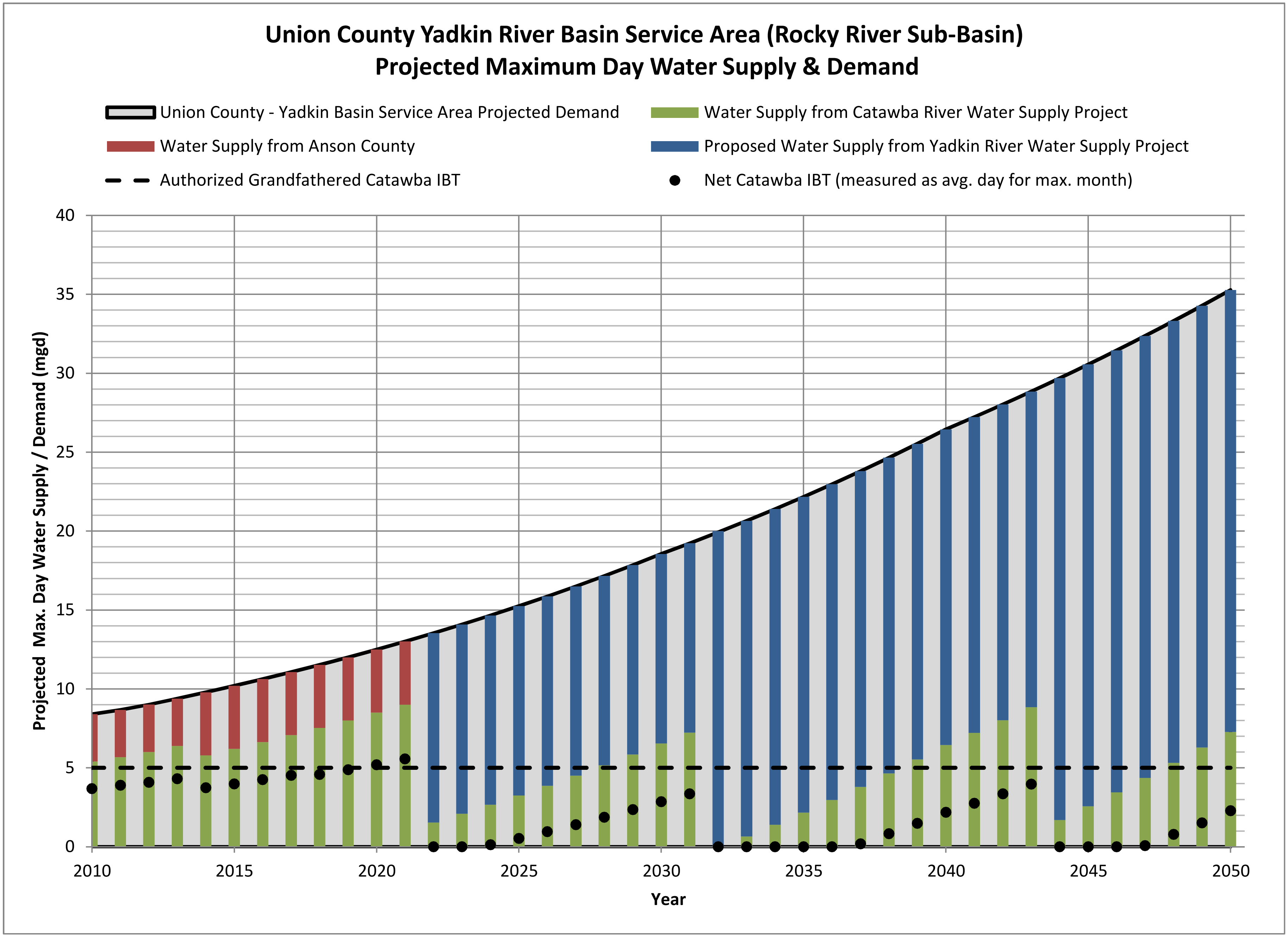


Union County Yadkin River Basin Service Area (Rocky River Sub-Basin)
Projected Maximum Month Average Day Water Supply & Demand
Union County - Yadkin Basin Service Area Projected Demand
Water Supply from Catawba River Water Supply Project
Water Supply from Anson County
Proposed Water Supply fromYadkin River Water Supply Project
Authorized Grandfathered Catawba IBT
Net Catawba IBT
Projected Max. Day Water Supply / Demand (mgd)
30
25
20
15
10
5
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year



Union County Yadkin River Basin Service Area (Rocky River Sub-Basin)
Projected Maximum Day Water Supply & Demand
Union County - Yadkin Basin Service Area Projected Demand
Water Supply from Catawba River Water Supply Project
Water Supply from Anson County
Proposed Water Supply from Yadkin River Water Supply Project
Authorized Grandfathered Catawba IBT
Net Catawba IBT (measured as avg. day for max. month)
Projected Max. Day Water Supply / Demand (mgd)
0
5
10
15
20
25
30
35
40
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year

B.2

APPENDIX B.2

Union County Public Works Water and Wastewater Comprehensive Master Plan Evaluation

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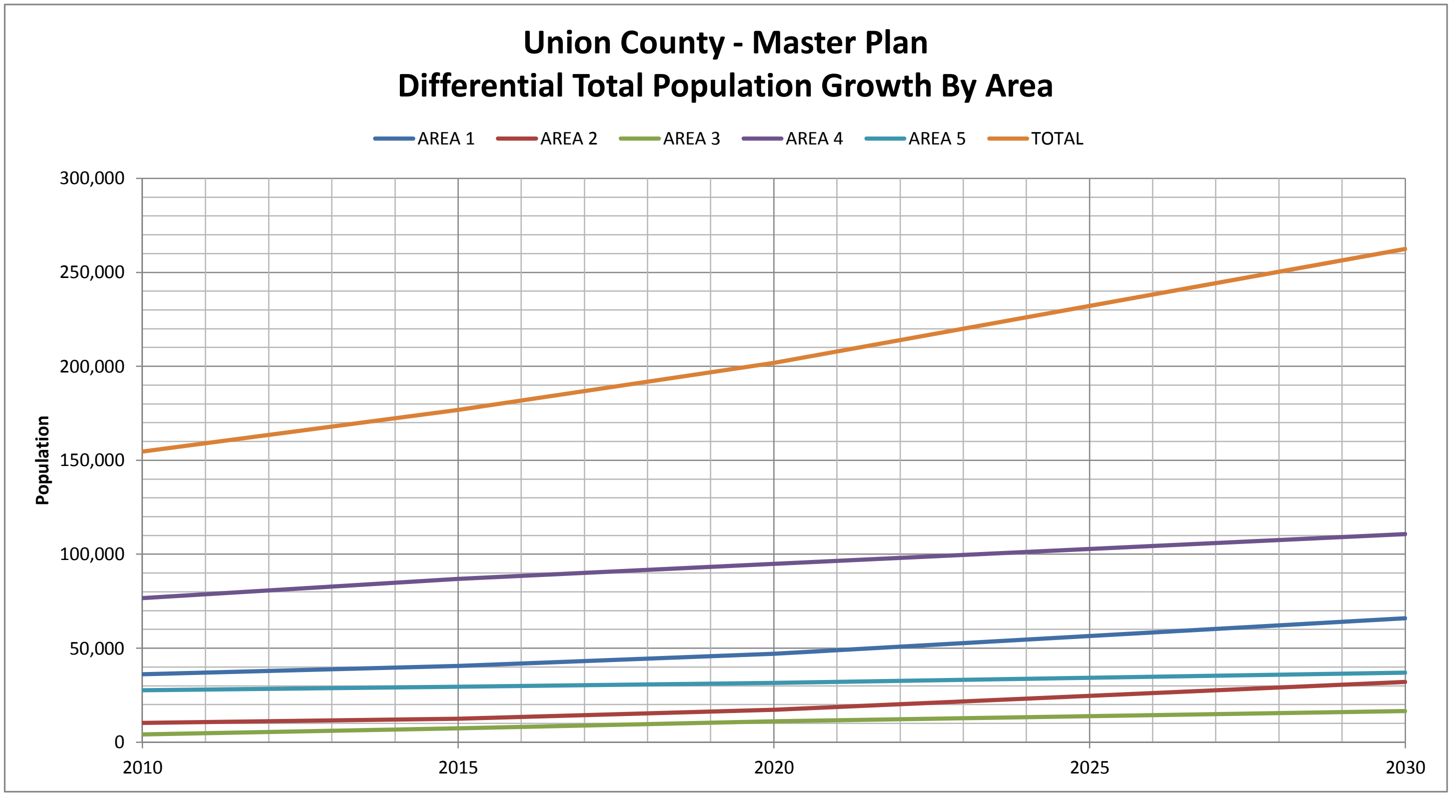
Union County Master Plan Projections

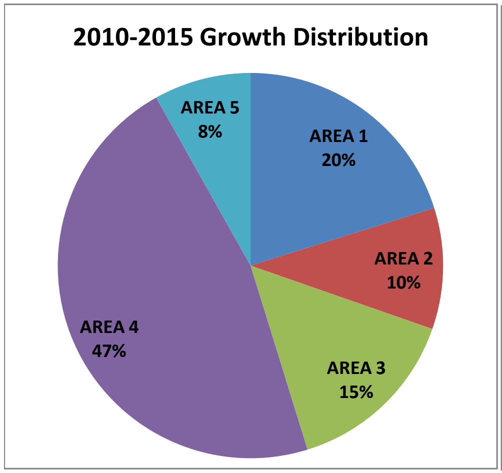
TABLE 2-1 DIFFERENTIAL TOTAL POPULATION GROWTH BY AREA

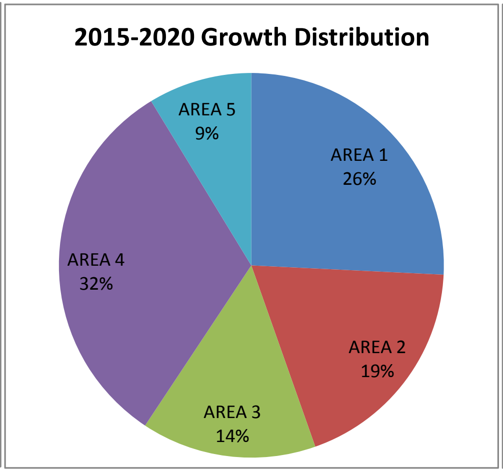
	AREA 1	AREA 2	AREA 3	AREA 4	AREA 5	TOTAL
2010	36,116	10,236	4,069	76,590	27,652	154,663
Distribution Per Area (%)	20	12	15	43	10	100
2015	40,564	12,479	7,356	86,880	29,450	176,729
Distribution Per Area (%)	25	20	15	30	10	100
2020	47,008	17,192	11,032	94,878	31,630	201,740
Distribution Per Area (%)	30	25	10	25	10	100
2030	66,008	32,093	16,561	110,759	37,024	262,445

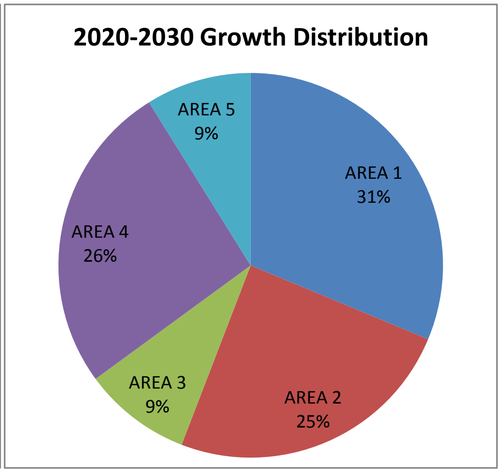
Note: Excludes Marshville, Wingate and City of Monroe population.

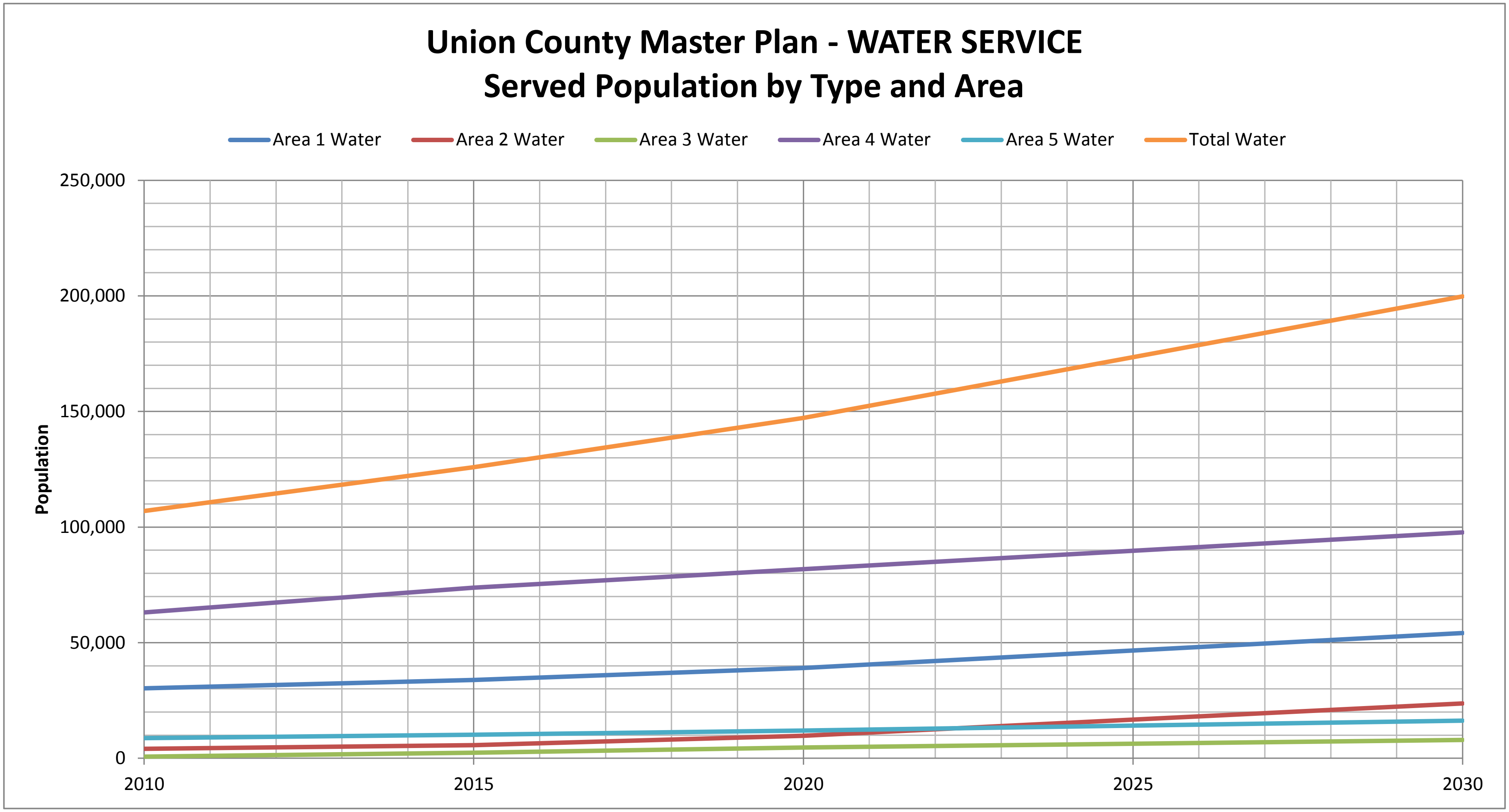
Union County Master Plan Projections











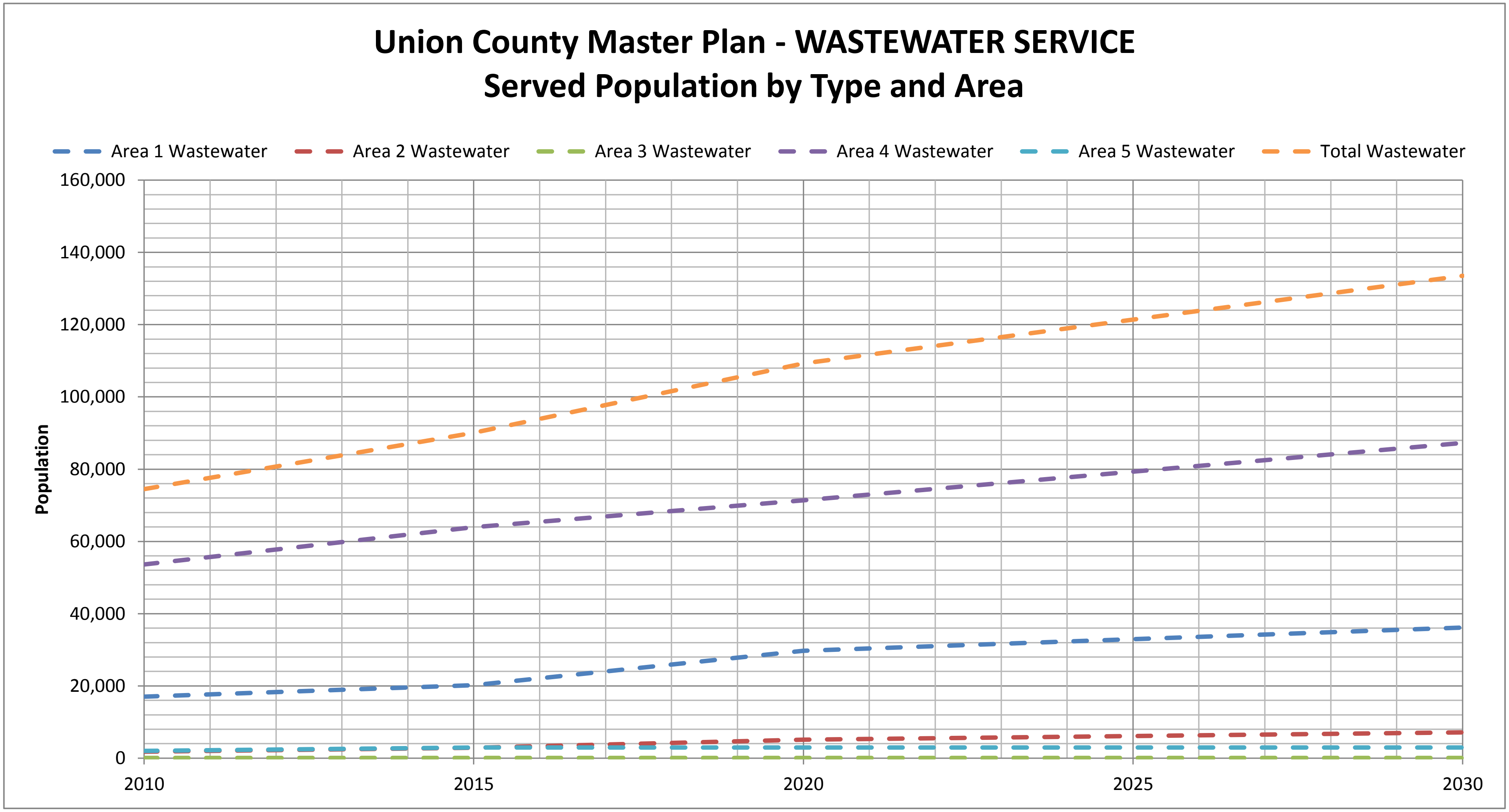
Union County Master Plan - WATER SERVICE
Served Population by Type and Area
Area 1 Water
Area 2 Water
Area 3 Water
Area 4 Water
Area 5 Water
Total Water
Population
250,000
200,000
150,000
100,000
50,000
0
2010
2015
2020
2025
2030

Union County Master Plan Projections

TABLE 2-2 SERVED POPULATION COUNT BY TYPE & AREA

	SERVICE TYPE	2010	2015	2020	2030
Area 1	Water	30,222	33,856	39,010	54,114
	Wastewater	16,999	20,226	29,757	36,126
Area 2	Water	4,053	5,622	9,782	23,703
	Wastewater	1,813	2,909	5,148	7,148
Area 3	Water	763	2,407	4,613	7,932
	Wastewater	53	53	53	53
Area 4	Water	63,104	73,832	81,829	97,710
	Wastewater	53,618	63,946	71,364	87,242
Area 5	Water	8,760	10,199	11,943	16,258
	Wastewater	2,010	2,936	2,936	2,936
Total	Water	106,902	125,916	147,177	199,717
	Wastewater	74,493	90,070	109,258	133,505

Note: Excludes Marshville and Wingate wholesale wastewater population

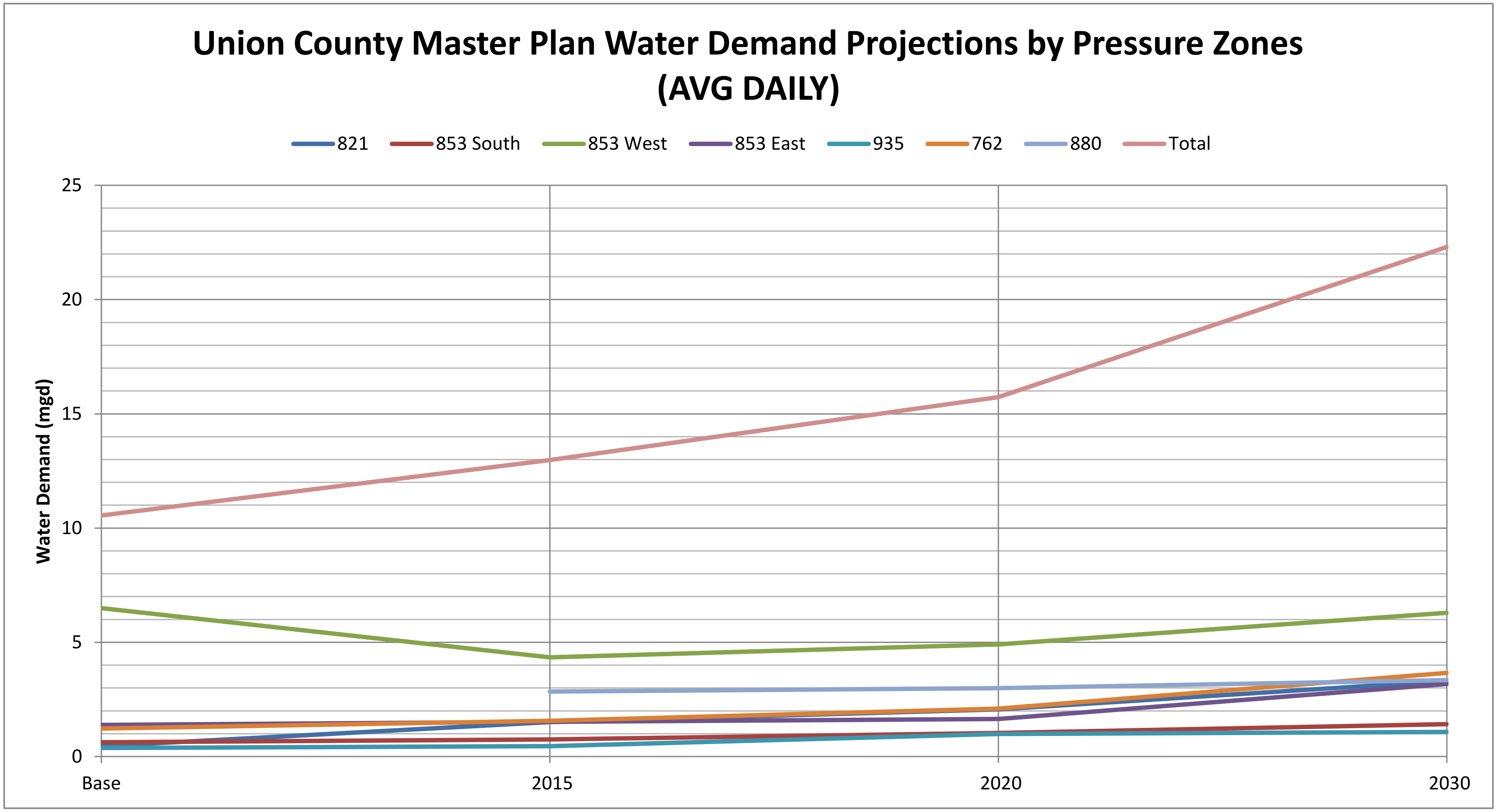


Union County Master Plan - WASTEWATER SERVICE
Served Population by Type and Area
Area 1 Wastewater
Area 2 Wastewater
Area 3 Wastewater
Area 4 Wastewater
Area 5 Wastewater
Total Wastewater
Population
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2010
2015
2020
2025
2030

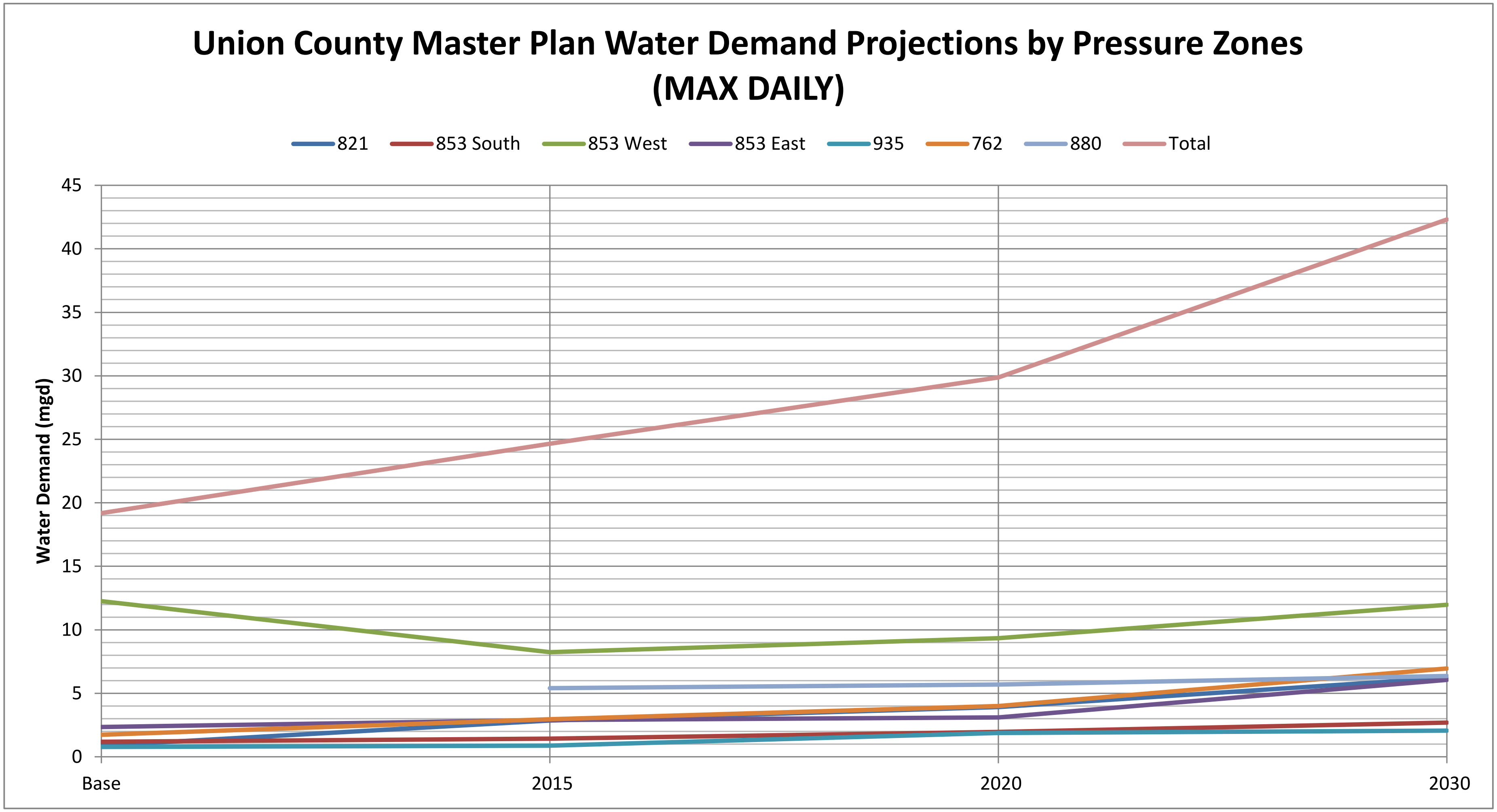
Union County Master Plan Projections

TABLE 2-3 WATER DEMAND PROJECTIONS

YEAR	BASE		2015		2020		2030	
PRESSURE	AVG DAY	MAX DAY	AVG DAY	MAX DAY	AVG DAY	MAX DAY	AVG DAY	MAX DAY
821	0.46	0.88	1.51	2.86	2.06	3.92	3.31	6.22
853 South	0.62	1.18	0.75	1.42	1.03	1.96	1.42	2.69
853 West	6.5	12.26	4.34	8.24	4.91	9.33	6.29	11.96
853 East	1.38	2.34	1.52	2.9	1.64	3.11	3.18	6.05
935	0.37	0.78	0.46	0.88	0.99	1.87	1.08	2.06
762	1.22	1.74	1.56	2.96	2.1	3.99	3.66	6.96
880			2.85	5.41	2.99	5.69	3.35	6.37
Total	10.55	19.18	12.98	24.66	15.73	29.87	22.3	42.3



Union County Master Plan Water Demand Projections by Pressure Zones
(AVG DAILY)
821
853 South
853 West
853 East
935
762
880
Total
Water Demand (mgd)
25
20
15
10
5
0
Base
2015
2020
2030

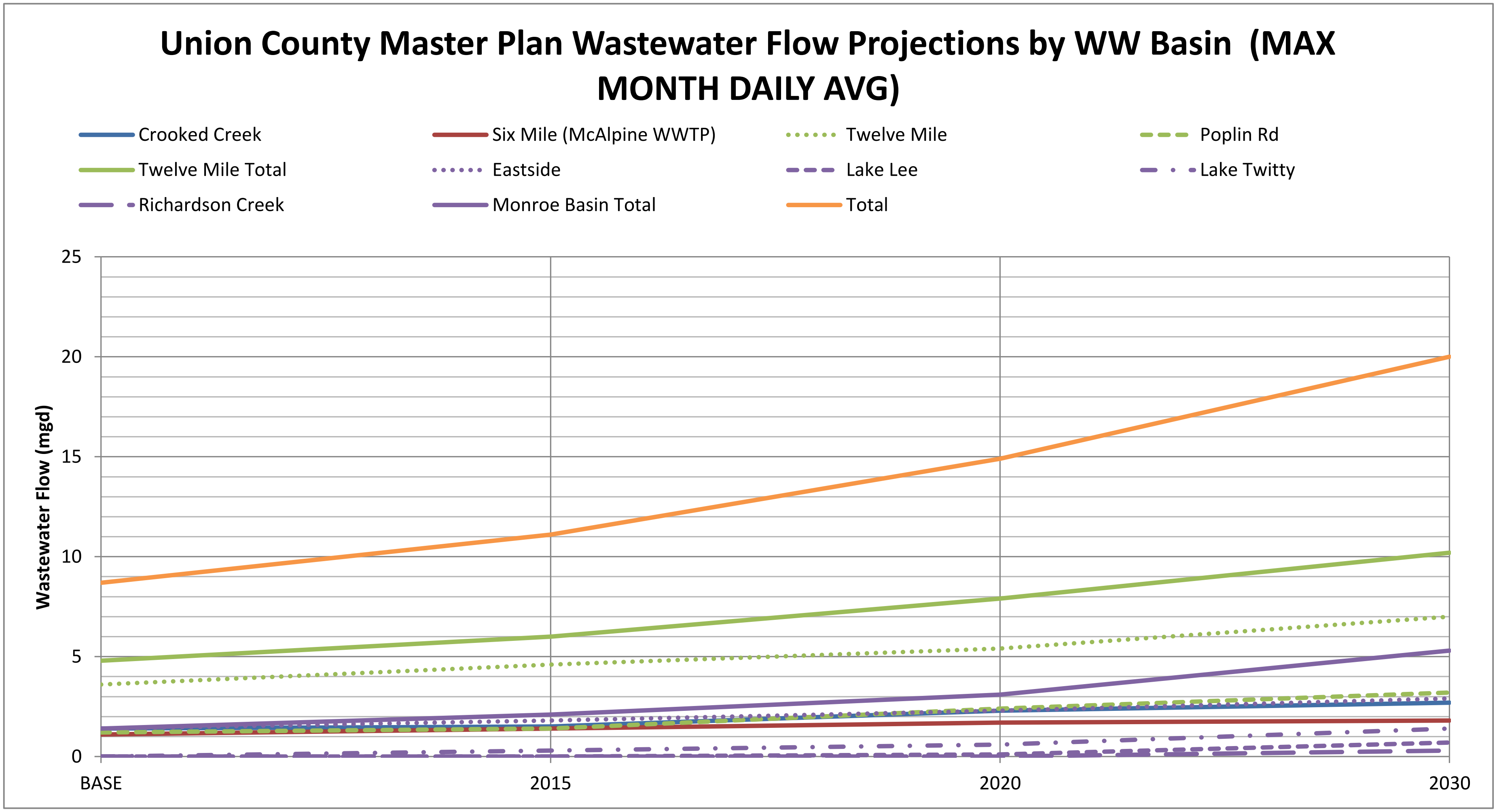


Union County Master Plan Water Demand Projections by Pressure Zones
(MAX DAILY)
821
853 South
853 West
853 East
935
762
880
Total
Water Demand (mgd)
45
40
35
30
25
20
15
10
5
0
Base
2015
2020
2030

Union County Master Plan Projections

TABLE 2-4 WASTEWATER FLOW PROJECTIONS

YEAR	BASE	2015	2020	2030
BASIN	MAXIMUM MONTH FLOW (MGD)			
Crooked Creek	1.4	1.5	2.3	2.7
Six Mile (McAlpine WWTP)	1.1	1.4	1.7	1.8
Twelve Mile	3.6	4.6	5.4	7
Poplin Rd	1.2	1.4	2.4	3.2
Twelve Mile Total	4.8	6	7.9	10.2
Eastside	1.4	1.8	2.3	2.9
Lake Lee	0	0	0.1	0.7
Lake Twitty	0	0.3	0.6	1.4
Richardson Creek	0	0	0	0.3
Monroe Basin Total	1.4	2.1	3.1	5.3
Total	8.7	11.1	14.9	20


Union County Master Plan Wastewater Flow Projections by WW Basin (MAX MONTH DAILY AVG)
Crooked Creek
Six Mile (McAlpine WWTP)
Twelve Mile
Poplin Rd
Twelve Mile Total
Eastside
Lake Lee
Lake Twitty
Richardson Creek
Monroe Basin Total
Total
Wastewater Flow (mgd)
25
20
15
10
5
0
BASE
2015
2020
2030

B.3

APPENDIX B.3

Union County Historical Population Evaluation

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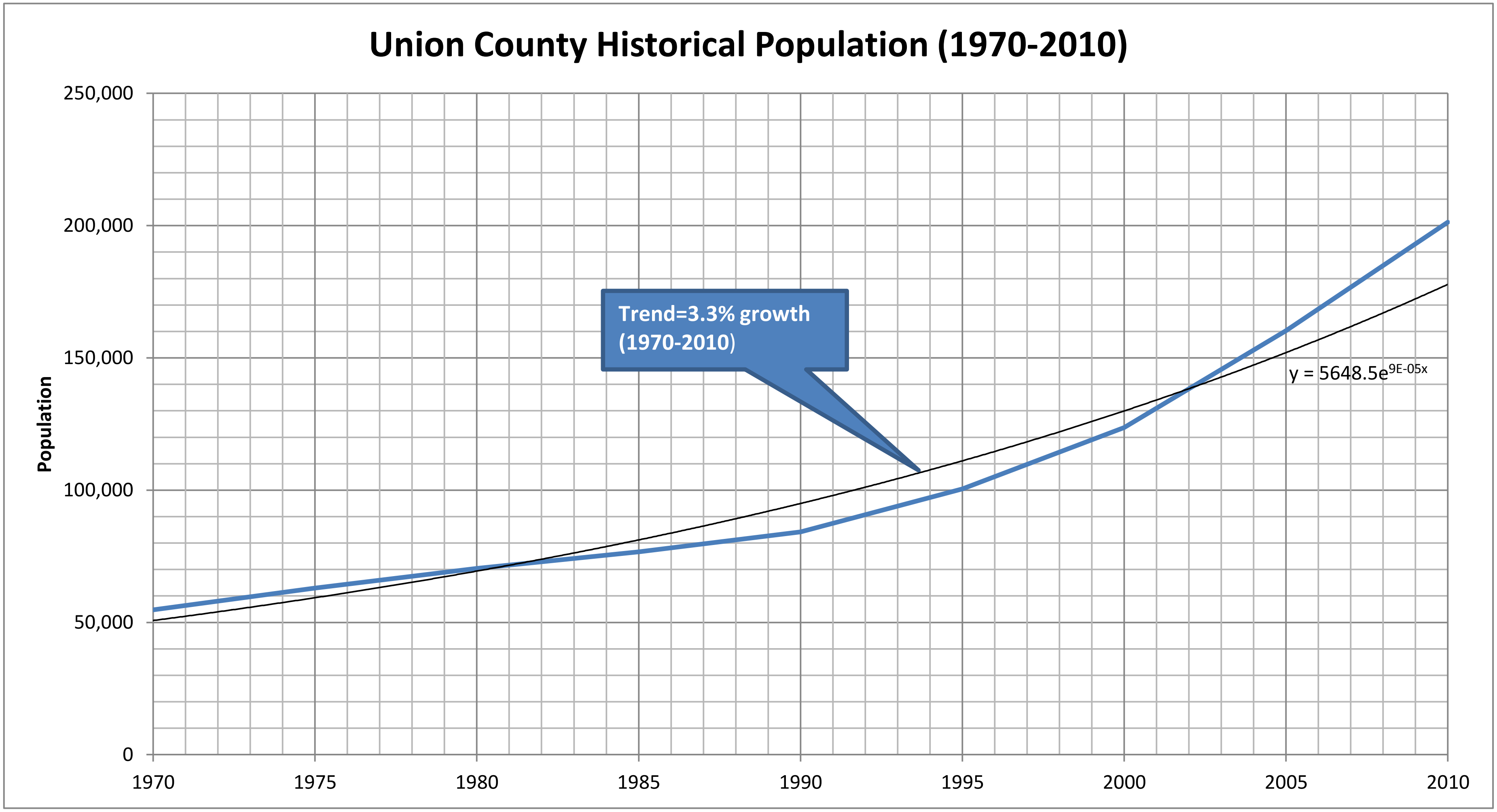
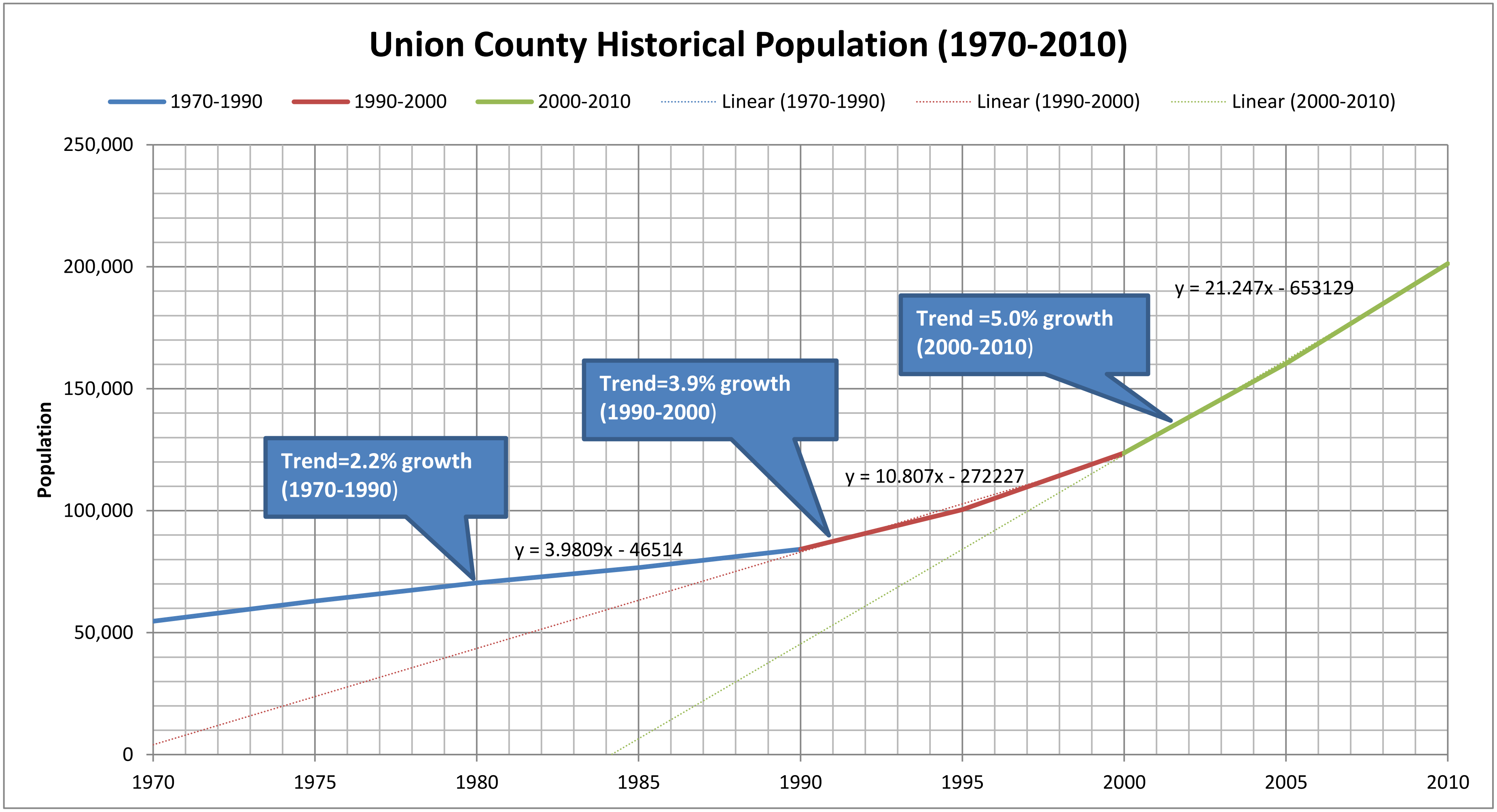
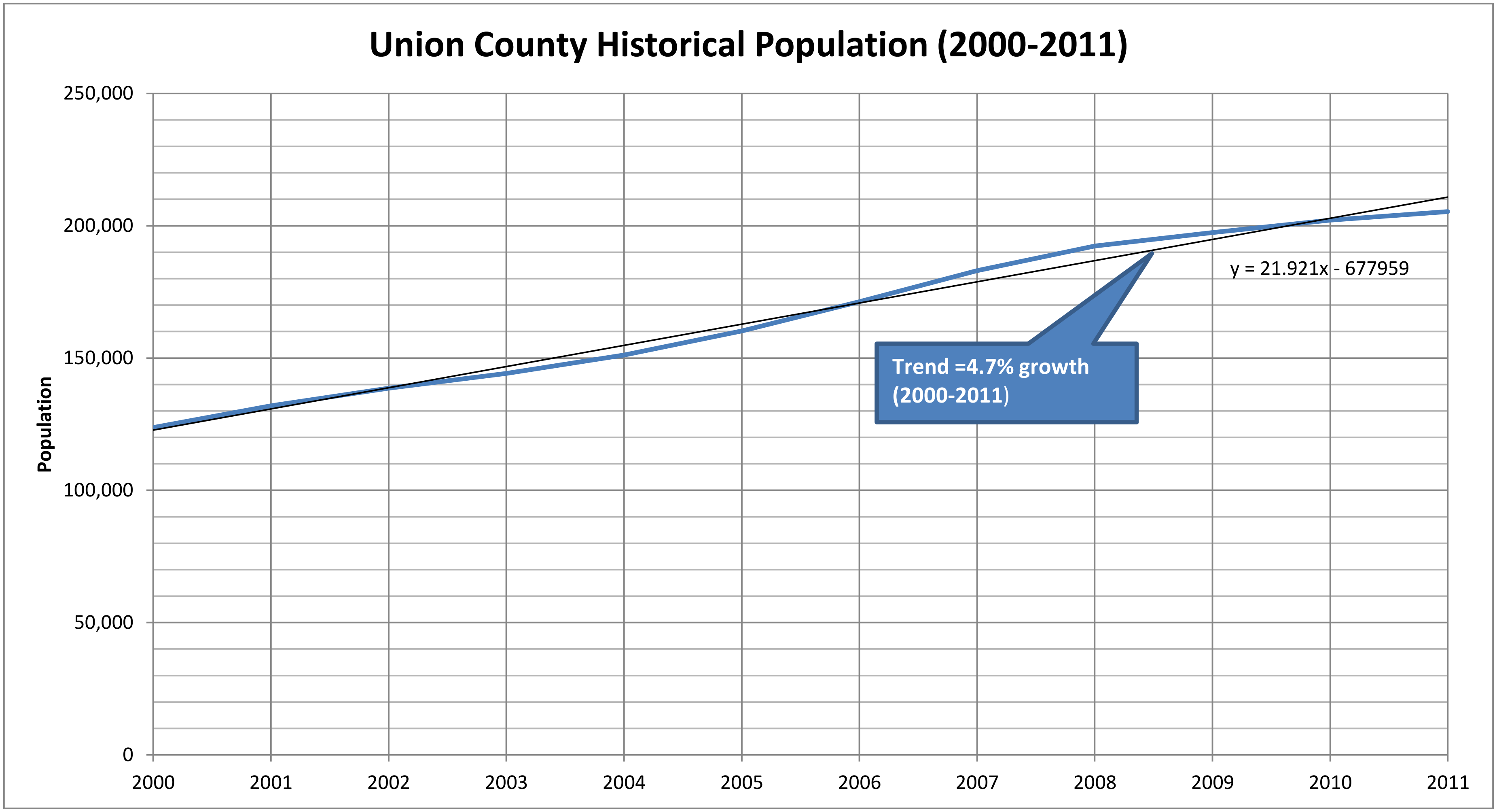
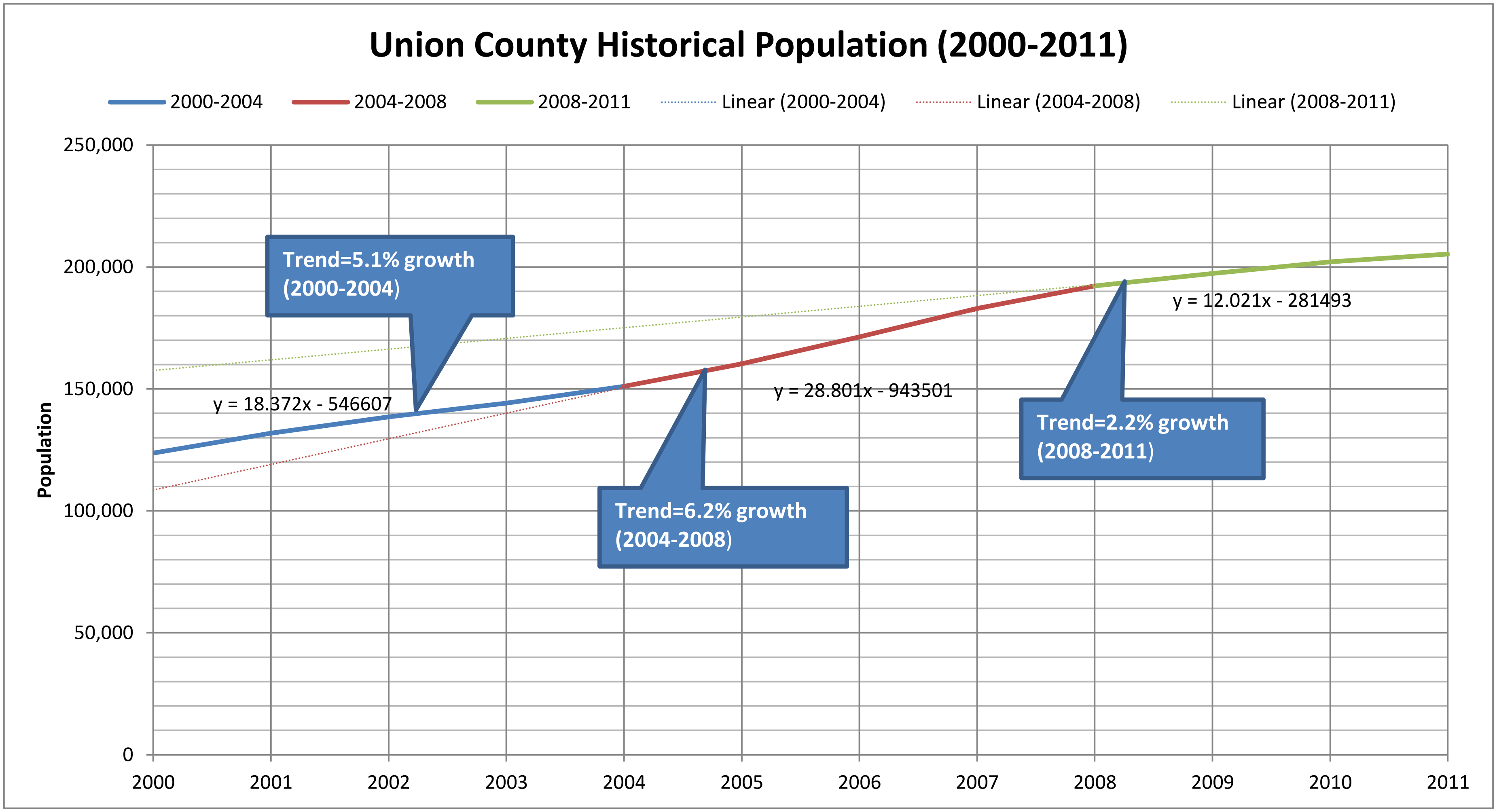

Union County Historical Population (1970-2010)
Population
250,000
200,000
150,000
100,000
50,000
0
1970
1975
1980
1985
1990
1995
2000
2005
2010
Trend=3.3% growth (1970-2010)
y = 5648.5e^9E-05x


Union County Historical Population (1970-2010)
1970-1990
1990-2000
2000-2010
Linear (1970-1990)
Linear (1990-2000)
Linear (2000-2010)
Population
250,000
200,000
150,000
100,000
50,000
0
1970
1975
1980
1985
1990
1995
2000
2005
2010
Trend=2.2% growth (1970-1990)
Trend=3.9% growth (1990-2000)
Trend =5.0% growth (2000-2010)
y = 3.9809x - 46514
y = 10.807x - 272227
y = 21.247x - 653129



Union County Historical Population (2000-2011)
250,000
200,000
150,000
100,000
50,000
0
Population
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
y = 21.921x - 677959
Trend =4.7% growth
(2000-2011)



Union County Historical Population (2000-2011)
2000-2004
2004-2008
2008-2011
Linear (2000-2004)
Linear (2004-2008)
Linear (2008-2011)
Population
250,000
200,000
150,000
100,000
50,000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Trend=5.1% growth (2000-2004)
y = 18.372x - 546607
Trend=6.2% growth (2004-2008)
y = 28.801x - 943501
Trend=2.2% growth (2008-2011)
y = 12.021x - 281493

B.4

APPENDIX B.4

Union County Per Capita Water Use Evaluation

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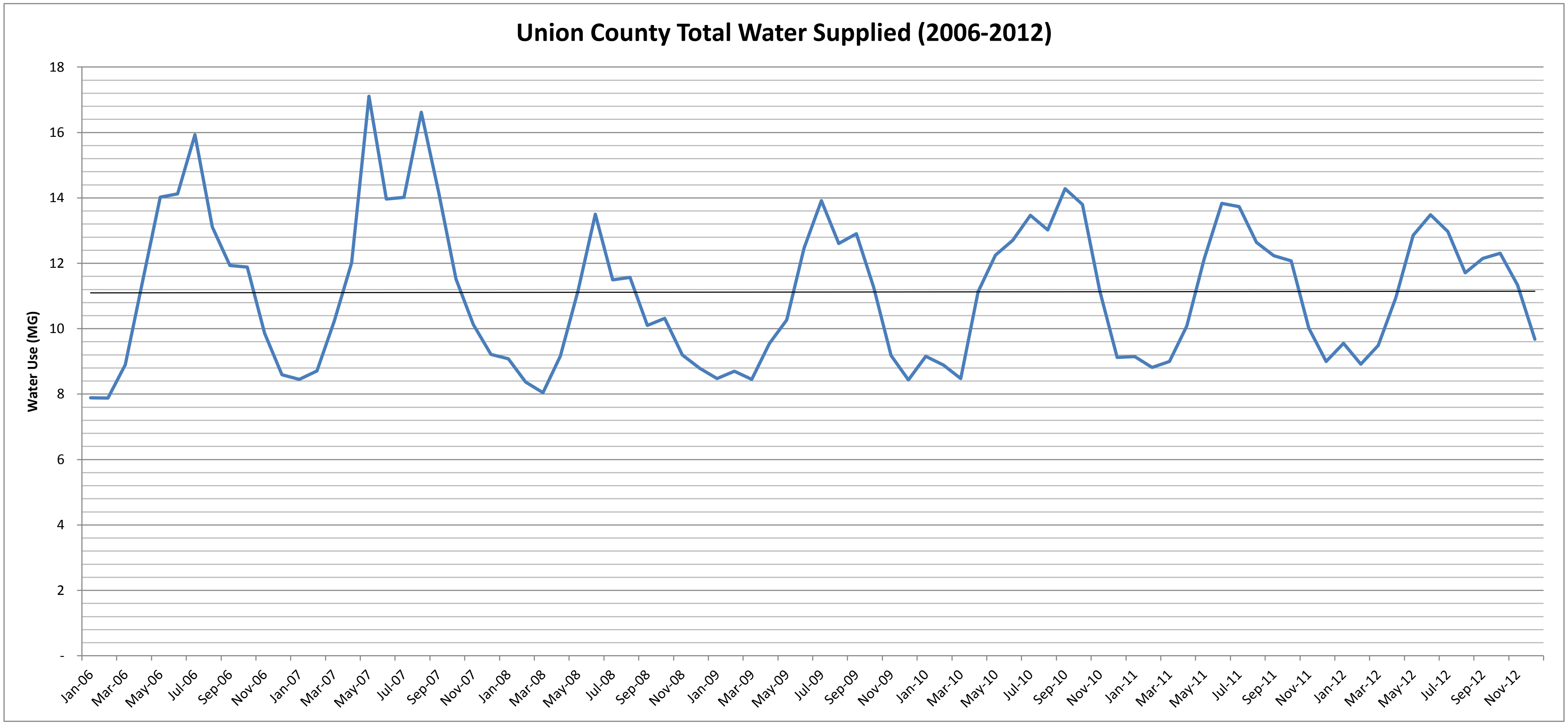
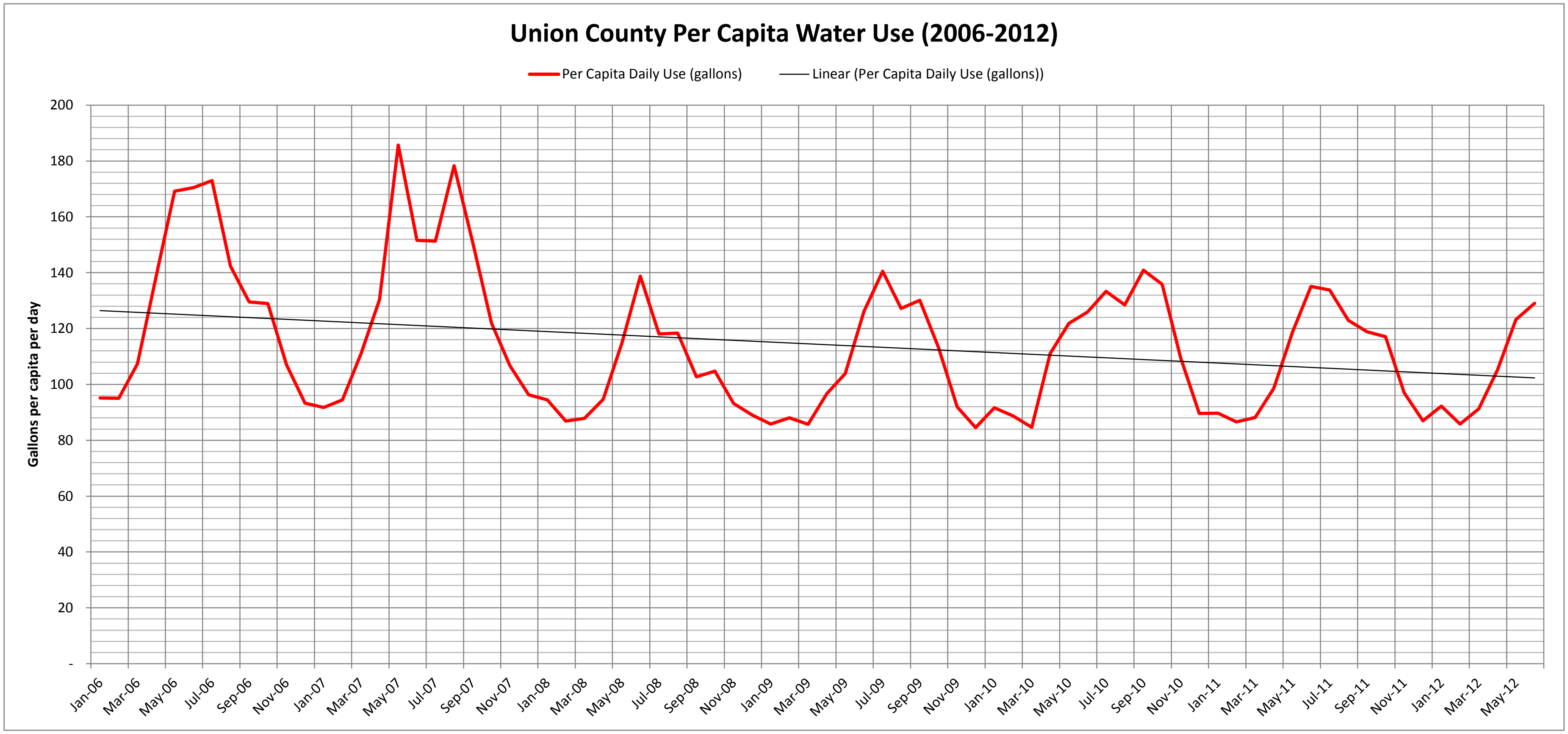
Per Capita Use Evaluation

UNION COUNTY PER CAPITA USE AVERAGES				
	Per Capita Use (Total Supply, gpcd)	**AVERAGE**	Per Capita Use (Total Consumptive Use, gpcd)	**AVERAGE**
FY 2006-2007	128		117	
FY 2007-2008	119		106	
FY 2008-2009	101	**113**	90	**101**
FY 2009-2010	109		97	
FY2010-2011	113		101	
FY2011-2012	109		96	
2006	129			
2007	131		119	
2008	104		93	
2009	106	**114**	94	**99**
2010	113		102	
2011	108		95	
2012	104		93	

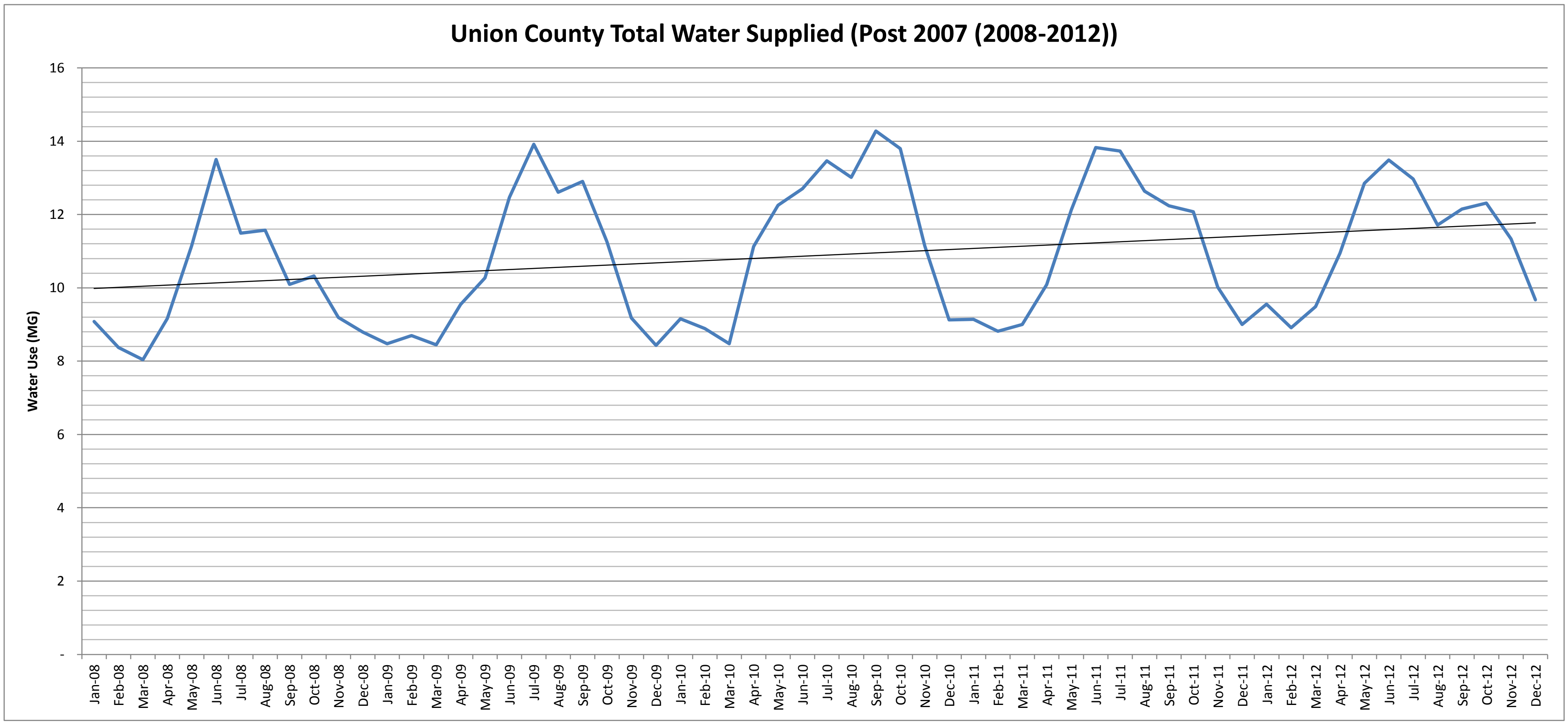
Notes:
1) Values do not reflect an approximate additional 5 gpcd of system wide water demand used for WTP process purposes at the County's jointly owned and operated Catawba River Water Treatment Plant in Lancaster County, SC.
2) Selected per capita use rate (120 gpcd) for YRWSP projection purposes is representative of the average per capita use for total supply, plus approximately 5 gpcd assumed process water demand for the WTP.



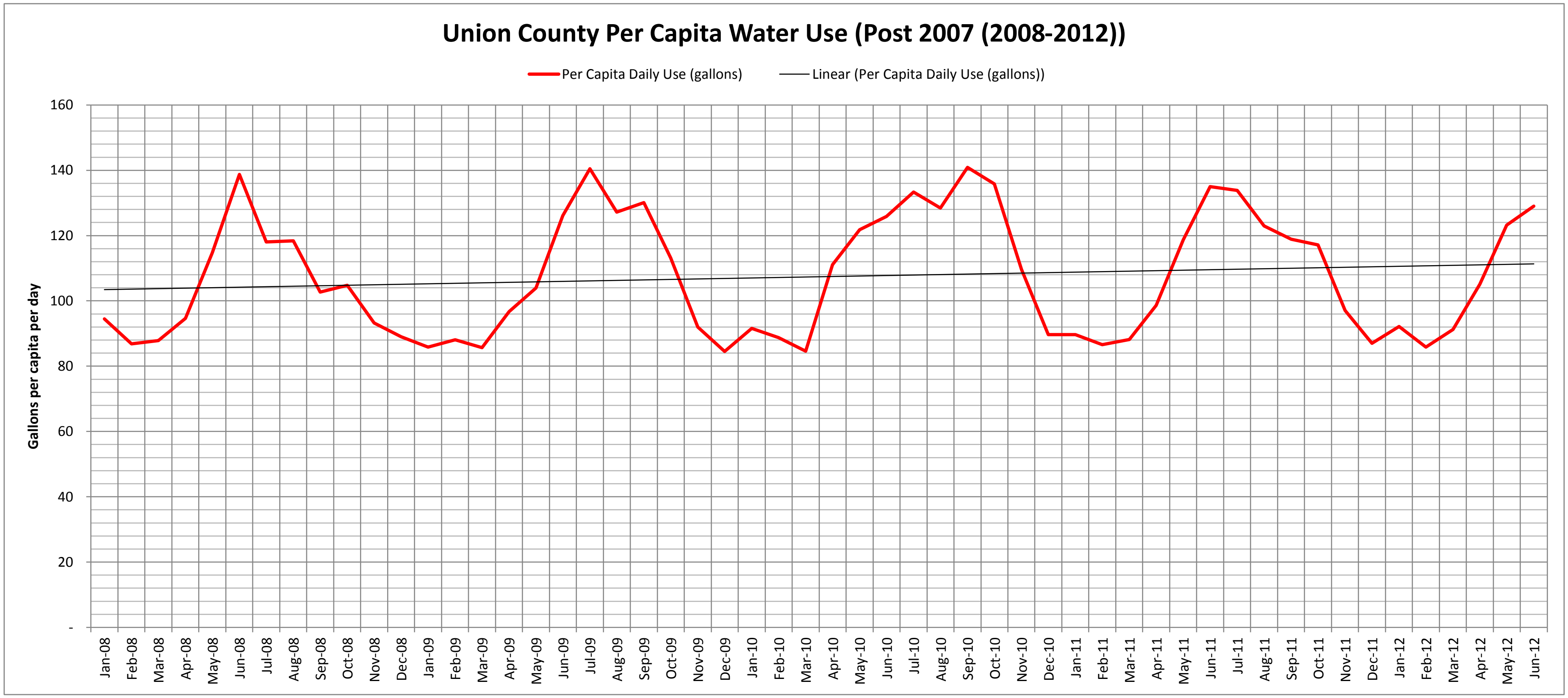
Note: Linear trend of Union County total water supplied to customers indicates a very slight increasing trend from 2006-2012.



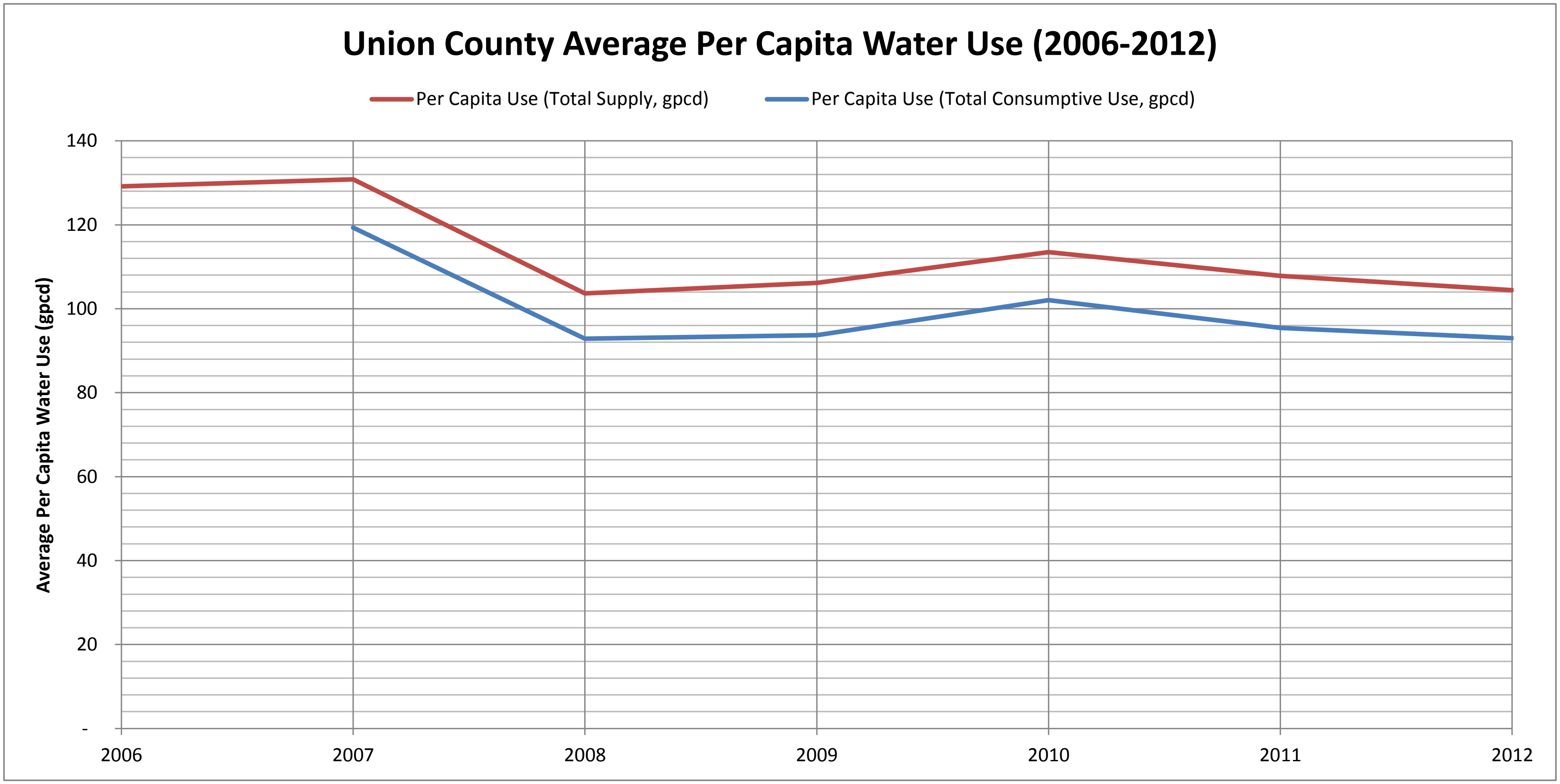
Note: Linear trend of Union County per capita water use indicates a decreasing trend from 2006-2012, largely in part to higher per capita use during the last Drought of Record, 2006-2008.



Note: Linear trend of Union County total water supplied to customers from 2008-2012, following the extreme drought year of 2007, indicates an increasing trend.



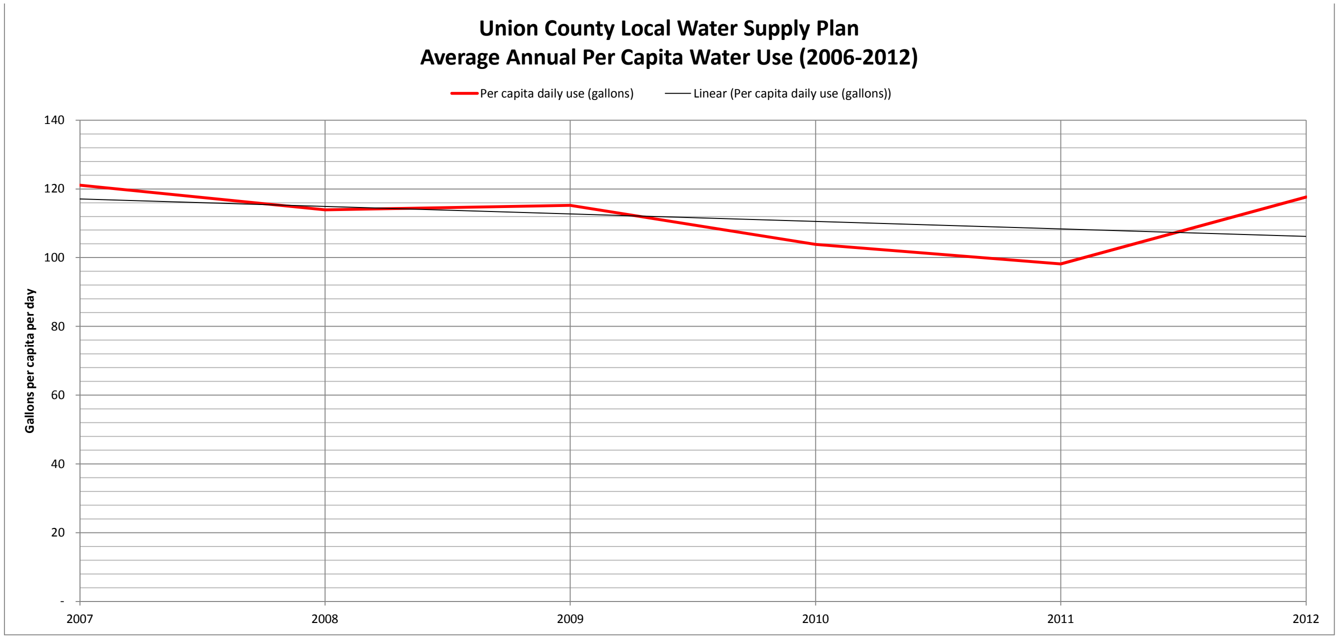
Note: Linear trend of Union County per capita water use indicates a slight increasing trend from 2008-2012, following the extreme drought year of 2007.



Union County Average Per Capita Water Use (2006-2012)
Per Capita Use (Total Supply, gpcd)
Per Capita Use (Total Consumptive Use, gpcd)
Average Per Capita Water Use (gpcd)
140
120
100
80
60
40
20
-
2006
2007
2008
2009
2010
2011
2012

Per Capita Use Evaluation

NC Local Water Supply Plan Per Capita Use (Union County)			
Year	Total Use (mgd)	Estimated Population	Per capita daily use (gallons)
2007	12.24	93,159	121
2008	10.07	97,056	114
2009	10.48	99,082	115
2010	11.42	100,909	104
2011	11.06	102,574	98
2012	11.28	104,077	118
		AVERAGE	**112**



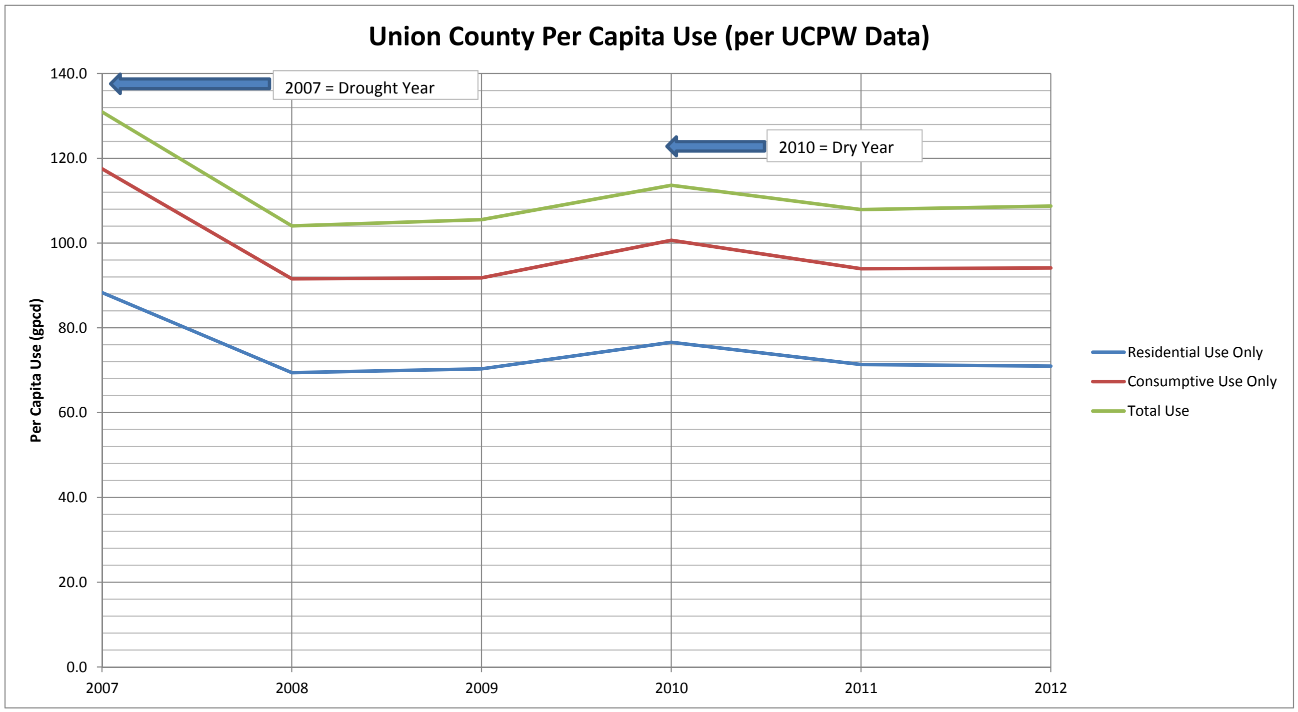
Notes:
1) Values do not reflect an approximate additional 5 gpcd of system wide water demand used for WTP process purposes at the County's jointly owned and operated Catawba River Water Treatment Plant in Lancaster County, SC.
2) The linear trend tends to indicate per capita use rates are decreasing slightly since the last Drought of Record during 2007-2008.

Union County Public Works Historical Records - Per Capita Use Calculation

	Metered Connections					Average Use Use (MGD) Metered/Billed Water (Consumption)							Per Capita Use (gpcd)			
LWSP Year	Residential	Commercial	Industrial	Institutional	Wholesale	Residential	Commercial	Industrial	Institutional	Wholesale	Non-Revenue Water	Total	Est. Population	Residential Use Only	Consumptive Use Only	Total Use
2007	35,705	1,656	44	238	1	8.23	1.39	0.68	0.29	0.36	1.25	12.2	93,154	88.3	117.5	131.0
2008	38,031	2,089	61	395	2	6.74	0.97	0.67	0.23	0.28	1.21	10.1	97,056	69.4	91.6	104.1
2009	38,124	2,078	63	396	2	7.02	0.98	0.63	0.26	0.27	1.37	10.53	99,786	70.4	91.8	105.5
2010	39,688	2,192	63	409	2	7.73	1.11	0.72	0.3	0.3	1.31	11.47	100,909	76.6	100.7	113.7
2011	40,097	2,171	66	394	1	7.32	1.03	0.7	0.3	0.29	1.42	11.07	102,574	71.4	94.0	107.9
2012	40,434	2,194	66	397	1	7.39	1.09	0.71	0.3	0.31	1.47	11.32	104,077	71.0	94.2	108.8
													AVERAGE	74.5	98.3	111.8

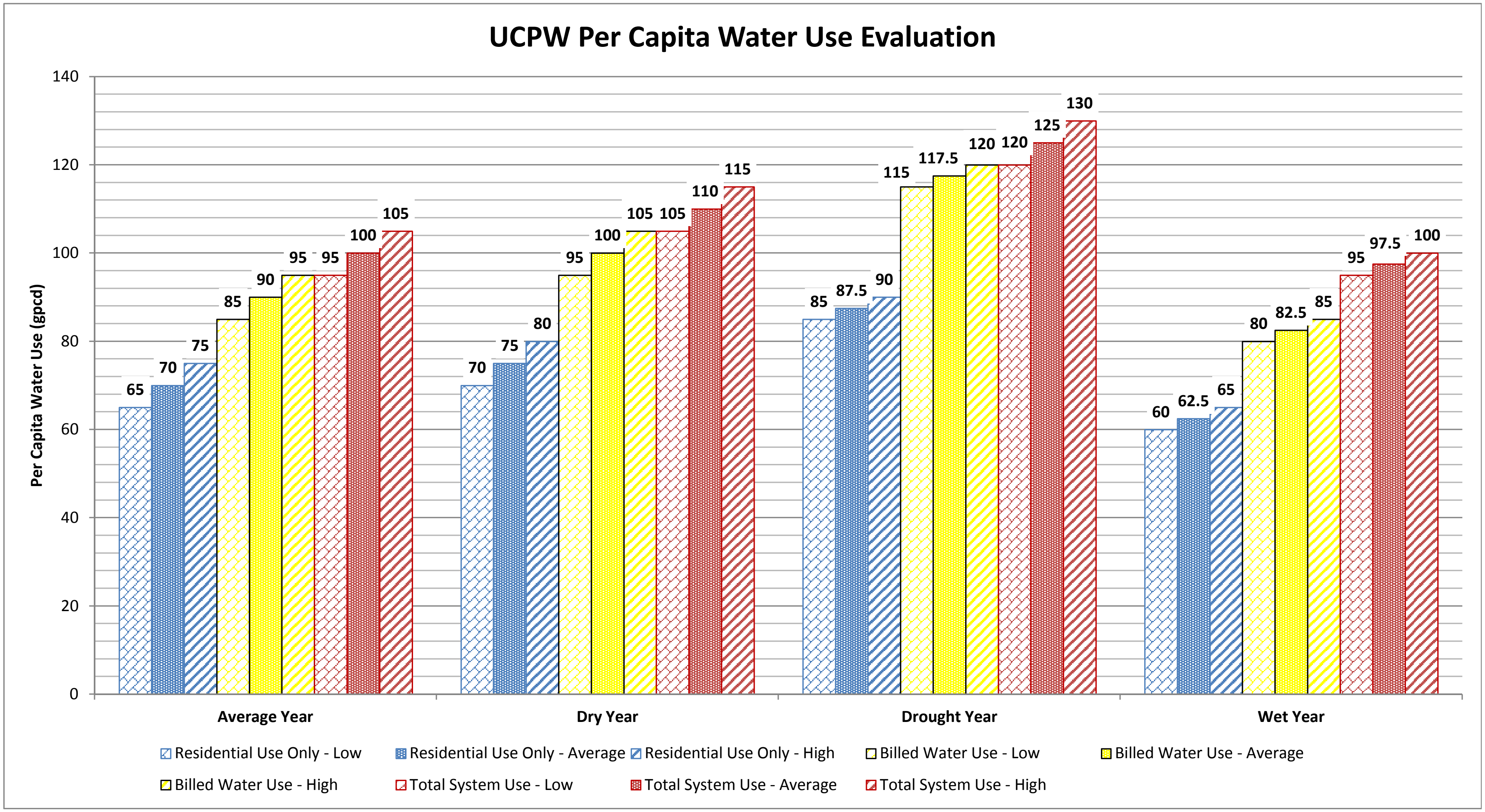
Non-Revenue Water (NRW) Calculation

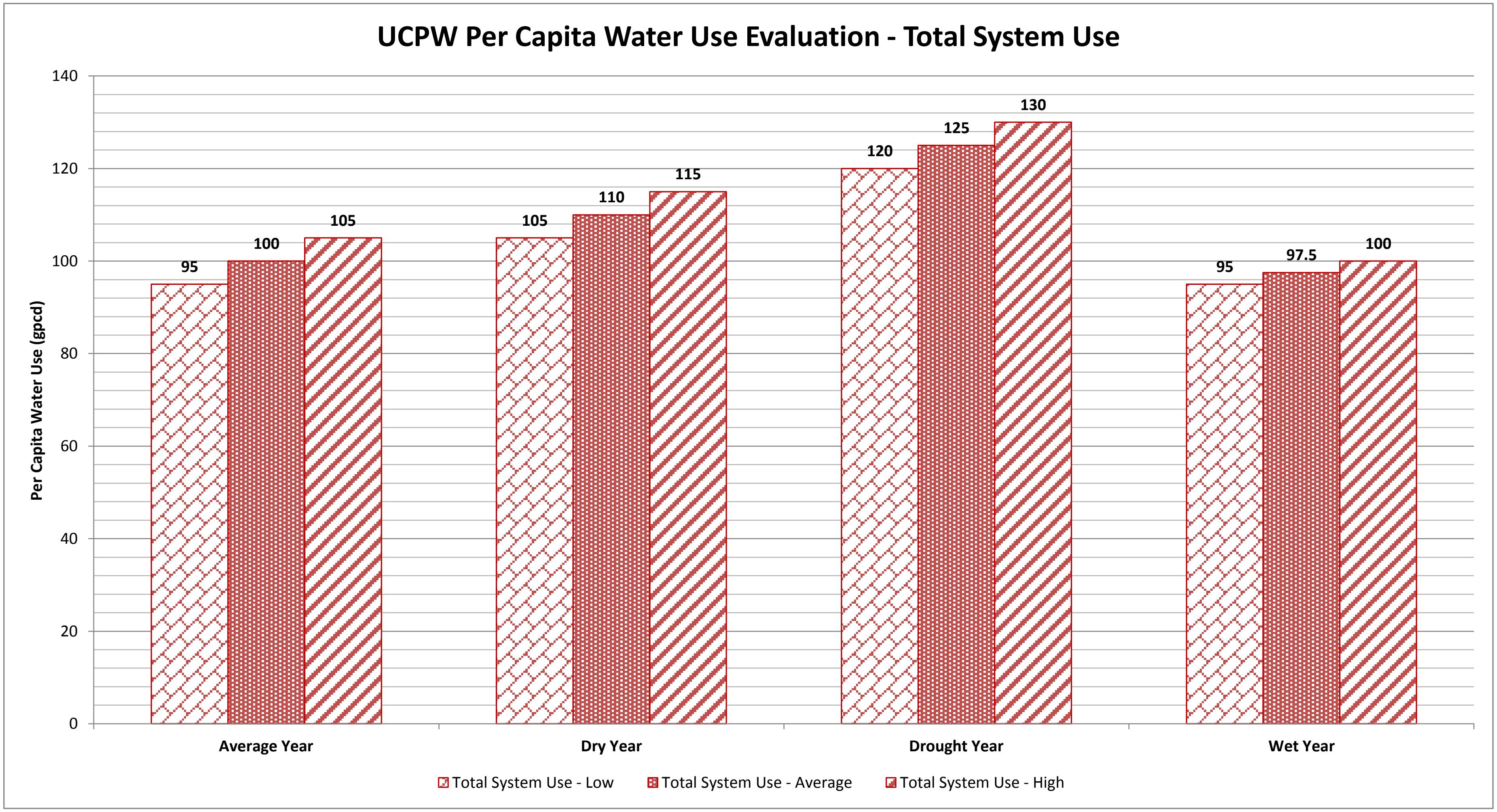
Year	NRW % of Total Use
2007	10.2%
2008	12.0%
2009	13.0%
2010	11.4%
2011	12.9%
2012	13.4%
AVERAGE	**12.2%**



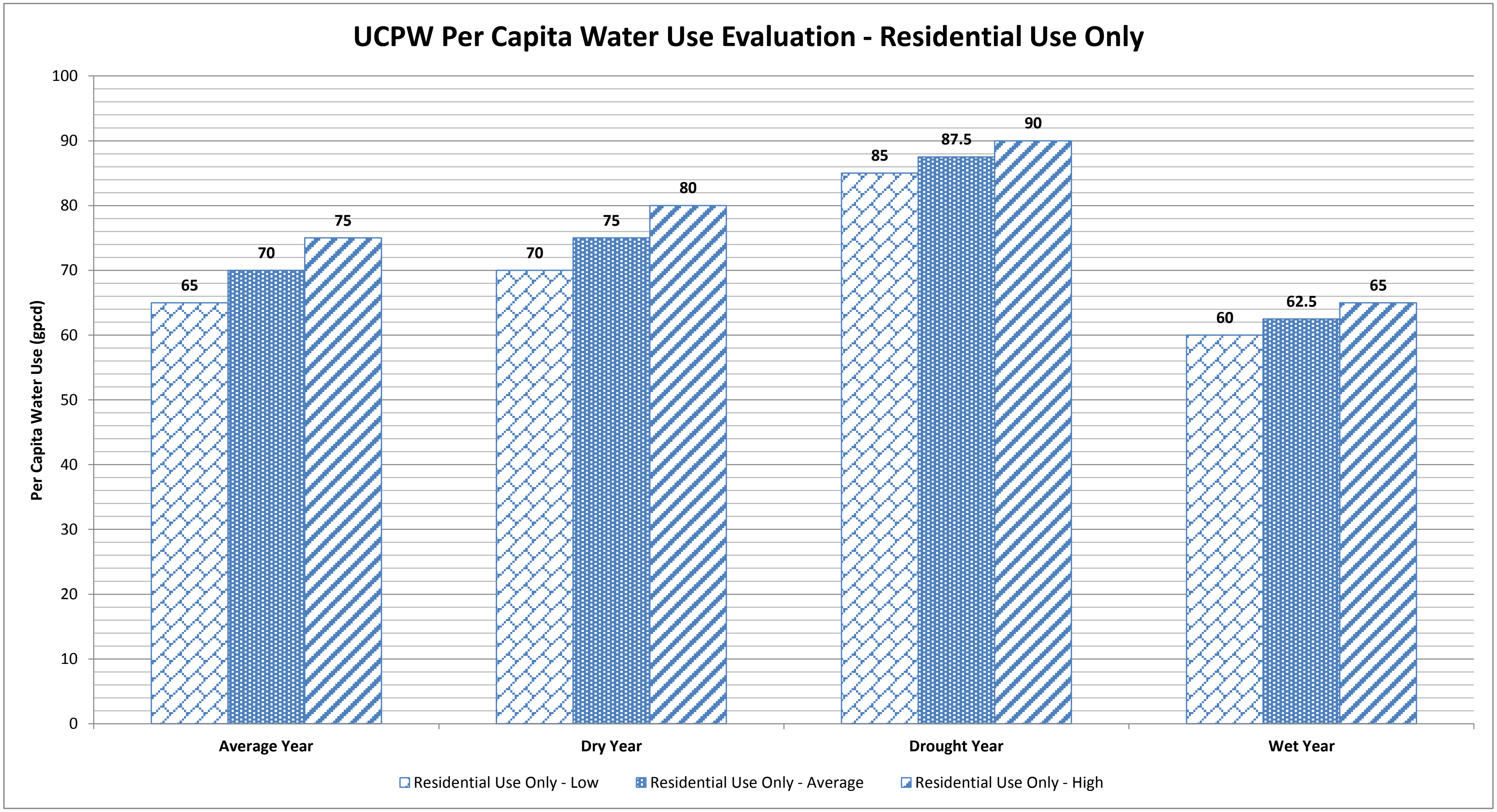
Notes:
1) Values do not reflect an approximate additional 5 gpcd of system wide water demand used for WTP process purposes at the County's jointly owned and operated Catawba River Water Treatment Plant in Lancaster County, SC.
2) Selected per capita use rate for YRWSP projection purposes is based upon typical dry (non-extreme drought) year demand, as representative of Year 2010 (approx 115 gpcd), plus 5 gpcd assumed process water demand for WTP, for a total per capita demand rate of 120 gpcd.

	Union County Per Capita Water Demands (gpcd)											
	Average Year			Dry Year			Drought Year			Wet Year		
Use Category	High	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average
Residential Only	75	65	70	80	70	75	90	85	87.5	65	60	62.5
Billed Water Use	95	85	90	105	95	100	120	115	117.5	85	80	82.5
Total System Use	105	95	100	115	105	110	130	120	125	100	95	97.5

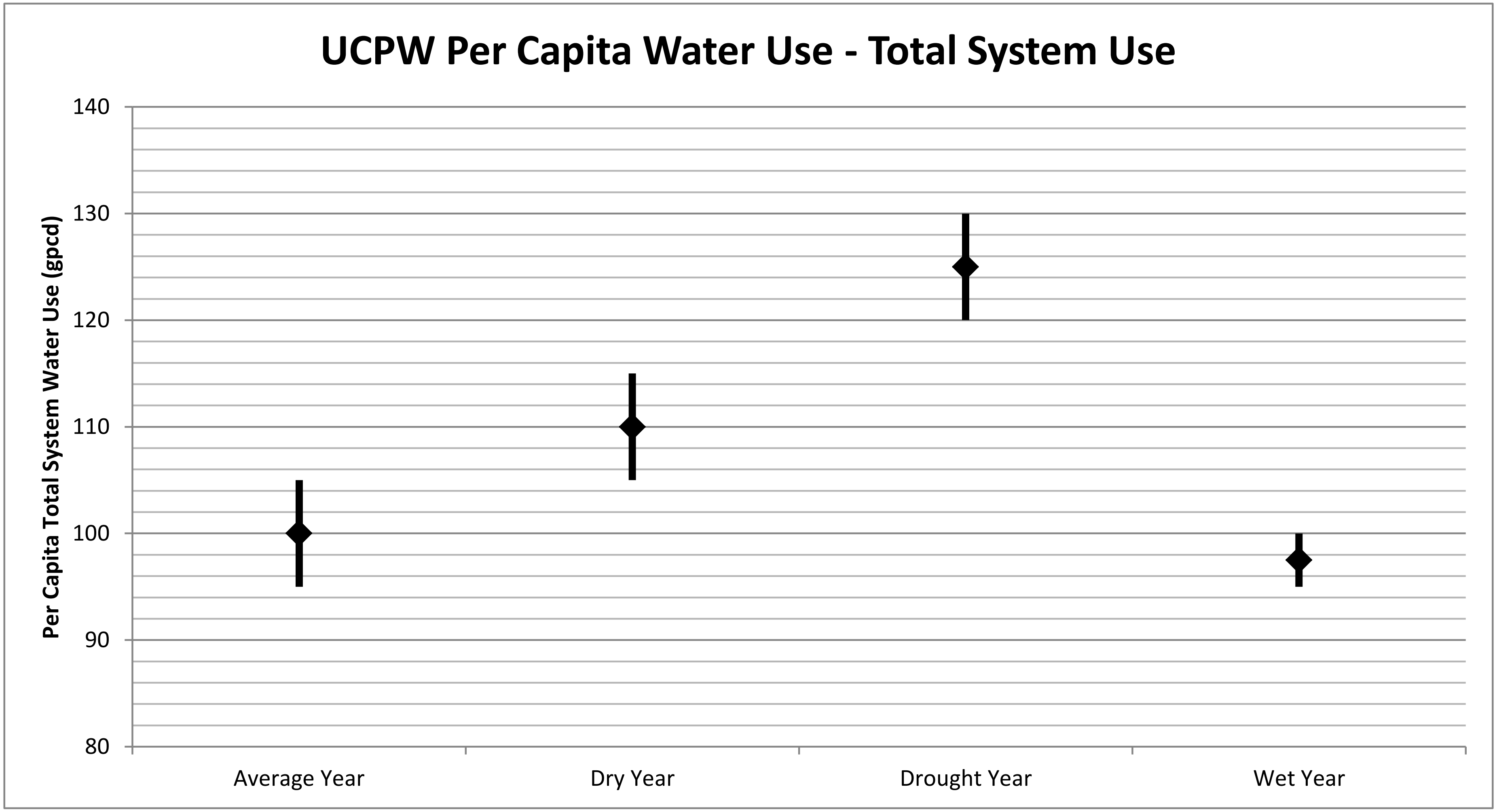


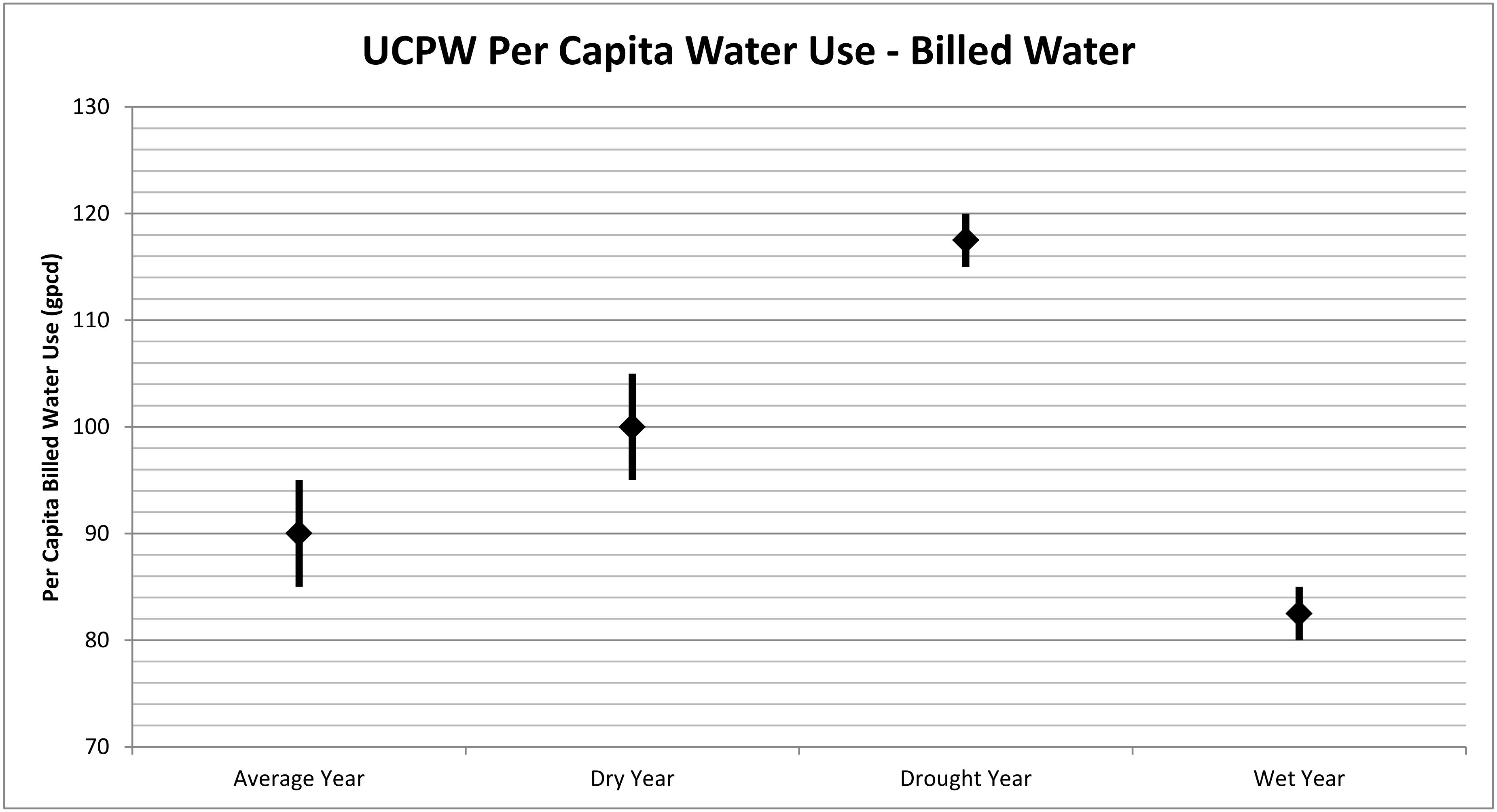


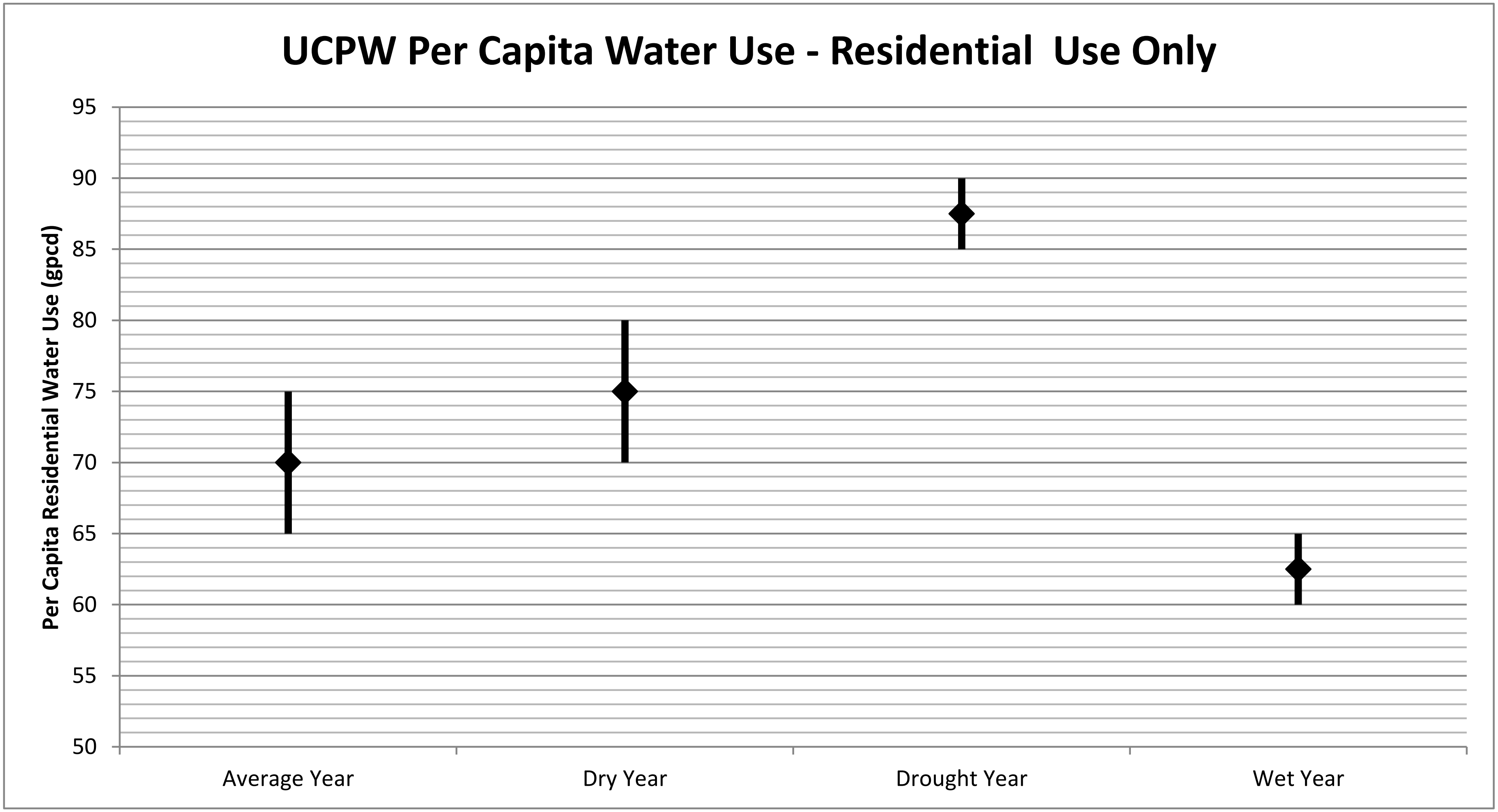
UCPW Per Capita Water Use Evaluation - Total System Use
140
120
100
80
60
40
20
0
Per Capita Water Use (gpcd)
95
100
105
105
110
115
120
125
130
95
97.5
100
Average Year
Dry Year
Drought Year
Wet Year
Total System Use - Low
Total System Use - Average
Total System Use - High



UCPW Per Capita Water Use Evaluation - Residential Use Only
Per Capita Water Use (gpcd)
100
90
80
70
60
50
40
30
20
10
0
65
70
75
70
75
80
85
87.5
90
60
62.5
65
Average Year
Dry Year
Drought Year
Wet Year
Residential Use Only - Low
Residential Use Only - Average
Residential Use Only - High


UCPW Per Capita Water Use - Total System Use
Per Capita Total System Water Use (gpcd)
140
130
120
110
100
90
80
Average Year
Dry Year
Drought Year
Wet Year


UCPW Per Capita Water Use - Billed Water
Per Capita Billed Water Use (gpcd)
130
120
110
100
90
80
70
Average Year
Dry Year
Drought Year
Wet Year


UCPW Per Capita Water Use - Residential Use Only
Per Capita Residential Water Use (gpcd)
95
90
85
80
75
70
65
60
55
50
Average Year
Dry Year
Drought Year
Wet Year

B.5

APPENDIX B.5

Union County Water Demand Peaking Factor Evaluation

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Water Supply Peaking Factor Evaluation

UNION COUNTY PUBLIC WORKS - CALENDAR YEAR WATER SUPPLY TOTALS

DATE	CRWTP Water					Anson Water					Total Water Supply			
	Total (MG)	% of Total Supply	Avg (MGD)	Max Day (MGD)	Max to Avg (Ratio)	Total (MG)	% of Total Supply	Avg (MGD)	Max Day (MGD)	Max to Avg (Ratio)	Total (MG)	Avg (MGD)	Max Day (MGD)	Max: Avg (Ratio)
2006	3,775.69	91.3%	10.34	18.36	1.77	357.73	8.7%	0.98	1.19	1.21	4,133.42	11.32	18.36	1.62
2007	4,075.97	91.5%	11.17	21.33	1.91	378.36	8.5%	1.04	1.28	1.23	4,454.33	12.20	21.33	1.75
2008	3,340.13	90.6%	9.15	19.81	2.17	345.60	9.4%	0.95	1.17	1.23	3,685.74	10.10	20.75	2.05
2009	3,502.83	91.2%	9.60	16.01	1.67	339.33	8.8%	0.93	1.20	1.30	3,842.16	10.53	17.21	1.63
2010	3,782.03	90.4%	10.36	18.48	1.78	403.23	9.6%	1.10	1.69	1.53	4,185.26	11.47	19.50	1.70
2011	3,327.66	82.3%	9.12	15.37	1.69	713.61	17.7%	1.96	3.69	1.89	4,041.26	11.07	16.98	1.53
2012	3,401.87	82.3%	9.32	15.03	1.61	729.69	17.7%	2.00	4.64	2.32	4,131.56	11.32	17.02	1.50
2013	3,238.43	81.0%	8.87	-	-	762.06	19.0%	2.09	-	-	4,000.49	10.96	-	-

Note: 2013 Prorated for 12 months based on 5 months data to-date, as compared to first five months of 2012.

Union County
YRWSP

Water Supply Peaking Factor Evaluation

Peaking Factor Evaluation (average peaking factors)

<u>2006-2012</u>

CRWTP	1.8
Anson	1.53
Total	1.69

<u>20010-2012 (last 3 years)</u>

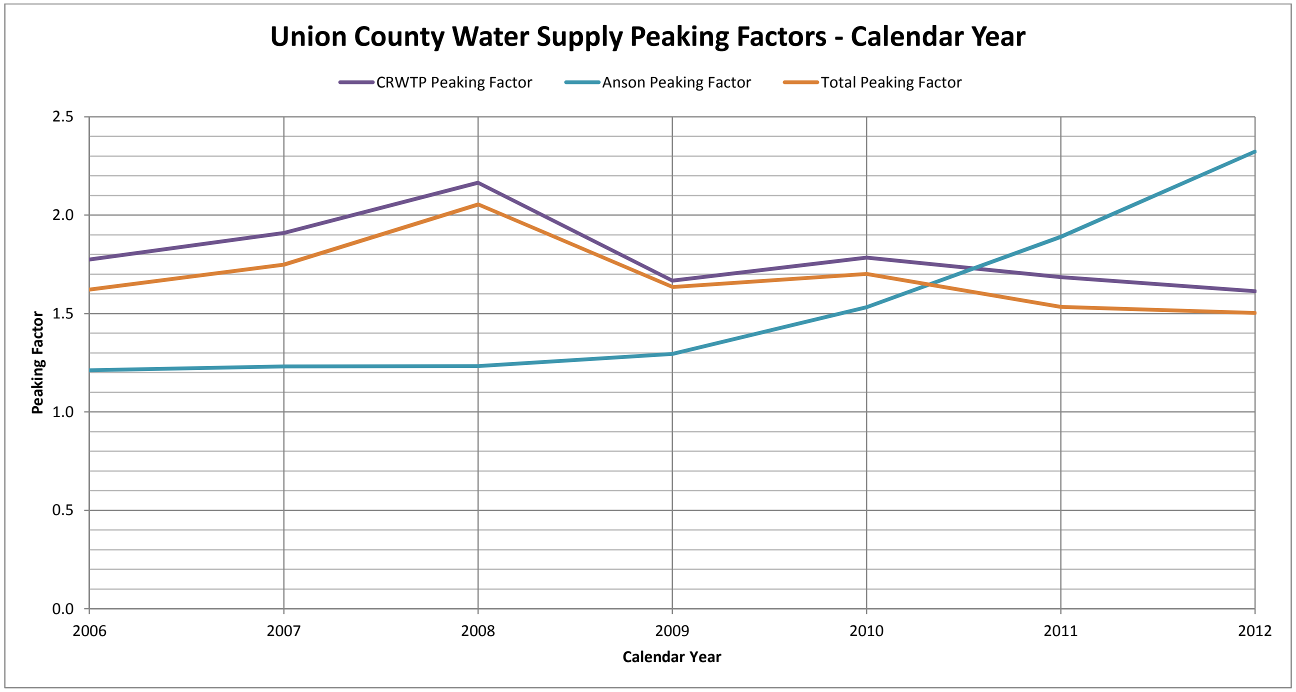
CRWTP	1.69
Anson	1.91
Total	1.58

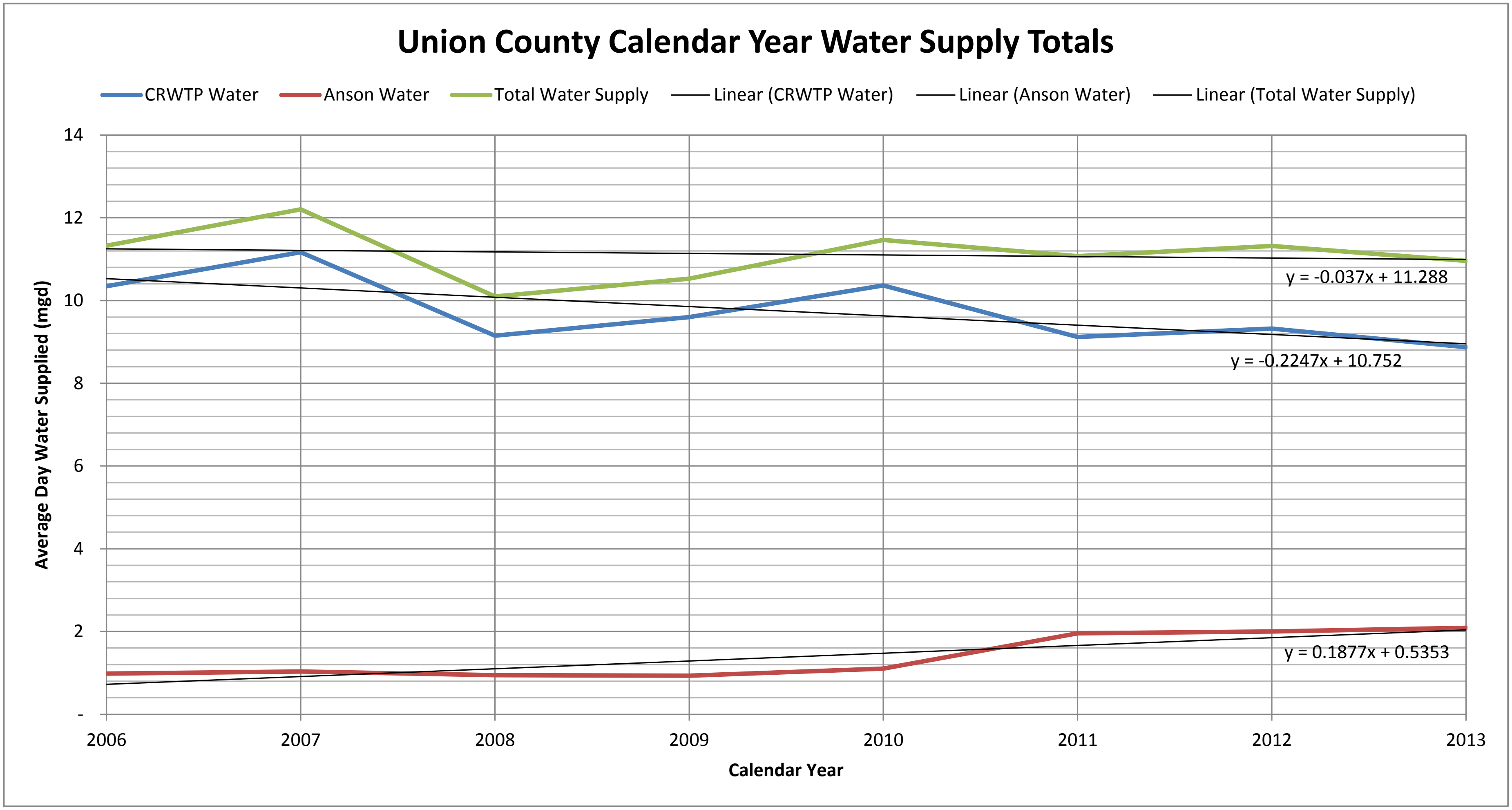
<u>2007-2009 (drought)</u>

CRWTP	1.88
Anson	1.24
Total	1.76

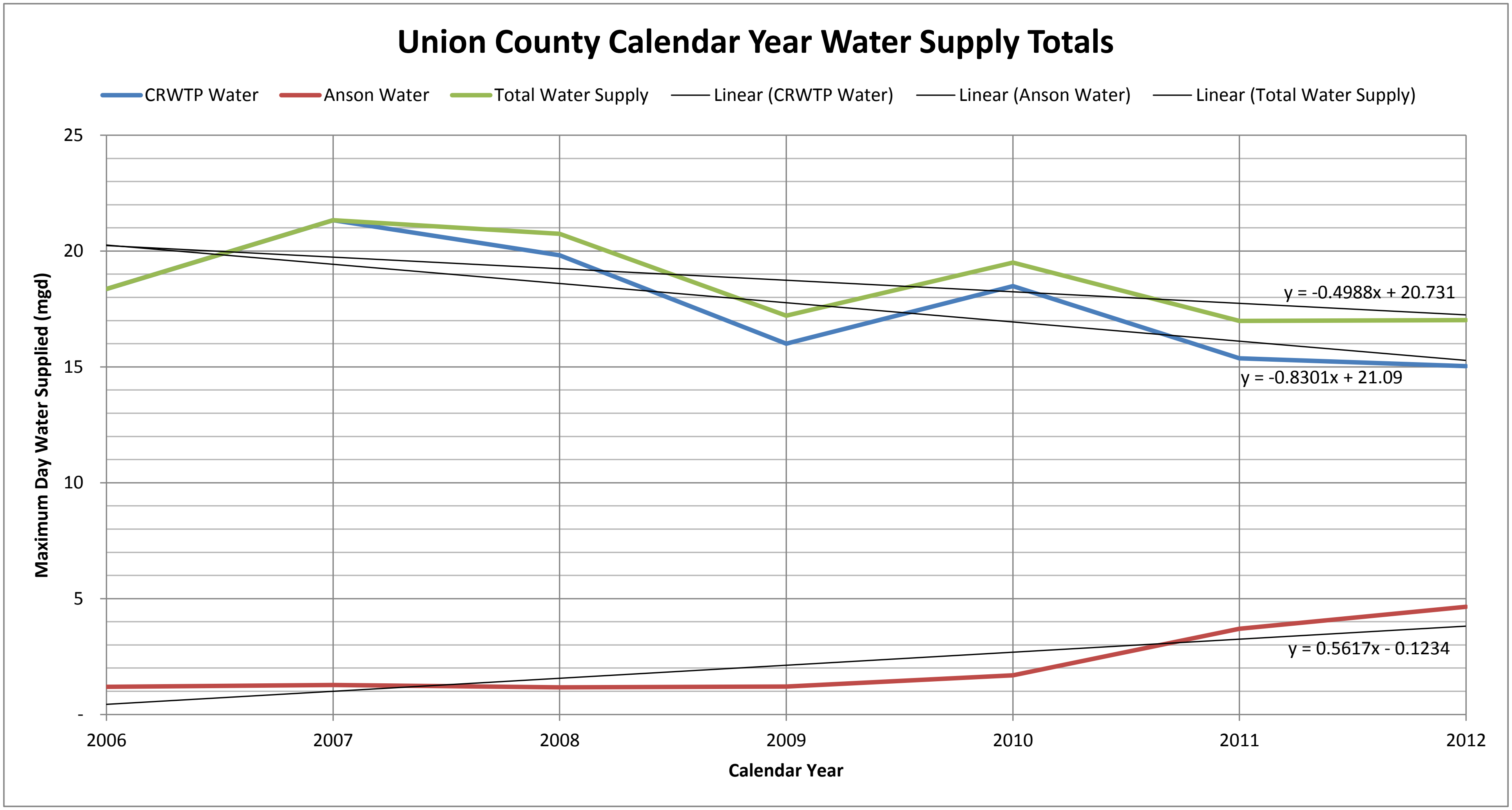
Note: Average Non-Revenue Water = 12.3% (2007-2013)

SUMMARY:
Peaking Factor of 1.7 selected for YRWSP projections is consistent with historical data reflected above for system-wide Max Day / Annual Avg. Day peaking.

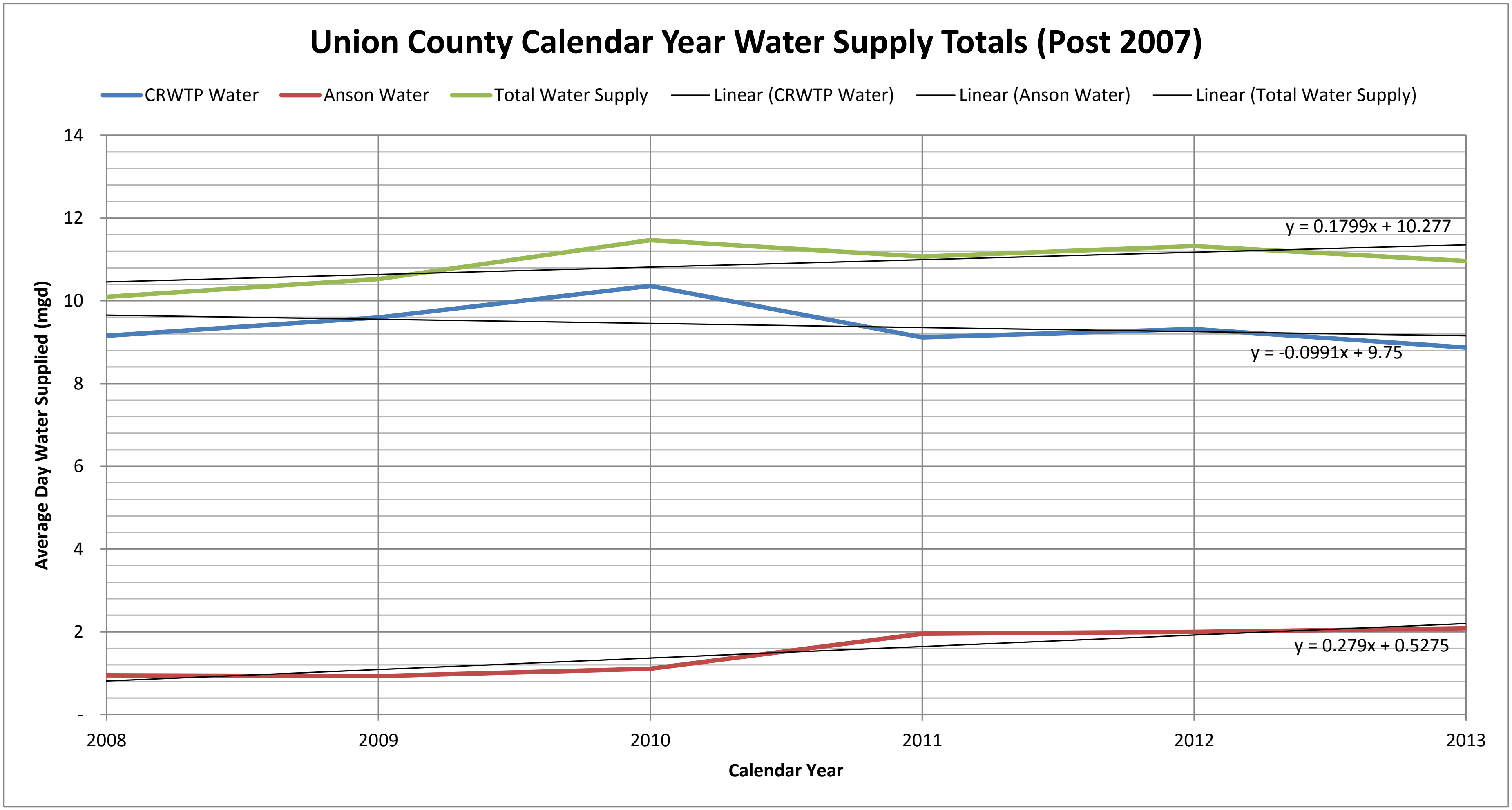


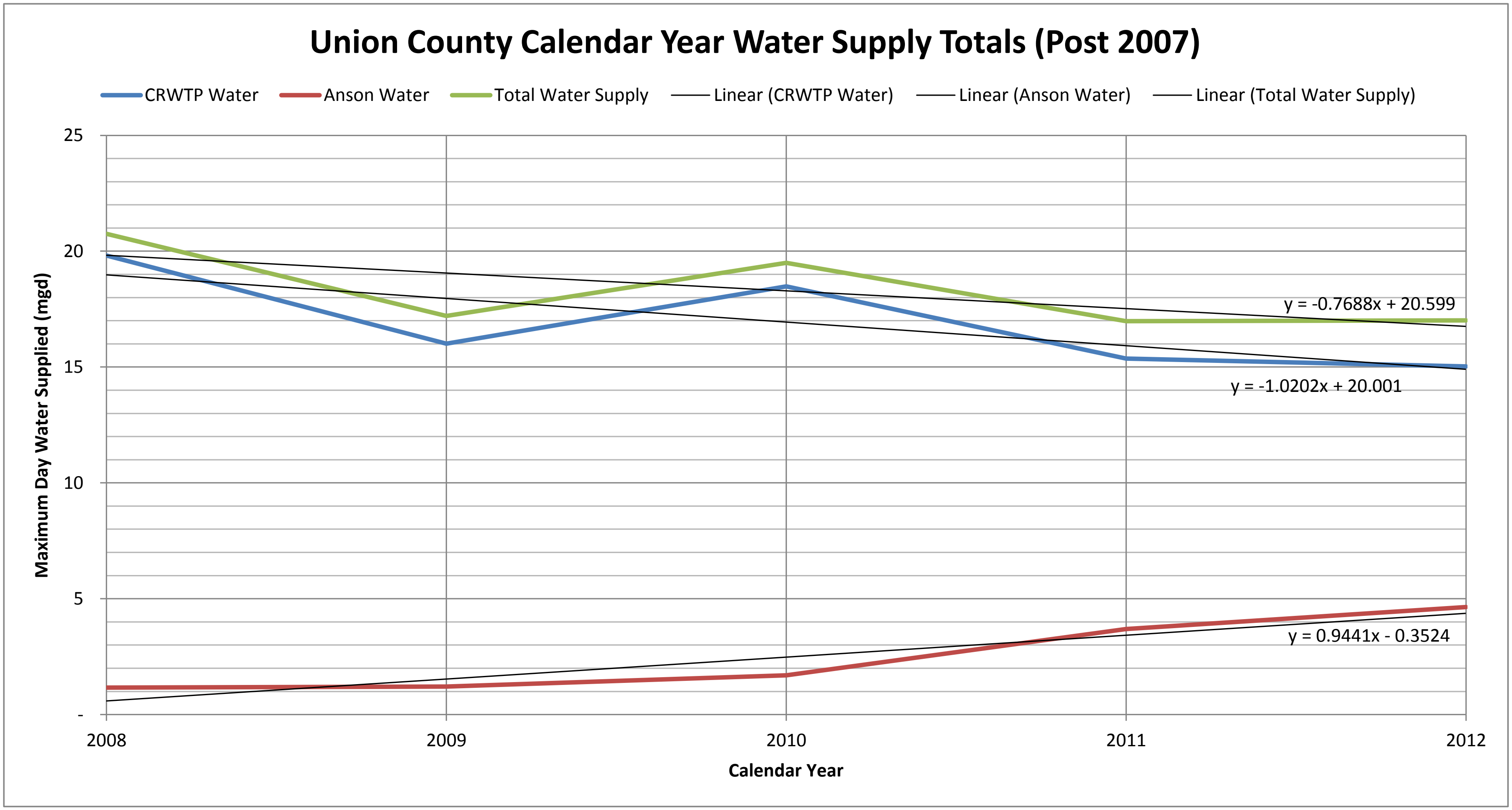


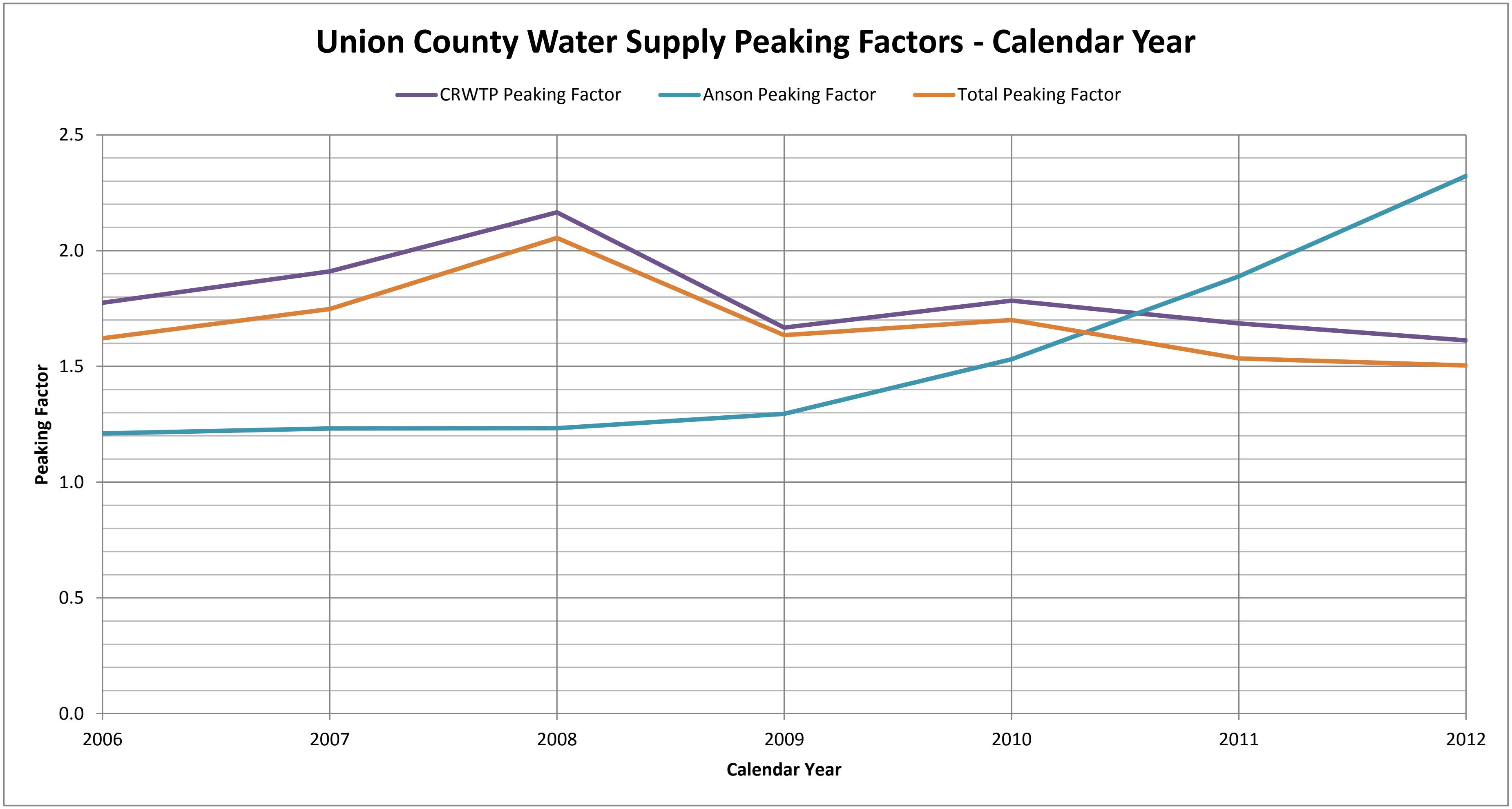
Union County Calendar Year Water Supply Totals
CRWTP Water
Anson Water
Total Water Supply
Linear (CRWTP Water)
Linear (Anson Water)
Linear (Total Water Supply)
14
12
10
8
6
4
2
-
Average Day Water Supplied (mgd)
y = -0.037x + 11.288
y = -0.2247x + 10.752
y = 0.1877x + 0.5353
2006
2007
2008
2009
2010
2011
2012
2013
Calendar Year



Union County Calendar Year Water Supply Totals
CRWTP Water
Anson Water
Total Water Supply
Linear (CRWTP Water)
Linear (Anson Water)
Linear (Total Water Supply)
Maximum Day Water Supplied (mgd)
25
20
15
10
5
-
2006
2007
2008
2009
2010
2011
2012
Calendar Year
y = -0.4988x + 20.731
y = -0.8301x + 21.09
y = 0.5617x - 0.1234


Union County Calendar Year Water Supply Totals (Post 2007)
CRWTP Water
Anson Water
Total Water Supply
Linear (CRWTP Water)
Linear (Anson Water)
Linear (Total Water Supply)
Average Day Water Supplied (mgd)
14
12
10
8
6
4
2
-
y = 0.1799x + 10.277
y = -0.0991x + 9.75
y = 0.279x + 0.5275
2008
2009
2010
2011
2012
2013
Calendar Year


Union County Calendar Year Water Supply Totals (Post 2007)
CRWTP Water
Anson Water
Total Water Supply
Linear (CRWTP Water)
Linear (Anson Water)
Linear (Total Water Supply)
Maximum Day Water Supplied (mgd)
25
20
15
10
5
-
2008
2009
2010
2011
2012
Calendar Year
y = -0.7688x + 20.599
y = -1.0202x + 20.001
y = 0.9441x - 0.3524

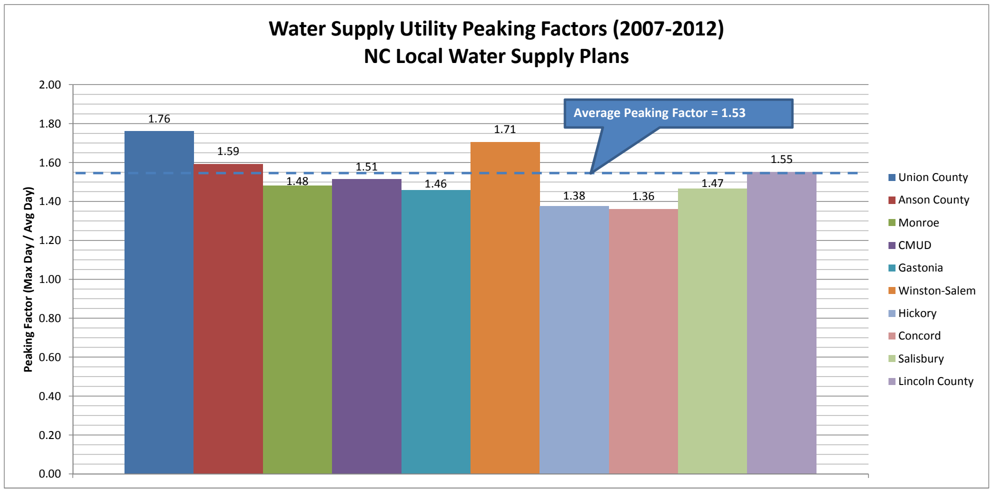

Union County Water Supply Peaking Factors - Calendar Year
CRWTP Peaking Factor
Anson Peaking Factor
Total Peaking Factor
Peaking Factor
2.5
2.0
1.5
1.0
0.5
0.0
2006
2007
2008
2009
2010
2011
2012
Calendar Year

Peaking Factor Comparisons for Other Regional Utilities

Data from NC Local Water Supply Plans

Year	Union County			Anson County			Monroe			CMUD			Gastonia		
	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor
2007	12.21	23.29	1.91	5.97	9.57	1.60	6.23	9.78	1.57	114.52	169.23	1.48	17.36	20.23	1.17
2008	10.05	21.23	2.11	5.64	9.02	1.60	[redacted]			98.86	163.15	1.65	[redacted]		
2009	10.47	17.4	1.66	5.73	10.47	1.83	5.67	8.06	1.42	103.7	189.64	1.83	16.82	25.6	1.52
2010	11.41	20.06	1.76	6.49	10.05	1.55	6.04	9.1	1.51	121.35	156.6	1.29	[redacted]		
2011	11.05	17.84	1.61	6.28	10.04	1.60	6.2	9.1	1.47	102.2	143.5	1.40	17.33	27.7	1.60
2012	11.28	17.02	1.51	5.66	7.79	1.38	5.89	8.52	1.45	101.25	145.44	1.44	17.98	27.7	1.54
AVERAGE	11.08	19.47	**1.76**	5.96	9.49	**1.59**	6.01	8.91	**1.48**	106.98	161.26	**1.51**	17.37	25.31	**1.46**

Year	Winston-Salem			Hickory			Concord			Salisbury			Lincoln County		
	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor
2007	41.12	63.7	1.55	13.52	19.72	1.46	12.52	19.03	1.52	7.7	12.1	1.57	[redacted]		
2008	38.75	54.1	1.40	[redacted]						7.4	11.1	1.50	2.43	3.93	1.62
2009	37.4	66.5	1.78	12.12	15.85	1.31	10.47	14.17	1.35	7.8	11.6	1.49	2.56	3.78	1.48
2010	38.7	72	1.86	[redacted]			10.51	14.06	1.34	8.2	11.4	1.39	2.72	3.85	1.42
2011	38.4	74.7	1.95	14.43	19.64	1.36	10.43	13.5	1.29	8.4	12.1	1.44	2.65	4.57	1.72
2012	37.8	64.6	1.71	11.49	15.855	1.38	10.65	13.87	1.30	8.7	12.2	1.40	2.55	3.89	1.53
AVERAGE	38.70	65.93	**1.71**	12.89	17.77	**1.38**	10.92	14.93	**1.36**	8.03	11.75	**1.47**	2.58	4.00	**1.55**



Union County YRWSP - Determination of Max Day / Max Month Avg Day Peaking Factor

Catawba to Yadkin IBT Comparison - Max Day/Avg Day UC Provided IBT Data				
Month	Total IBT (AVG Day, mgd)	Total IBT (MAX Day), mgd	Max Month Max Day / Max Month Avg Day	Max Month Avg Day / Annual Avg Day
Jan-09	2.62	3.49		-
Feb-09	2.50	3.06		-
Mar-09	2.33	2.93		-
Apr-09	2.71	4.64		-
May-09	2.98	3.73		-
Jun-09	3.41	4.97		-
Jul-09	3.45	4.48		-
Aug-09	3.49	4.28	1.22	1.21
Sep-09	3.30	4.15		-
Oct-09	3.04	4.42		-
Nov-09	2.38	3.24	USE	-
Dec-09	2.34	2.84		-
Jan-10	2.74	3.21		-
Feb-10	2.42	2.87		-
Mar-10	2.60	3.26		-
Apr-10	3.13	4.56		-
May-10	3.09	4.44		-
Jun-10	3.28	5.73		-
Jul-10	4.02	5.19		-
Aug-10	4.16	5.32	1.27	1.33
Sep-10	3.49	4.53		-
Oct-10	3.19	4.22		-
Nov-10	2.70	3.48		-
Dec-10	2.54	3.11		-
Jan-11	1.41	1.72		-
Feb-11	0.80	1.35		-
Mar-11	1.75	2.19		-
Apr-11	1.39	1.87		-
May-11	1.76	2.95		-
Jun-11	2.18	2.91		-
Jul-11	2.86	3.60	1.25	1.47
Aug-11	2.59	3.39		-
Sep-11	2.36	3.17		-
Oct-11	2.22	3.06		-
Nov-11	2.10	2.81		-
Dec-11	1.80	2.21		-
Jan-12	2.09	2.78		-
Feb-12	2.03	2.82		-
Mar-12	2.09	2.63		-
Apr-12	2.38	3.57		-
May-12	2.43	3.49		-
Jun-12	2.74	3.63	1.32	1.20
Jul-12	2.65	3.93		-
Aug-12	2.32	3.25		-
Sep-12	2.05	2.86		-
Oct-12	2.21	2.77		-
Nov-12	2.35	3.12		-
Dec-12	1.91	2.40		-
	IBT Max Month AVG (mgd)	IBT Max Day AVG (mgd)	IBT Max Month Max Day / Max Month Avg Day (Avg Ratio)	IBT Max Month Avg Day / Avg Day (Avg Ratio)
	3.31	4.56	1.26	1.30

Total Water Comparison - Max Day/Max Month Avg Day NC LWSP Data			
Year	Max Month (AVG Day, mgd)	MAX Day (mgd)	Max Day / Max Month Avg Day
2007	17.22	23.29	1.35
2008	13.47	21.23	1.58
2009	12.52	15.44	1.23
2010	13.63	18.23	1.34
2011	14.02	17.84	1.27
2012	13.49	16.29	1.21
AVG	14.06	18.72	1.33

Total Water Comparison - Max Month Avg Day / Annual Avg Day NC LWSP Data			
Year	Max Month AVG Day (mgd)	Annual Avg Day (mgd)	Max Month Avg Day / Avg Annual Day
2007	17.22	12.21	1.41
2008	13.47	10.06	1.34
2009	12.52	10.5	1.19
2010	13.63	11.41	1.19
2011	14.02	11.05	1.27
2012	13.49	11.28	1.20
AVG	14.06	11.09	1.27

SUMMARY:

Max Day / Max Month Avg Day peaking factor has been determined based on an analysis of Union County's historical data for the Catawba to Yadkin IBT, as well as total system water use as stated in NC Local Water Supply Plans.

For purposes of determining the Yadkin River Water Supply Project Max Day to Max Month Avg Day conversion, it is more reasonable to evaluate the Catawba-Yadkin IBT, which is representative of water being used in the County's Yadkin River Basin Service Area, and is what would be expected for the YRWSP.

As such, the 1.22 value derived from 2009 IBT data is used for purposes of the YRWSP projection conversion of Max Day demands to Max Month Avg Day demands, as this value is most representative of a hotter, drier year, and therefore, the necessary basis for the YRWSP projections.

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B.6

APPENDIX B.6

Union County Wastewater Projections

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UNION COUNTY COMPRESHENSIVE WATER AND WW MASTER PLAN PROJECTIONS

	Max Month Sewer Flow (mgd)					
Treatment Destination	Base Year (2010)	2015	2020	2030	2040	2050
Crooked Creek WRF (Yadkin)	**1.4**	**1.5**	**2.3**	**2.7**	[redacted]	[redacted]
Crooked Creek (Returned to Yadkin)	1.4	1.5	1.9	1.9	[redacted]	[redacted]
Six Mile (McAlpine WWTP, Catawba)	**1.1**	**1.4**	**1.7**	**1.8**	[redacted]	[redacted]
Twelve Mile Basin (Catawba)	3.6	4.6	5.4	7	[redacted]	[redacted]
Poplin PS Pump-over (Yadkin to Catawba)	1.2	1.4	2.4	3.2	[redacted]	[redacted]
Crooked Creek (scalping to Catawba)	0	0	0.4	0.8	[redacted]	[redacted]
Twelve Mile WRF Total (Catawba)	**4.8**	**6**	**8.2**	**11**	[redacted]	[redacted]
Lake Twitty Basin (Yadkin)	0	0.3	0.6	1.4	[redacted]	[redacted]
Eastside Basins (Yadkin)	1.4	1.8	2.3	2.9	[redacted]	[redacted]
Lake Lee Basin (Yadkin)	0	0	0.1	0.7	[redacted]	[redacted]
Richardson Creek Basin (Yadkin)	0	0	0	0.3	[redacted]	[redacted]
Monroe WWTP Total (Yadkin)	**1.4**	**2.1**	**3.1**	**5.3**	[redacted]	[redacted]
Union County Total	**8.7**	**11.1**	**14.9**	**20**	[redacted]	[redacted]

YRWSP WASTEWATER PROJECTIONS

Treatment Destination	Max Month Sewer Flow (mgd)						Max Day Sewer Flow (mgd)						Annual Avg Day Sewer Flow (mgd)						Min Month Sewer Flow (mgd)					
	Base Year (2010)	2015	2020	2030	2040	2050	Base Year (2010)	2015	2020	2030	2040	2050	Base Year (2010)	2015	2020	2030	2040	2050	Base Year (2010)	2015	2020	2030	2040	2050
Crooked Creek WRF (Yadkin)[1]	**1.3**	**1.4**	**2.1**	**2.5**	**3.5**	**4.8**	**2.3**	**2.5**	**3.8**	**4.4**	**6.1**	**8.5**	**1.0**	**1.1**	**1.6**	**1.9**	**2.7**	**3.7**	**0.9**	**0.9**	**1.4**	**1.7**	**2.3**	**3.2**
Crooked Creek (Returned to Yadkin)	1.3	1.4	1.9	1.9	1.9	1.9	2.3	2.5	3.4	3.4	3.4	3.4	1.0	1.1	1.5	1.5	1.5	1.5	0.9	0.9	1.3	1.3	1.3	1.3
Six Mile (McAlpine WWTP, Catawba)	**1.0**	**1.3**	**1.6**	**1.7**	**2.1**	**2.6**	**1.8**	**2.3**	**2.8**	**3.0**	**3.7**	**4.6**	**0.8**	**1.0**	**1.2**	**1.3**	**1.6**	**2.0**	**0.7**	**0.9**	**1.1**	**1.1**	**1.4**	**1.7**
Twelve Mile Basin (Catawba)	3.3	4.3	5.0	6.5	8.1	10.1	5.9	7.6	8.9	11.5	14.4	17.9	2.6	3.3	3.9	5.0	6.2	7.8	2.2	2.9	3.4	4.4	5.4	6.8
Poplin PS Pump-over (Yadkin to Catawba)	1.1	1.3	2.2	3.0	4.1	5.7	2.0	2.3	3.9	5.3	7.3	10.0	0.9	1.0	1.7	2.3	3.2	4.4	0.7	0.9	1.5	2.0	2.7	3.8
Crooked Creek (scalping to Catawba)[1]	0.0	0.0	0.2	0.6	1.6	2.9	0.0	0.0	0.4	1.1	2.8	5.1	0.0	0.0	0.2	0.5	1.2	2.2	0.0	0.0	0.2	0.4	1.0	1.9
Lake Lee Basin (Yadkin)[3]	0.0	0.0	0.0	0.3	0.4	0.6	0.0	0.0	0.1	0.6	0.8	1.1	0.0	0.0	0.0	0.3	0.3	0.5	0.0	0.0	0.0	0.2	0.3	0.4
Richardson Creek Basin (Yadkin)[3]	0.0	0.0	0.0	0.1	0.2	0.3	0.0	0.0	0.0	0.2	0.3	0.5	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.2
Twelve Mile WRF Total (Catawba)[2]	**4.5**	**5.6**	**7.5**	**10.6**	**14.4**	**19.5**	**7.9**	**9.9**	**13.3**	**18.7**	**25.5**	**34.6**	**3.4**	**4.3**	**5.8**	**8.1**	**11.1**	**15.0**	**3.0**	**3.7**	**5.0**	**7.1**	**9.7**	**13.1**
Lake Twitty Basin (Yadkin)	0.0	0.3	0.6	1.3	1.8	2.5	0.0	0.5	1.0	2.3	3.2	4.4	0.0	0.2	0.4	1.0	1.4	1.9	0.0	0.2	0.4	0.9	1.2	1.7
Eastside Basins (Yadkin)	1.3	1.7	2.1	2.7	3.7	5.1	2.3	3.0	3.8	4.8	6.6	9.1	1.0	1.3	1.6	2.1	2.9	3.9	0.9	1.1	1.4	1.8	2.5	3.4
Lake Lee Basin (Yadkin)[3]	0.0	0.0	0.0	0.3	0.4	0.6	0.0	0.0	0.1	0.6	0.8	1.1	0.0	0.0	0.0	0.3	0.3	0.5	0.0	0.0	0.0	0.2	0.3	0.4
Richardson Creek Basin (Yadkin)[3]	0.0	0.0	0.0	0.1	0.2	0.3	0.0	0.0	0.0	0.2	0.3	0.5	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.2
Monroe WWTP Total (Yadkin)[4]	**1.3**	**2.0**	**2.7**	**4.5**	**6.2**	**8.5**	**2.3**	**3.5**	**4.9**	**7.9**	**10.9**	**15.0**	**1.0**	**1.5**	**2.1**	**3.4**	**4.7**	**6.5**	**0.9**	**1.3**	**1.8**	**3.0**	**4.1**	**5.7**
Monroe WWTP - Current Capacity[5]	1.3	2.0	2.7	2.7	2.7	2.7	2.3	3.5	4.7	4.7	4.7	4.7	1.0	1.5	2.0	2.0	2.0	2.0	0.9	1.3	1.8	1.8	1.8	1.8
Monroe WWTP - Additional Capacity[6]	0.0	0.0	0.1	1.8	3.5	5.8	0.0	0.0	0.2	3.2	6.2	10.3	0.0	0.0	0.1	1.4	2.7	4.5	0.0	0.0	0.1	1.2	2.3	3.9
Union County Total	**8.1**	**10.2**	**13.8**	**18.6**	**24.6**	**32.5**	**14.3**	**18.1**	**24.4**	**32.9**	**43.5**	**57.6**	**6.2**	**7.9**	**10.6**	**14.3**	**18.9**	**25.0**	**5.4**	**6.8**	**9.2**	**12.4**	**16.4**	**21.8**

PROJECTION FACTORS

HDR 2030 Avg Day Water Demand Projections / B&V Master Plan	**0.93**	
2030-2050 AGR (Yadkin)	**3.27%**	*(As based on HDR avg day water demand projections)*
2030-2050 AGR (Catawba)	**2.23%**	*(As based on HDR avg day water demand projections)*
Max Month / Avg Day Ratio[7]	**1.3**	
Max Day / Avg Day Ratio[8]	**2.3**	
Min Month / Avg Day Ratio[9]	**0.87**	

PROJECTION NOTES

[1] Crooked Creek WRF capacity assumed to remain at 1.9 mgd; all additional flow assumed scalped for transfer to Catawba Basin and treated at the Twelve Mile WRF

[2] Twelve Mile WRF projections include Twelve Mile Basin flows, pump-over from Poplin Rd Pump Station (including Crooked Creek WRF scalping flows) and portion of Lake Lee and Richardson Creek Basin flows

[3] Half of projected Lake Lee and Richardson Creek Basin flows projected to be pumped to Twelve Mile WRF and half projected to be treated at the Monroe-WWTP

[4] Union County - Monroe projections include Union County serviced areas, but do not include Monroe's service area

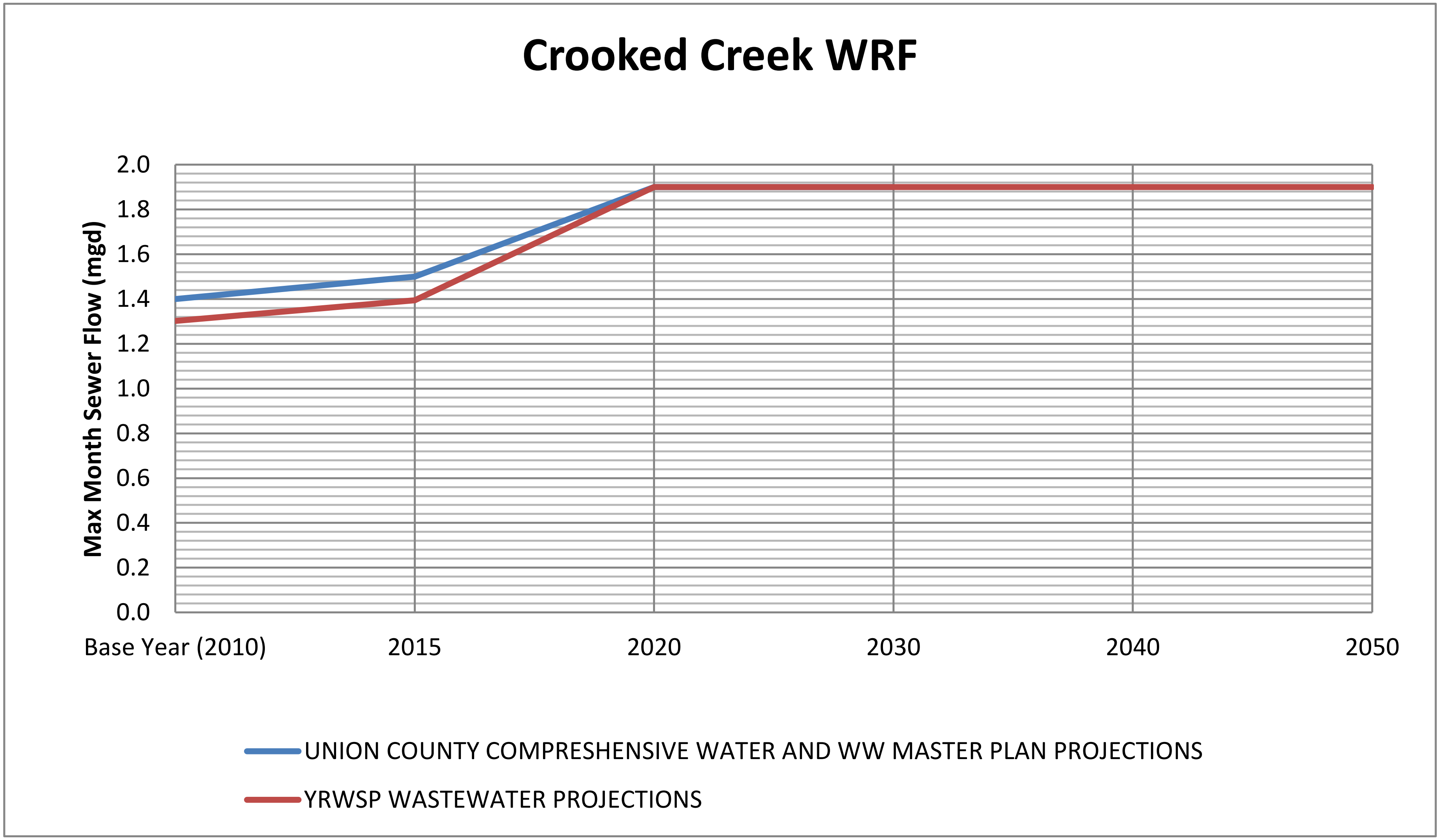
[5] Union County's capacity at Monroe's WWTP is 2.65 mgd; all additional flow in this basin will need to be treated through additional leased capacity and may require plant expansion

[6] Additional leased capacity or expansion of Monroe WWTP needed to meet Union County wastewater production in this basin

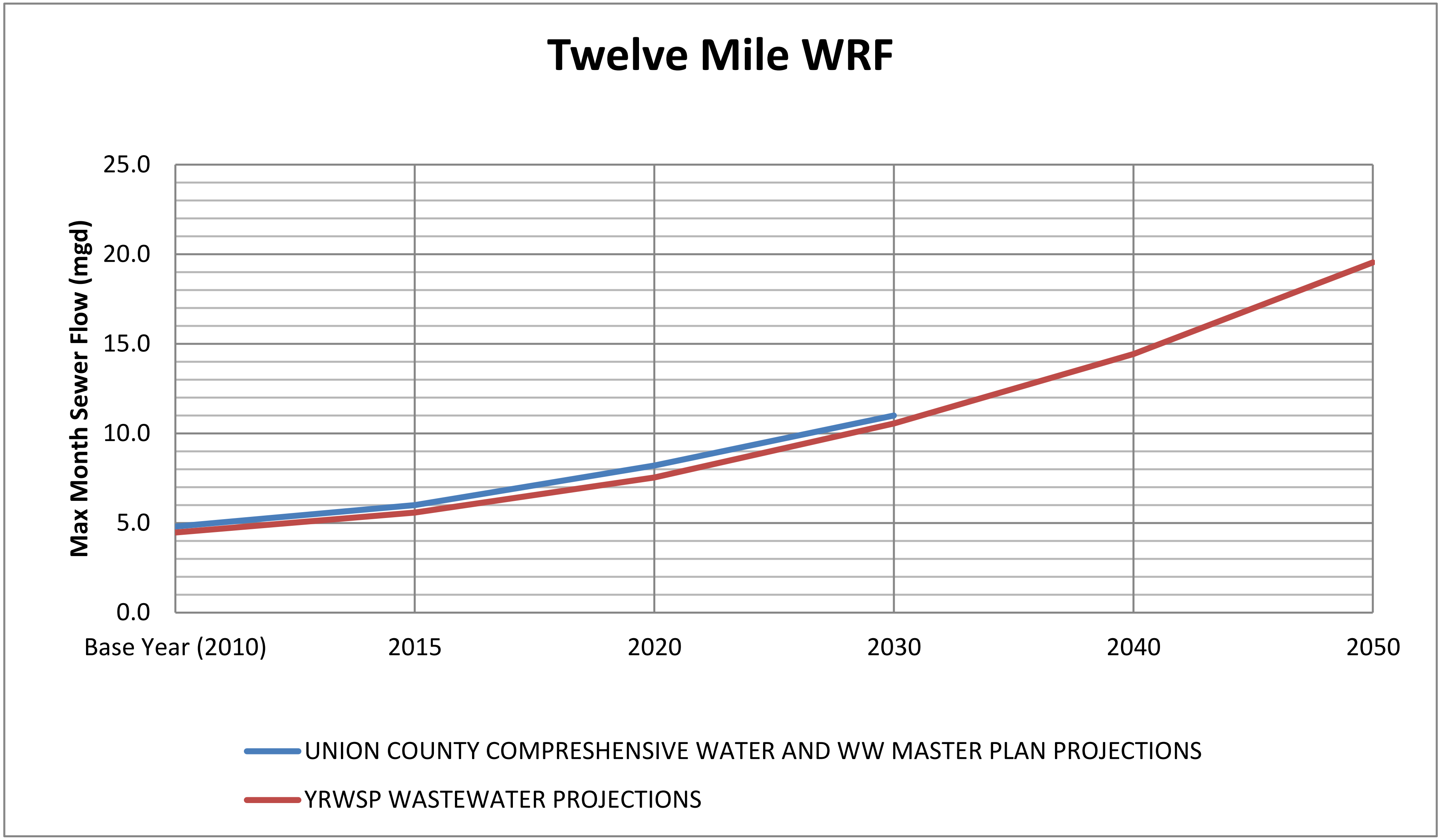
[7] Annual average daily flow peaking factor to max month average day, as based on Union County Master Plan

[8] Annual average daily flow peaking factor to max day, as based on historical NC Local Water Supply Plan wastewater data for Union County's Crooke Creek and Twelve Mile WRFs (2002 and 2007 to 2012)

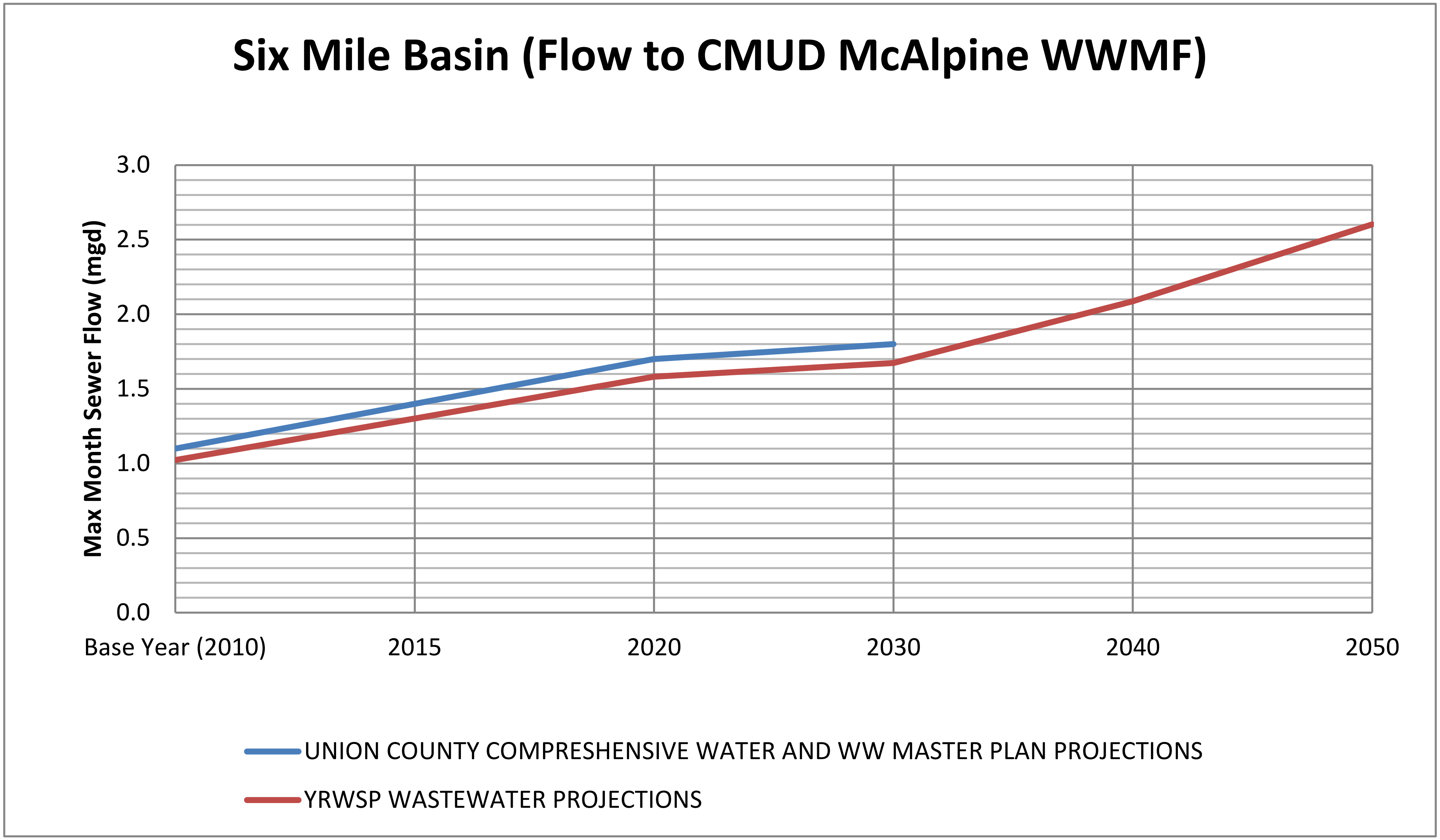
[9] Annual average daily flow conversion factor to min month (dry weather wastewater flows), as based on NC LWSPs for total Union County wastewater flow (2002 and 2007 to 2012)



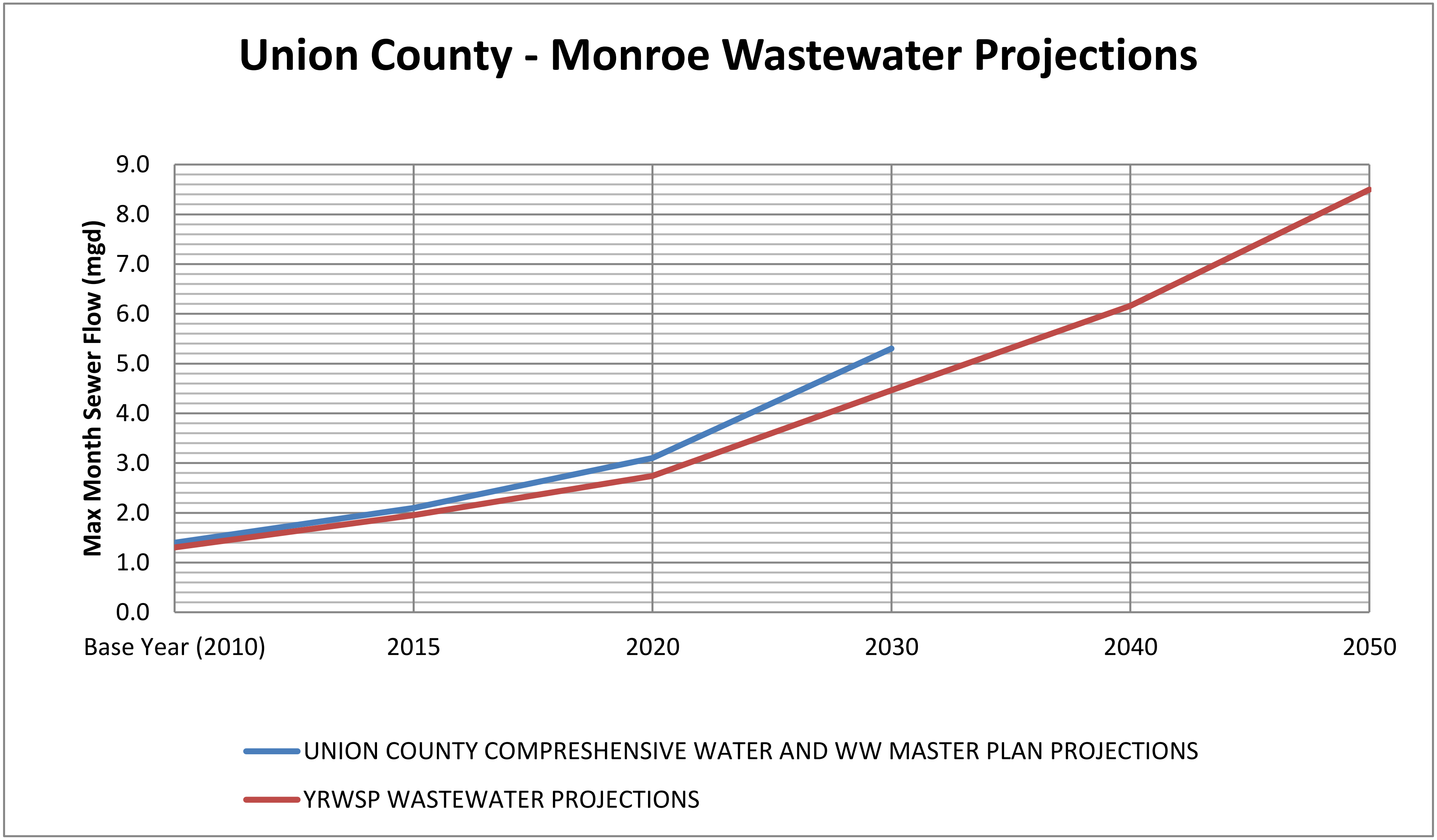
Note: This chart includes only Union County's wastewater services areas treated at the Crooked Creek WRF (does not include wastewater flow scalped and transferred to the Poplin Rd Pump Station.



Note: This chart includes Union County's wastewater services areas currently or projected to be treated at the Twelve Mile WRF.



Note: This chart includes only Union County's wastewater services areas within the Six Mile Creek Sub-Basin transferred to CMUD's McAlpine Creek WWMF for treatment.



Note: This chart includes only Union County's wastewater services areas treated at the Monroe WWTP.

YADKIN SERVICE AREA WATER SUPPLY

WATER UTILIZED IN THE YADKIN BASIN

YEAR	Max. Day (mgd)	Max Month (mgd)	Avg. Day (mgd)
2010	8.4	6.9	4.9
2015	10.2	8.4	6.0
2020	12.5	10.3	7.4
2030	18.6	15.3	10.9
2040	26.4	21.6	15.6
2050	35.3	28.9	20.8

WATER SUPPLIED FROM THE YADKIN BASIN

YEAR	Max. Day (mgd)	Max Month (mgd)	Avg. Day (mgd)
2010	3.0	2.5	1.8
2015	3.0	2.5	1.8
2020	4.0	3.3	2.4
2030	12.0	9.8	7.1
2040	20.0	16.4	11.8
2050	28.0	23.0	16.5

YADKIN SERVICE AREA WASTEWATER

WASTEWATER GENERATED IN THE YADKIN BASIN

YEAR	Max. Day (mgd)	Max Month (mgd)	Avg. Day (mgd)	Min Month (mgd)
2010	6.6	3.7	2.9	2.5
2015	8.2	4.7	3.6	3.1
2020	12.7	7.2	5.5	4.8
2030	18.4	10.4	8.0	7.0
2040	25.4	14.4	11.1	9.6
2050	35.1	19.8	15.2	13.3

WASTEWATER RETURNED TO THE YADKIN BASIN

YEAR	Max. Day (mgd)	Max Month (mgd)	Avg. Day (mgd)	Min Month (mgd)
2010	4.6	2.6	2.0	1.7
2015	5.9	3.3	2.6	2.2
2020	8.2	4.6	3.6	3.1
2030	11.3	6.4	4.9	4.3
2040	14.3	8.1	6.2	5.4
2050	18.4	10.4	8.0	7.0

NET YADKIN RIVER TO ROCKY RIVER TRANSFER

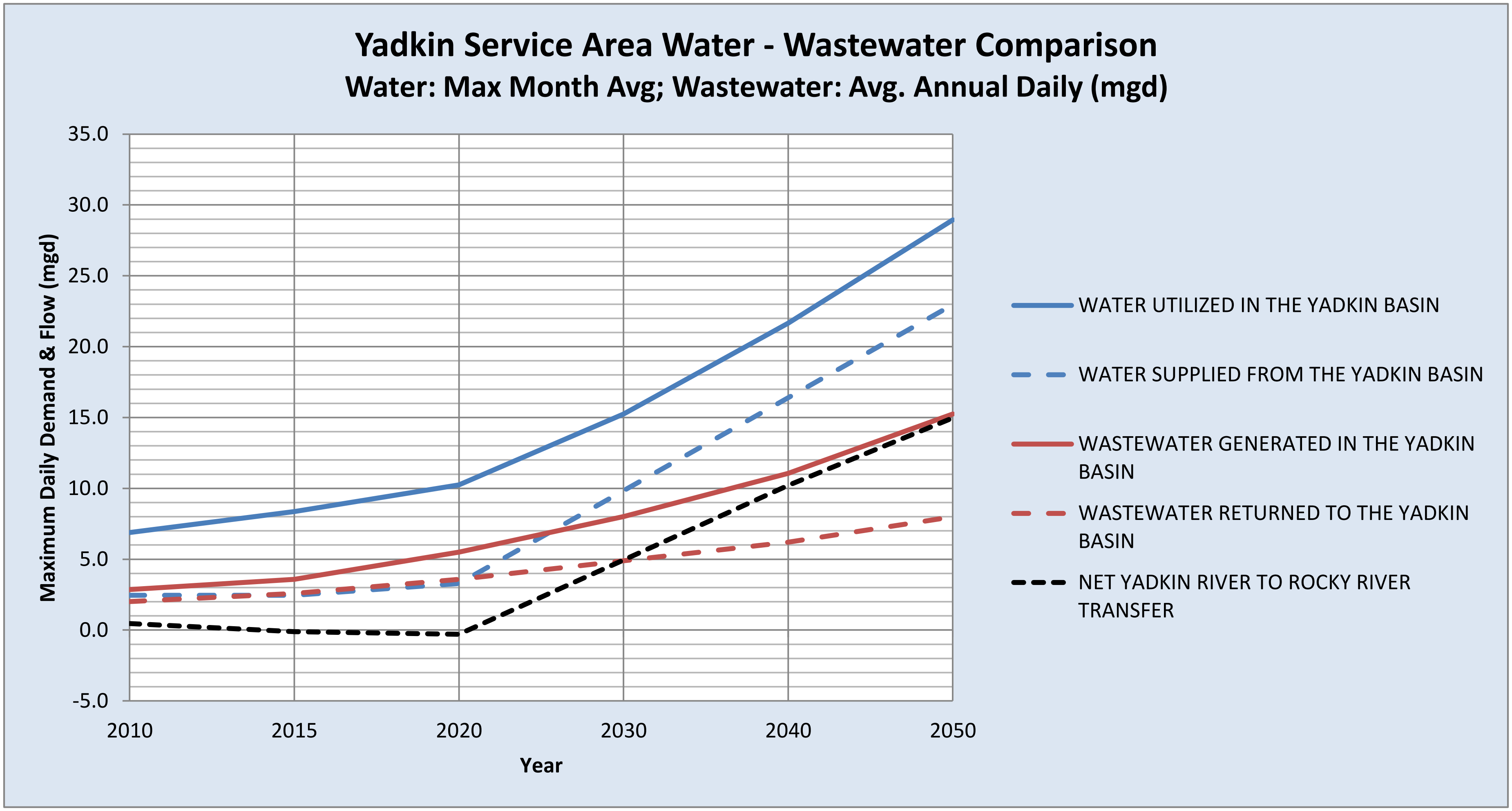
YEAR	Max. Day (mgd)	Max Month (mgd)	Avg. Day (mgd)	Max Month Water & Avg Month WW (mgd)	Max Month Water & Min Month WW (mgd)	
2010	-1.6	-0.1	-0.2	0.5	0.7	Until new YRWSP is completed, Union County transfers more water into the Yadkin Basin through wastewater returns than it withdraws, due to it's Catawba IBT
2015	-2.9	-0.9	-0.8	-0.1	0.2	
2020	-4.2	-1.4	-1.2	-0.3	0.2	
2030	0.7	3.5	2.2	4.9	5.6	Once the YRWSP is completed, Union County will withdraw more water from the Yadkin Basin than it returns through wastewater flow due the proposed Yadkin River to Rocky River IBT; however, the net effect of the IBT withdrawal is reduced due to wastewater returns back into the Rocky River in the Yadkin Service area.
2040	5.7	8.3	5.6	10.2	11.0	
2050	9.6	12.6	8.5	15.0	16.0	

SUMMARY:

	Max Day (mgd)		Max Month (mgd)		Avg Day (mgd)		Max Month Water & Avg Month WW (mgd)		Max Month Water & Min. Month WW (mgd)	
Year	**2010**	**2050**	**2010**	**2050**	**2010**	**2050**	**2010**	**2050**	**2010**	**2050**
Water Supplied From Yadkin Basin	3	28	2.5	23.0	1.8	16.5	2.5	23.0	2.5	23.0
WW Returned to Yadkin Basin (Rocky River)	4.6	18.4	2.6	10.4	2.0	8.0	2.0	8.0	1.7	7.0
Net Yadkin to Rocky River Transfer	**-1.6**	**9.6**	**-0.1**	**12.6**	**0.7**	**8.5**	**0.5**	**15.0**	**0.7**	**16.0**

Note: Does not include additional WW returns from miscellaneous Union County package plants (Miscellaneous package plants include Union County operated facilities (Tallwood Estates WWTP, Grassy Branch WWTP, and Olde Sycamore WWTP) and privately operated facilities to neighborhoods served by Union County water (Country Woods WWTP and Hemby Acres WWTP).

USE THESE VALUES FOR IBT PLANNING PURPOSES



Yadkin Service Area Water - Wastewater Comparison
Water: Max Month Avg; Wastewater: Avg. Annual Daily (mgd)
Maximum Daily Demand & Flow (mgd)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
2010
2015
2020
2030
2040
2050
Year
WATER UTILIZED IN THE YADKIN BASIN
WATER SUPPLIED FROM THE YADKIN BASIN
WASTEWATER GENERATED IN THE YADKIN BASIN
WASTEWATER RETURNED TO THE YADKIN BASIN
NET YADKIN RIVER TO ROCKY RIVER TRANSFER

NC Local Water Supply Plans
Union County Wastewater Peaking Factors

Annual Average Daily to Maximum Daily

	Crooked Creek WRF			Twelve Mile WRF			TOTAL			Monroe WWTP		
Plan Year	Avg Day (mgd)	Max Day (mgd)	Max Day/ Avg Day	Avg Day (mgd)	Max Day (mgd)	Max Day/ Avg Day	Avg Day (mgd)	Max Day (mgd)	Max Day/ Avg Day	Avg Day (mgd)	Max Day (mgd)	Max Day/ Avg Day[1]
2002	1.18	4	3.39	1.07	2.8	2.62	2.25	6.8	3.02	1.45	3.32	2.29
2007	1.29	2.28	1.77	2.74	5.51	2.01	4.03	7.79	1.93	1.18	2.70	2.29
2008	1.08	2.64	2.44	3.32	7.59	2.29	4.4	10.23	2.33	1.28	2.93	2.29
2009	1.02	3.05	2.99	3.55	8.4	2.37	4.57	11.45	2.51	1.25	2.86	2.29
2010	0.975	3.49	3.58	3.553	8.72	2.45	4.528	12.21	2.70	1.3	2.98	2.29
2011	0.997	2.295	2.30	3.557	6.31	1.77	4.554	8.605	1.89	1.213	2.78	2.29
2012	1.048	2.22	2.12	3.556	6.96	1.96	4.604	9.18	1.99	1.218	2.79	2.29
Avg	**1.08**	**2.85**	**2.63**	**3.05**	**6.61**	**2.17**	**4.13**	**9.47**	**2.29**	**1.27**	**2.91**	**2.29**

Notes:

[1] Assumed ratio based on average of Crooked Creek WRF plus Twelve Mile WRF wastewater flows, in the absence of Union County data for max day flow sent to Monroe WWTP

[2] Max day Union County wastewater flow sent to Monroe WWTP calculated as average day flow (known) multiplied by assumed max day to average day ratio as described in note 1 above

CONCLUSIONS

Use 2.3 as assumed annual average daily to maximum day wastewater flow peaking factor for wastewater projections.
Based on 1.3 annual average daily to maximum month daily average wastewater flow peaking factor (as communicated by Union County), the maximum month daily average to maximum day wastewater flow peaking factor is 1.8 (2.3 divided by 1.3).

Annual Average Daily to Minimum Month Daily Average

	NC LWSP Total Wastewater Monthly Average Wastewater Flow (mgd) by YEAR							
Month	2002	2007	2008	2009	2010	2011	2012	
January	2.3	4.898	4.316	4.808	5.816	4.381	7.924	
February	3	4.6	4.8	4.531	6.319	4.696	7.291	
March	2.2	4.472	4.963	5.939	5.429	5.273	7.508	
April	2.1	4.183	4.828	4.748	4.299	5.533	6.982	
May	1.9	3.874	4.205	4.483	4.565	4.596	7.368	
June	2	3.867	3.905	4.357	4.91	4.388	6.673	
July	1.85	3.88	4.048	3.802	4.256	4.244	6.633	
August	2	3.738	4.38	3.894	4.273	4.874	7.262	
September	2.3	3.874	4.421	3.789	3.965	4.591	7.09	
October	1.9	3.775	4.146	3.956	3.908	4.81	6.865	
November	1.95	3.621	4.478	5.096	3.929	4.67	6.601	
December	2.1	4.04	4.882	6.17	4.256	4.905	7.441	
Annual Avg	**2.13**	**4.07**	**4.45**	**4.63**	**4.65**	**4.75**	**7.14**	
Min Month	**1.85**	**3.62**	**3.91**	**3.79**	**3.91**	**4.24**	**6.60**	***AVG***
Min Month / Annual Avg	***0.87***	***0.89***	***0.88***	***0.82***	***0.84***	***0.89***	***0.92***	***0.87***

CONCLUSIONS

Use 0.87 as assumed annual average daily to minimum month average day wastewater flow peaking factor for wastewater projections.

C

APPENDIX C – Alternatives Conceptual Cost Analysis

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Transmission Main Take-off to WTP Site Area A, by Alternative (not including land easement acquisition)

	Pipe					Fittings									
Alternatives	Length (miles)	Length (feet)	Pipe Dia. (inches)	Cost[1] ($/LF)	Total Pipe Cost	45deg Elbow	Cost/Elbow ($/unit)	90deg Elbows	Cost/elbow ($/unit)	Plug Valves	Cost/valve ($/unit)	Total Valve Cost	Total Fitting & Valve Cost	**Overall Cost[2]**	**Total Cost/Foot[2]**
1A	24	126,720	36	$275	$34,848,000	22	$6,300	8	$8,100	25	$85,500	$2,137,500	$2,340,900	**$74,377,800**	**$587**
1B	26	137,280	36	$275	$37,752,000	21	$6,300	5	$8,100	27	$85,500	$2,308,500	$2,481,300	**$80,466,600**	**$586**
2A	35	184,800	36	$275	$50,820,000	28	$6,300	9	$8,100	37	$85,500	$3,163,500	$3,412,800	**$108,465,600**	**$587**
2B	35	184,800	36	$275	$50,820,000	26	$6,300	6	$8,100	37	$85,500	$3,163,500	$3,375,900	**$108,391,800**	**$587**
3A	29	153,120	36	$305	$46,701,600	12	$6,300	5	$8,100	31	$85,500	$2,650,500	$2,766,600	**$98,936,400**	**$646**
4	21	110,880	36	$275	$30,492,000	15	$6,300	5	$8,100	22	$85,500	$1,881,000	$2,016,000	**$65,016,000**	**$586**
5	3	15,840	36	$275	$4,356,000	2	$6,300	1	$8,100	4	$85,500	$342,000	$362,700	**$9,437,400**	**$596**

Notes:

[1] Higher cost of $305/LF due to requirement for higher pressure class piping required for alternative

[2] Overall costs presented for dual (2) redundant raw water tranmission mains

Summary of Project Transmission Main Costs to WTP Site Area A, by Alternative (not including land easement acquisition)

Alternative 1A

Subtotal	$	74,377,800
Contingency (15%)	$	11,156,670
Extended Subtotal	$	85,534,470
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	17,106,894
Extended Subtotal	$	102,641,364
Engineer's Design and Construction Admin Fee (15%)	$	15,396,205
Estimated Project Total - Transmission	**$**	**118,037,569**

Alternative 2B

Subtotal	$	108,391,800
Contingency (15%)	$	16,258,770
Extended Subtotal	$	124,650,570
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	24,930,114
Extended Subtotal	$	149,580,684
Engineer's Design and Construction Admin Fee (15%)	$	22,437,103
Estimated Project Total - Transmission	**$**	**172,017,787**

Alternative 5

Subtotal	$	9,437,400
Contingency (15%)	$	1,415,610
Extended Subtotal	$	10,853,010
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	2,170,602
Extended Subtotal	$	13,023,612
Engineer's Design and Construction Admin Fee (15%)	$	1,953,542
Estimated Project Total - Transmission	**$**	**14,977,154**

Alternative 1B

Subtotal	$	80,466,600
Contingency (15%)	$	12,069,990
Extended Subtotal	$	92,536,590
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	18,507,318
Extended Subtotal	$	111,043,908
Fee (15%)	$	16,656,586
Estimated Project Total - Transmission	**$**	**127,700,494**

Alternative 3A

Subtotal	$	98,936,400
Contingency (15%)	$	14,840,460
Extended Subtotal	$	113,776,860
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	22,755,372
Extended Subtotal	$	136,532,232
(15%)	$	20,479,835
Estimated Project Total - Transmission	**$**	**157,012,067**

Alternative 2A

Subtotal	$	108,465,600
Contingency (15%)	$	16,269,840
Extended Subtotal	$	124,735,440
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	24,947,088
Extended Subtotal	$	149,682,528
Engineer's Design and Construction Admin Fee (15%)	$	22,452,379
Estimated Project Total - Transmission	**$**	**172,134,907**

Alternative 4

Subtotal	$	65,016,000
Contingency (15%)	$	9,752,400
Extended Subtotal	$	74,768,400
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	14,953,680
Extended Subtotal	$	89,722,080
Engineer's Design and Construction Admin Fee (15%)	$	13,458,312
Estimated Project Total - Transmission	**$**	**103,180,392**

Transmission Main Take-off to WTP Site Area B, by Alternative (not including land easement acquisition)

	Pipe					Fittings									
Alternative	Length (miles)	Length (feet)	Pipe Dia. (inches)	Cost ($/LF)	Total Pipe Cost	45deg Elbow	Cost/Elbow ($/unit)	90deg Elbows	Cost/elbow ($/unit)	Plug Valves	Cost/valve ($/unit)	Total Valve Cost	Total Fitting & Valve Cost	**Overall Cost**	**Total Cost/Foot**
1A	32	168,960	36	$275	$46,464,000	27	$6,300	12	$8,100	34	$85,500	$2,907,000	$3,174,300	**$99,276,600**	**$588**
1B	34	179,520	36	$275	$49,368,000	26	$6,300	9	$8,100	36	$85,500	$3,078,000	$3,314,700	**$105,365,400**	**$587**
2A	43	227,040	36	$275	$62,436,000	33	$6,300	13	$8,100	46	$85,500	$3,933,000	$4,246,200	**$133,364,400**	**$587**
2B	43	227,040	36	$275	$62,436,000	31	$6,300	10	$8,100	46	$85,500	$3,933,000	$4,209,300	**$133,290,600**	**$587**
3A	37	195,360	36	$305	$59,584,800	17	$6,300	9	$8,100	39	$85,500	$3,334,500	$3,514,500	**$126,198,600**	**$646**
4	29	153,120	36	$305	$46,701,600	20	$6,300	9	$8,100	31	$85,500	$2,650,500	$2,849,400	**$99,102,000**	**$647**
5	11	58,080	36	$275	$15,972,000	7	$6,300	5	$8,100	12	$85,500	$1,026,000	$1,110,600	**$34,165,200**	**$588**

Notes:

[1] Higher cost of $305/LF due to requirement for higher pressure class piping required for alternative

[2] Overall costs presented for dual (2) redundant raw water tranmission mains

Summary of Project Transmission Main Costs to WTP Site Area B, by Alternative (not including land easement acquisition)

Alternative 1A

Subtotal	$	99,276,600
Contingency (15%)	$	14,891,490
Extended Subtotal	$	114,168,090
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	22,833,618
Extended Subtotal	$	137,001,708
Engineer's Design and Construction Admin Fee (15%)	$	20,550,256
Estimated Project Total - Transmission	**$**	**157,551,964**

Alternative 2B

Subtotal	$	133,290,600
Contingency (15%)	$	19,993,590
Extended Subtotal	$	153,284,190
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	30,656,838
Extended Subtotal	$	183,941,028
Engineer's Design and Construction Admin Fee (15%)	$	27,591,154
Estimated Project Total - Transmission	**$**	**211,532,182**

Alternative 5

Subtotal	$	34,165,200
Contingency (15%)	$	5,124,780
Extended Subtotal	$	39,289,980
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	7,857,996
Extended Subtotal	$	47,147,976
Engineer's Design and Construction Admin Fee (15%)	$	7,072,196
Estimated Project Total - Transmission	**$**	**54,220,172**

Alternative 1B

Subtotal	$	105,365,400
Contingency (15%)	$	15,804,810
Extended Subtotal	$	121,170,210
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	24,234,042
Extended Subtotal	$	145,404,252
Admin Fee (15%)	$	21,810,638
Estimated Project Total - Transmission	**$**	**167,214,890**

Alternative 3A

Subtotal	$	126,198,600
Contingency (15%)	$	18,929,790
Extended Subtotal	$	145,128,390
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	29,025,678
Extended Subtotal	$	174,154,068
Fee (15%)	$	26,123,110
Estimated Project Total - Transmission	**$**	**200,277,178**

Alternative 2A

Subtotal	$	133,364,400
Contingency (15%)	$	20,004,660
Extended Subtotal	$	153,369,060
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	30,673,812
Extended Subtotal	$	184,042,872
Engineer's Design and Construction Admin Fee (15%)	$	27,606,431
Estimated Project Total - Transmission	**$**	**211,649,303**

Alternative 4

Subtotal	$	99,102,000
Contingency (15%)	$	14,865,300
Extended Subtotal	$	113,967,300
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	22,793,460
Extended Subtotal	$	136,760,760
Engineer's Design and Construction Admin Fee (15%)	$	20,514,114
Estimated Project Total - Transmission	**$**	**157,274,874**

Transmission Main Take-off to WTP Site Area C, by Alternative (not including land easement acquisition)

	Pipe					Fittings									
Alternatives	Length (miles)	Length (feet)	Pipe Dia. (inches)	Cost ($/LF)	Total Pipe Cost	45deg Elbow	Cost/Elbow ($/unit)	90deg Elbows	Cost/elbow ($/unit)	Plug Valves	Cost/valve ($/unit)	Total Valve Cost	Total Fitting & Valve Cost	**Overall Cost**	**Total Cost/Foot**
1A	31	163,680	36	$275	$45,012,000	27	$6,300	12	$8,100	33	$85,500	$2,821,500	$3,088,800	**$96,201,600**	**$588**
1B	33	174,240	36	$275	$47,916,000	26	$6,300	9	$8,100	35	$85,500	$2,992,500	$3,229,200	**$102,290,400**	**$587**
2A	42	221,760	36	$275	$60,984,000	33	$6,300	13	$8,100	44	$85,500	$3,762,000	$4,075,200	**$130,118,400**	**$587**
2B	42	221,760	36	$275	$60,984,000	31	$6,300	10	$8,100	44	$85,500	$3,762,000	$4,038,300	**$130,044,600**	**$586**
3A	36	190,080	36	$305	$57,974,400	17	$6,300	9	$8,100	38	$85,500	$3,249,000	$3,429,000	**$122,806,800**	**$646**
4	38	200,640	36	$305	$61,195,200	20	$6,300	9	$8,100	30	$85,500	$2,565,000	$2,763,900	**$127,918,200**	**$638**
5	10	52,800	36	$275	$14,520,000	7	$6,300	5	$8,100	11	$85,500	$940,500	$1,025,100	**$31,090,200**	**$589**

Notes:

[1] Higher cost of $305/LF due to requirement for higher pressure class piping required for alternative

[2] Overall costs presented for dual (2) redundant raw water tranmission mains

Summary of Project Transmission Main Costs to WTP Site Area C, by Alternative (not including land easement acquisition)

Alternative 1A

Subtotal	$	96,201,600
Contingency (15%)	$	14,430,240
Extended Subtotal	$	110,631,840
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	22,126,368
Extended Subtotal	$	132,758,208
Engineer's Design and Construction Admin Fee (15%)	$	19,913,731
Estimated Project Total - Transmission	**$**	**152,671,939**

Alternative 2B

Subtotal	$	130,044,600
Contingency (15%)	$	19,506,690
Extended Subtotal	$	149,551,290
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	29,910,258
Extended Subtotal	$	179,461,548
Engineer's Design and Construction Admin Fee (15%)	$	26,919,232
Estimated Project Total - Transmission	**$**	**206,380,780**

Alternative 5

Subtotal	$	31,090,200
Contingency (15%)	$	4,663,530
Extended Subtotal	$	35,753,730
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	7,150,746
Extended Subtotal	$	42,904,476
Engineer's Design and Construction Admin Fee (15%)	$	6,435,671
Estimated Project Total - Transmission	**$**	**49,340,147**

Alternative 1B

Subtotal	$	102,290,400
Contingency (15%)	$	15,343,560
Extended Subtotal	$	117,633,960
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	23,526,792
Extended Subtotal	$	141,160,752
Admin Fee (15%)	$	21,174,113
Estimated Project Total - Transmission	**$**	**162,334,865**

Alternative 3A

Subtotal	$	122,806,800
Contingency (15%)	$	18,421,020
Extended Subtotal	$	141,227,820
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	28,245,564
Extended Subtotal	$	169,473,384
Fee (15%)	$	25,421,008
Estimated Project Total - Transmission	**$**	**194,894,392**

Alternative 2A

Subtotal	$	130,118,400
Contingency (15%)	$	19,517,760
Extended Subtotal	$	149,636,160
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	29,927,232
Extended Subtotal	$	179,563,392
Engineer's Design and Construction Admin Fee (15%)	$	26,934,509
Estimated Project Total - Transmission	**$**	**206,497,901**

Alternative 4

Subtotal	$	127,918,200
Contingency (15%)	$	19,187,730
Extended Subtotal	$	147,105,930
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	29,421,186
Extended Subtotal	$	176,527,116
Engineer's Design and Construction Admin Fee (15%)	$	26,479,067
Estimated Project Total - Transmission	**$**	**203,006,183**

Transmission Main Take-off to WTP Site Area D, by Alternative (not including land easement acquisition)

	Pipe					Fittings									
Alternatives	Length (miles)	Length (feet)	Pipe Dia. (inches)	Cost ($/LF)	Total Pipe Cost	45deg Elbow	Cost/Elbow ($/unit)	90deg Elbows	Cost/elbow ($/unit)	Plug Valves	Cost/valve ($/unit)	Total Valve Cost	Total Fitting & Valve Cost	**Overall Cost**	**Total Cost/Foot**
3B	30	158,400	36	$305	$48,312,000	9	$6,300	8	$8,100	32	$85,500	$2,736,000	$2,857,500	**$102,339,000**	**$646**
8 [3]	12.5	66,000	36	$275										**$38,808,000**	**$588**

Notes:

[1] Higher cost of $305/LF due to requirement for higher pressure class piping required for alternative

[2] Overall costs presented for dual (2) redundant raw water tranmission mains

[3] Cost of Alternative 8 transmission mains estimated by use of the average total cost per foot of standard class piping for all other alternatives, ($586/ft), due to relatively short length of alignment as compared with other alternatives

Summary of Project Transmission Main Costs to WTP Site Area D, by Alternative (not including land easement acquisition)

Alternative 3B

Subtotal	$	102,339,000
Contingency (15%)	$	15,350,850
Extended Subtotal	$	117,689,850
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	23,537,970
Extended Subtotal	$	141,227,820
Engineer's Design and Construction Admin Fee (15%)	$	21,184,173
Estimated Project Total - Transmission	**$**	**162,411,993**

Alternative 8

Subtotal	$	38,808,000
Contingency (15%)	$	5,821,200
Extended Subtotal	$	44,629,200
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$	8,925,840
Extended Subtotal	$	53,555,040
Engineer's Design and Construction Admin Fee (15%)	$	8,033,256
Estimated Project Total - Transmission	**$**	**61,588,296**

ALTERNATIVES 1-3: Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

12 MGD Facility, Phase 1

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake, Screens and Appurtenances	LS	1	$ 1,250,000	$ 1,250,000
Raw Water Pumping Station	SF	2000	$ 200	$ 400,000
6 MGD Vertical Turbine Pumps	EA	2	$ 125,000	$ 250,000
12 MGD Vertical Turbine Pumps	EA	1	$ 250,000	$ 250,000
Installation	LS	1	$ 150,000	$ 150,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 200,000	$ 200,000
Electrical and I&C Improvements	LS	1	$ 350,000	$ 350,000
			Subtotal	**$ 3,350,000**
Subtotal for Construction				**$ 3,350,000**
Site/Civil (3%)				**$ 100,500**
Subtotal				**$ 3,450,500**
Contingency (15%)				**$ 517,575**
Subtotal				**$ 3,968,075**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 793,615**
Subtotal				**$ 4,761,690**
Escalation - None				**$ -**
Engineer's Design and Construction Admin Fee (15%)				**$ 714,254**
Phase 1 Estimated Raw Water PS & Intake Improvements Total				**$ 5,475,944**
Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 60,000	$ 120,000
Tank Construction	CY	80	$ 550	$ 44,000
Excavation and Backfill	CY	140	$ 35	$ 4,900
Equipment Installation	LS	1	$ 110,000	$ 110,000
42" Influent Line	LF	150	$ 300	$ 45,000
Slide Gates	EA	4	$ 25,000	$ 100,000
Electrical and I&C Improvements	L S	1	$ 84,780	$ 84,780
			Subtotal	***$ 508,680***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 690,000	$ 1,380,000
Tank Construction	CY	1857	$ 550	$ 1,021,350
Excavation and Backfill	CY	930	$ 35	$ 32,550
Equipment Installation	LS	1	$ 414,000	$ 414,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Electrical and I&C Improvements	LS	1	$ 434,685	$ 434,685
			Subtotal	***$ 3,332,585***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 1,000,000	$ 1,000,000
Tank Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	360	$ 50	$ 18,000
Equipment Installation	LS	1	$ 250,000	$ 250,000
Miscellanous Metals	LS	1	$ 65,000	$ 65,000
Sluice Gates	EA	4	$ 25,000	$ 100,000
42" DIP Effluent Line	LF	380	$ 300	$ 114,000
42" DIP Influent Line	LF	60	$ 300	$ 18,000
Electrical and I&C Improvements	LS	1	$ 223,000	$ 223,000
			Subtotal	***$ 2,338,000***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	1800	$ 150	$ 270,000
*GAC Filter Media**	LBS	565000	$ 1.5	$ 847,500
Underdrain Equipment, Troughs	EA	4	$ 180,000	$ 720,000
Filter Box Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	1200	$ 35	$ 42,000
Equipment Installation	EA	4	$ 100,000	$ 400,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	4000	$ 40	$ 160,000
Pipe Gallery Piping/Valving	EA	4	$ 125,000	$ 500,000
42" Steel Effluent Line	LF	200	$ 300	$ 60,000
Electrical and I&C Improvements	LS	1	$ 496,400	$ 496,400
			Subtotal	***$ 3,825,900***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	6,000	$ 200	$ 1,200,000
Maintenance Shop	SF	1,500	$ 125	$ 187,500
			Subtotal	**$ 1,387,500**
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	1	$ 300,000	$ 300,000
Concrete Pad	CY	10	$ 600	$ 6,000
Chemical Feed Pumps	EA	2	$ 25,500	$ 51,000
Alum Bulk Tanks - 20,000 gallon	EA	2	$ 40,000	$ 80,000
Chemical Feed Pumps	EA	2	$ 25,000	$ 50,000
Polymer Feed System	EA	2	$ 100,000	$ 200,000
Polymer Feed Pumps	EA	4	$ 25,000	$ 100,000
Caustic Bulk Tanks - 10,000 gallon	EA	2	$ 25,000	$ 50,000
Caustic Feed Pumps	EA	2	$ 25,000	$ 50,000
Hypo Bulk Storage Tank (20,000 gallons)	EA	3	$ 40,000	$ 120,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	2	$ 30,000	$ 60,000
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Corrosion Inhibitor Feed Pump	EA	2	$ 15,000	$ 30,000
Fluoride Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Fluoride Feed Pumps	EA	2	$ 15,000	$ 30,000
Chemical Building	SF	15000	$ 150	$ 2,250,000
Electrical and I&C Improvements	LS	1	$ 531,300	$ 531,300
Equipment Installation	LS	1	*$ 101,250*	*$ 101,250*
			Subtotal	***$ 4,174,550***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	2	$ 350,000	$ 700,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	2	$ 500,000	$ 1,000,000
Dewatering Building	SF	2,000	$ 150	$ 300,000
Thickening Polymer System	LS	1	$ 65,000	$ 65,000
Centrifuge Pumps	EA	2	$ 40,000	$ 80,000
Thickened Sludge Storage	CY	250	$ 550	$ 137,500
Thickened Sludge Storage Mixer	EA	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 814,000	$ 814,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 407,000	$ 407,000
			Subtotal	***$ 5,291,000***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	4,000,000	$ 0.60	$ 2,400,000
Electrical and I&C Improvements	LS	1	$ 240,000	$ 240,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 240,000	$ 240,000
			Subtotal	***$ 2,880,000***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	3	$ 125,000	$ 375,000
Pumping Station Building	SF	3,500	$ 150	$ 525,000
Electrical and I&C Improvements	LS	1	$ 180,000	$ 180,000
Miscellanous (Piping, etc.)	LS	1	$ 450,000	$ 450,000
			Subtotal	***$ 1,530,000***
Subtotal for Construction				$ 25,268,215
Site/Civil (3%)				$ 758,046
Subtotal				$ 26,026,261
Yard Piping (5%)				$ 1,263,411
Subtotal				$ 27,289,672
Contingency (25%)				$ 6,822,418
Subtotal				$ 34,112,090
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 6,822,418
Subtotal				$ 40,934,508
Escalation - None				$ 40,934,508
Engineer's Design and Construction Admin Fee (15%)				$ 6,140,176
Phase 1 Estimated WTP Total				**$ 47,074,685**

20 MGD Facility, Phase 2

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake, Screens and Appurtenances	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 150	$ -
12 MGD Vertical Turbine Pumps	EA	1	$ 250,000	$ 250,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	0	$ 500,000	$ -
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 75,000	$ 75,000
			Subtotal	**$ 450,000**
Subtotal for Construction				**$ 450,000**
Site/Civil (3%)				**$ 13,500**
Subtotal				**$ 463,500**
Contingency (15%)				**$ 69,525**
Subtotal				**$ 533,025**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 106,605**
Subtotal				**$ 639,630**
Escalation - None				**$ -**
Engineer's Design and Construction Admin Fee (15%)				**$ 95,945**
Phase 2 Estimated Raw Water PS & Intake Improvements Total				**$ 735,575**
Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	0	$ 60,000	$ -
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 35	$ -
Equipment Installation	LS	0	$ -	$ -
42" Influent Line	LF	0	$ 300	$ -
Slide Gates	EA	0	$ 25,000	$ -
Electrical and I&C Improvements	L S	0	$ -	$ -
			Subtotal	***$ -***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
			Subtotal	***$ 1,699,068***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	180	$ 50	$ 9,000
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	1	$ 35,000	$ 35,000
Sluice Gates	EA	2	$ 25,000	$ 50,000
42" DIP Effluent Line	LF	50	$ 300	$ 15,000
42" DIP Influent Line	LF	25	$ 300	$ 7,500
Electrical and I&C Improvements	LS	1	$ 98,300	$ 98,300
			Subtotal	***$ 1,089,800***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
			Subtotal	***$ 1,913,700***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
			Subtotal	**$ -**
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	1	$ 40,000	$ 40,000
Hypo Feed Pumps	EA	0	$ 25,000	$ -
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 21,000	$ 21,000
Equipment Installation	LS	1	*$ 18,750*	*$ 18,750*
			Subtotal	***$ 179,750***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
			Subtotal	***$ 2,681,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
			Subtotal	***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
			Subtotal	***$ 425,000***
Subtotal for Construction				$ 7,988,568
Site/Civil (3%)				$ 239,657
Subtotal				$ 8,228,225
Yard Piping (5%)				$ 399,428
Subtotal				$ 8,627,653
Contingency (25%)				$ 2,156,913
Subtotal				$ 10,784,566
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 2,156,913
Subtotal				$ 12,941,479
Escalation (0%)				$ 12,941,479
Engineer's Design and Construction Admin Fee (15%)				$ 1,941,222
Phase 2 Estimated WTP Total				**$ 14,882,701**

(*CONTINUED*) ALTERNATIVES 1-3: Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

28 MGD Facility, Phase 3

	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Raw Water Pump Station & Intake Improvements				
	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake, Screens and Appurtenances	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 150	$ -
12 MGD Vertical Turbine Pumps	EA	1	$ 250,000	$ 250,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 175,000	$ 175,000
			Subtotal	**$ 1,050,000**
			Subtotal for Construction	**$ 1,050,000**
			Site/Civil (3%)	**$ 31,500**
			Subtotal	**$ 1,081,500**
			Contingency (15%)	**$ 162,225**
			Subtotal	**$ 1,243,725**
			Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	**$ 248,745**
			Subtotal	**$ 1,492,470**
			Escalation - None	**$ -**
			Engineer's Design and Construction Admin Fee (15%)	**$ 223,871**
			Phase 3 Estimated Raw Water PS & Intake Improvements Total	**$ 1,716,341**
			Phase 1-3 Total	**$ 7,927,859**
Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 60,000	$ 60,000
Tank Construction	CY	40	$ 550	$ 22,000
Excavation and Backfill	CY	70	$ 35	$ 2,450
Equipment Installation	LS	1	$ 40,000	$ 40,000
42" Influent Line	LF	30	$ 300	$ 9,000
Slide Gates	EA	2	$ 25,000	$ 50,000
Electrical and I&C Improvements	L S	1	$ 36,690	$ 36,690
			Subtotal	***$ 220,140***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
			Subtotal	***$ 1,699,068***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 50	$ -
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	0	$ 35,000	$ -
Sluice Gates	EA	0	$ 25,000	$ -
42" DIP Effluent Line	LF	0	$ 300	$ -
42" DIP Influent Line	LF	0	$ 300	$ -
Electrical and I&C Improvements	LS	1	$ 20,000	$ 20,000
			Subtotal	***$ 620,000***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
			Subtotal	***$ 1,913,700***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
			Subtotal	***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	2	$ 40,000	$ 80,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	0	$ 35,000	$ -
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 36,750	$ 36,750
Equipment Installation	LS	1	*$ 45,000*	*$ 45,000*
			Subtotal	***$ 326,750***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
			Subtotal	***$ 2,681,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
			Subtotal	***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
			Subtotal	***$ 425,000***
			Subtotal for Construction	$ 7,885,908
			Site/Civil (3%)	$ 236,577
			Subtotal	$ 8,122,485
			Yard Piping (5%)	$ 394,295
			Subtotal	$ 8,516,780
			Contingency (25%)	$ 2,129,195
			Subtotal	$ 10,645,975
			Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$ 2,129,195
			Subtotal	$ 12,775,170
			Escalation (0%)	$ 12,775,170
			Engineer's Design and Construction Admin Fee (15%)	$ 1,916,276
			Phase 3 Estimated WTP Total	**$ 14,691,446**
			Phase 1-3 Total	**$ 76,648,831**

ALTERNATIVE 4 (Option A): Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

12 MGD Facility, Phase 1

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake	LS	1	$ 1,250,000	$ 1,250,000
Raw Water Pumping Station	SF	2000	$ 200	$ 400,000
6 MGD Vertical Turbine Pumps	EA	2	$ 125,000	$ 250,000
12 MGD Vertical Turbine Pumps	EA	1	$ 125,000	$ 125,000
Installation	LS	1	$ 150,000	$ 150,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 150,000	$ 150,000
Electrical and I&C Improvements	LS	1	$ 315,000	$ 315,000
Subtotal				**$ 3,140,000**
Subtotal for Construction				**$ 3,140,000**
Site/Civil (3%)				**$ 94,200**
Subtotal				**$ 3,234,200**
Contingency (25%)				**$ 808,550**
Subtotal				**$ 4,042,750**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 808,550**
Subtotal				**$ 4,851,300**
Escalation - None				**$ 4,851,300**
Engineer's Design and Construction Admin Fee (15%)				**$ 727,695**
Phase 1 Estimated Raw Water PS & Intake Improvements Total				**$ 5,578,995**

Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 60,000	$ 120,000
Tank Construction	CY	80	$ 550	$ 44,000
Excavation and Backfill	CY	140	$ 35	$ 4,900
Equipment Installation	LS	1	$ 110,000	$ 110,000
42" Influent Line	LF	150	$ 300	$ 45,000
Slide Gates	EA	4	$ 25,000	$ 100,000
Electrical and I&C Improvements	L S	1	$ 84,780	$ 84,780
Subtotal				***$ 508,680***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 690,000	$ 1,380,000
Tank Construction	CY	1857	$ 550	$ 1,021,350
Excavation and Backfill	CY	930	$ 35	$ 32,550
Equipment Installation	LS	1	$ 414,000	$ 414,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Electrical and I&C Improvements	LS	1	$ 434,685	$ 434,685
Subtotal				***$ 3,332,585***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 1,000,000	$ 1,000,000
Tank Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	360	$ 50	$ 18,000
Equipment Installation	LS	1	$ 250,000	$ 250,000
Miscellanous Metals	LS	1	$ 65,000	$ 65,000
Sluice Gates	EA	4	$ 25,000	$ 100,000
42" DIP Effluent Line	LF	380	$ 300	$ 114,000
42" DIP Influent Line	LF	60	$ 300	$ 18,000
Electrical and I&C Improvements	LS	1	$ 223,000	$ 223,000
Subtotal				***$ 2,338,000***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	1800	$ 150	$ 270,000
*GAC Filter Media**	LBS	565000	$ 1.5	$ 847,500
Underdrain Equipment, Troughs	EA	4	$ 180,000	$ 720,000
Filter Box Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	1200	$ 35	$ 42,000
Equipment Installation	EA	4	$ 100,000	$ 400,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	4000	$ 40	$ 160,000
Pipe Gallery Piping/Valving	EA	4	$ 125,000	$ 500,000
42" Steel Effluent Line	LF	200	$ 300	$ 60,000
Electrical and I&C Improvements	LS	1	$ 496,400	$ 496,400
Subtotal				***$ 3,825,900***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	6,000	$ 200	$ 1,200,000
Maintenance Shop	SF	1,500	$ 125	$ 187,500
Subtotal				***$ 1,387,500***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	1	$ 300,000	$ 300,000
Concrete Pad	CY	10	$ 600	$ 6,000
Chemical Feed Pumps	EA	2	$ 25,500	$ 51,000
Alum Bulk Tanks - 20,000 gallon	EA	2	$ 40,000	$ 80,000
Chemical Feed Pumps	EA	2	$ 25,000	$ 50,000
Polymer Feed System	EA	2	$ 100,000	$ 200,000
Polymer Feed Pumps	EA	4	$ 25,000	$ 100,000
Caustic Bulk Tanks - 10,000 gallon	EA	2	$ 25,000	$ 50,000
Caustic Feed Pumps	EA	2	$ 25,000	$ 50,000
Hypo Bulk Storage Tank (20,000 gallons)	EA	3	$ 40,000	$ 120,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	2	$ 30,000	$ 60,000
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Corrosion Inhibitor Feed Pump	EA	2	$ 15,000	$ 30,000
Fluoride Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Fluoride Feed Pumps	EA	2	$ 15,000	$ 30,000
Chemical Building	SF	15000	$ 150	$ 2,250,000
Electrical and I&C Improvements	LS	1	$ 531,300	$ 531,300
Equipment Installation	LS	1	*$ 101,250*	*$ 101,250*
Subtotal				***$ 4,174,550***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	2	$ 350,000	$ 700,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	2	$ 500,000	$ 1,000,000
Dewatering Building	SF	2,000	$ 150	$ 300,000
Thickening Polymer System	LS	1	$ 65,000	$ 65,000
Centrifuge Pumps	EA	2	$ 40,000	$ 80,000
Thickened Sludge Storage	CY	250	$ 550	$ 137,500
Thickened Sludge Storage Mixer	EA	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 814,000	$ 814,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 407,000	$ 407,000
Subtotal				***$ 5,291,000***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	4,000,000	$ 0.60	$ 2,400,000
Electrical and I&C Improvements	LS	1	$ 240,000	$ 240,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 240,000	$ 240,000
Subtotal				***$ 2,880,000***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	3	$ 125,000	$ 375,000
Pumping Station Building	SF	3,500	$ 150	$ 525,000
Electrical and I&C Improvements	LS	1	$ 180,000	$ 180,000
Miscellanous (Piping, etc.)	LS	1	$ 450,000	$ 450,000
Subtotal				***$ 1,530,000***
Terminal Reservoir	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Topsoil Stripping	CY	66000	$ 7.5	$ 495,000
Clearing and Grubbing	AC	60	$ 6,125	$ 367,500
Terminal Reservoir Earthwork Cut	CY	1471500	$ 6	$ 8,829,000
Terminal Reservoir Earthwork Fill	CY	1471500	$ 3	$ 4,414,500
Terminal Reservoir Liner	SF	3100000	$ 0.8	$ 2,325,000
Subtotal				***$ 16,431,000***
Subtotal for Construction				$ 41,699,215
Site/Civil (3%)				$ 1,250,976
Subtotal				$ 42,950,191
Yard Piping (5%)				$ 2,084,961
Subtotal				$ 45,035,152
Contingency (25%)				$ 11,258,788
Subtotal				$ 56,293,940
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 11,258,788
Subtotal				$ 67,552,728
Escalation - None				$ 67,552,728
Engineer's Design and Construction Admin Fee (15%)				$ 10,132,909
Phase 1 Estimated WTP Total				**$ 77,685,638**

20 MGD Facility, Phase 2

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake, Screens, and Appurtenances	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 200	$ -
6 MGD Vertical Turbine Pumps	EA	0	$ 125,000	$ -
12 MGD Vertical Turbine Pumps	EA	1	$ 250,000	$ 250,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	0	$ 500,000	$ -
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 75,000	$ 75,000
Subtotal				**$ 450,000**
Subtotal for Construction				**$ 450,000**
Site/Civil (3%)				**$ 13,500**
Subtotal				**$ 463,500**
Contingency (25%)				**$ 115,875**
Subtotal				**$ 579,375**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 115,875**
Subtotal				**$ 695,250**
Escalation (0%)				**$ 695,250**
Engineer's Design and Construction Admin Fee (15%)				**$ 104,288**
Phase 2 Estimated Raw Water PS & Intake Improvements Total				**$ 799,538**

Treatment Plant Processes				
Rapid Mix				
Equipment	EA	0	$ 60,000	$ -
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 35	$ -
Equipment Installation	LS	0	$ -	$ -
42" Influent Line	LF	0	$ 300	$ -
Slide Gates	EA	0	$ 25,000	$ -
Electrical and I&C Improvements	L S	0	$ -	$ -
Subtotal				***$ -***
Superpulsators				
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
Subtotal				***$ 1,699,068***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	180	$ 50	$ 9,000
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	1	$ 35,000	$ 35,000
Sluice Gates	EA	2	$ 25,000	$ 50,000
42" DIP Effluent Line	LF	50	$ 300	$ 15,000
42" DIP Influent Line	LF	25	$ 300	$ 7,500
Electrical and I&C Improvements	LS	1	$ 98,300	$ 98,300
Subtotal				***$ 1,089,800***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
Subtotal				***$ 1,913,700***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
Subtotal				***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	1	$ 40,000	$ 40,000
Hypo Feed Pumps	EA	0	$ 25,000	$ -
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 21,000	$ 21,000
Equipment Installation	LS	1	*$ 18,750*	*$ 18,750*
Subtotal				***$ 179,750***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
Subtotal				***$ 2,681,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
Subtotal				***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
Subtotal				***$ 425,000***
Terminal Reservoir	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Topsoil Stripping	CY		$ 7.5	$ -
Clearing and Grubbing	AC		$ 6,125	$ -
Terminal Reservoir Earthwork Cut	CY		$ 6	$ -
Terminal Reservoir Earthwork Fill	CY		$ 3	$ -
Terminal Reservoir Liner	SF		$ 0.5	$ -
Subtotal				***$ -***
Subtotal for Construction				$ 7,988,568
Site/Civil (3%)				$ 239,657
Subtotal				$ 8,228,225
Yard Piping (5%)				$ 399,428
Subtotal				$ 8,627,653
Contingency (25%)				$ 2,156,913
Subtotal				$ 10,784,566
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 2,156,913
Subtotal				$ 12,941,479
Escalation (0%)				$ 12,941,479
Engineer's Design and Construction Admin Fee (15%)				$ 1,941,222
Phase 2 Estimated WTP Total				**$ 14,882,702**

(*CONTINUED*) ALTERNATIVE 4 (Option A): Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

28 MGD Facility, Phase 3

Raw Water Pump Station & Intake Improvements				
	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 200	$ -
6 MGD Vertical Turbine Pumps	EA	0	$ 125,000	$ -
12 MGD Vertical Turbine Pumps	EA	1	$ 250,000	$ 250,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 175,000	$ 175,000
			Subtotal	**$ 1,050,000**
			Subtotal for Construction	**$ 1,050,000**
			Site/Civil (3%)	**$ 31,500**
			Subtotal	**$ 1,081,500**
			Contingency (25%)	**$ 270,375**
			Subtotal	**$ 1,351,875**
			Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	**$ 270,375**
			Subtotal	**$ 1,622,250**
			Escalation (0%)	**$ 1,622,250**
			Engineer's Design and Construction Admin Fee (15%)	**$ 243,338**
			Phase 3 Estimated Raw Water PS & Intake Improvements Total	**$ 1,865,588**
			Phase 1-3 Total	**$ 8,244,120**
Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 60,000	$ 60,000
Tank Construction	CY	40	$ 550	$ 22,000
Excavation and Backfill	CY	70	$ 35	$ 2,450
Equipment Installation	LS	1	$ 40,000	$ 40,000
42" Influent Line	LF	30	$ 300	$ 9,000
Slide Gates	EA	2	$ 25,000	$ 50,000
Electrical and I&C Improvements	L S	1	$ 36,690	$ 36,690
			Subtotal	***$ 220,140***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
			Subtotal	***$ 1,699,068***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 50	$ -
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	0	$ 35,000	$ -
Sluice Gates	EA	0	$ 25,000	$ -
42" DIP Effluent Line	LF	0	$ 300	$ -
42" DIP Influent Line	LF	0	$ 300	$ -
Electrical and I&C Improvements	LS	1	$ 20,000	$ 20,000
			Subtotal	***$ 620,000***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
			Subtotal	***$ 1,913,700***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
			Subtotal	***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	2	$ 40,000	$ 80,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	0	$ 35,000	$ -
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 36,750	$ 36,750
Equipment Installation	LS	1	*$ 45,000*	*$ 45,000*
			Subtotal	***$ 326,750***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
			Subtotal	***$ 2,681,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
			Subtotal	***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
			Subtotal	***$ 425,000***
Terminal Reservoir	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Topsoil Stripping	CY		$ 7.5	$ -
Clearing and Grubbing	AC		$ 6,125	$ -
Terminal Reservoir Earthwork Cut	CY		$ 6	$ -
Terminal Reservoir Earthwork Fill	CY		$ 3	$ -
Terminal Reservoir Liner	SF		$ 0.5	$ -
			Subtotal	***$ -***
			Subtotal for Construction	$ 7,885,908
			Site/Civil (3%)	$ 236,577
			Subtotal	$ 8,122,485
			Yard Piping (5%)	$ 394,295
			Subtotal	$ 8,516,780
			Contingency (25%)	$ 2,129,195
			Subtotal	$ 10,645,975
			Contractor Overhead, Profit, General Conditions, and Mobilization (20%)	$ 2,129,195
			Subtotal	$ 12,775,170
			Escalation (0%)	$ 12,775,170
			Engineer's Design and Construction Admin Fee (15%)	$ 1,916,276
			Phase 3 Estimated WTP Total	**$ 14,691,446**
			Phase 1-3 Total	**$ 107,259,784**

ALTERNATIVE 4 (Option B): Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

12 MGD Facility, Phase 1

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Cost of Raney Well	EA	1	$ 7,500,000	7,500,000
Permitting Cost	LS	0	$ 50,000	50,000
Intake	LS	0	$ 1,000,000	$ -
Raw Water Pumping Station	SF	0	$ 200	$ -
6 MGD Vertical Turbine Pumps	EA	0	$ 125,000	$ -
12 MGD Vertical Turbine Pumps	EA	2	$ 250,000	$ 500,000
Installation	LS	1	$ 150,000	$ 150,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 150,000	$ 150,000
Electrical and I&C Improvements	LS	1	$ 260,000	$ 260,000
Subtotal				**$ 9,110,000**
Subtotal for Construction				**$ 9,110,000**
Site/Civil (3%)				**$ 273,300**
Subtotal				**$ 9,383,300**
Contingency (25%)				**$ 2,345,825**
Subtotal				**$ 11,729,125**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 2,345,825**
Subtotal				**$ 14,074,950**
Escalation - None				**$ 14,074,950**
Engineer's Design and Construction Admin Fee (15%)				**$ 2,111,243**
Phase 1 Estimated Raw Water PS & Intake Improvements Total				**$ 16,186,193**

Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 60,000	$ 120,000
Tank Construction	CY	80	$ 550	$ 44,000
Excavation and Backfill	CY	140	$ 35	$ 4,900
Equipment Installation	LS	1	$ 110,000	$ 110,000
42" Influent Line	LF	150	$ 300	$ 45,000
Slide Gates	EA	4	$ 25,000	$ 100,000
Electrical and I&C Improvements	L S	1	$ 84,780	$ 84,780
Subtotal				***$ 508,680***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 690,000	$ 1,380,000
Tank Construction	CY	1857	$ 550	$ 1,021,350
Excavation and Backfill	CY	930	$ 35	$ 32,550
Equipment Installation	LS	1	$ 414,000	$ 414,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Electrical and I&C Improvements	LS	1	$ 434,685	$ 434,685
Subtotal				***$ 3,332,585***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 1,000,000	$ 1,000,000
Tank Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	360	$ 50	$ 18,000
Equipment Installation	LS	1	$ 250,000	$ 250,000
Miscellanous Metals	LS	1	$ 65,000	$ 65,000
Sluice Gates	EA	4	$ 25,000	$ 100,000
42" DIP Effluent Line	LF	380	$ 300	$ 114,000
42" DIP Influent Line	LF	60	$ 300	$ 18,000
Electrical and I&C Improvements	LS	1	$ 223,000	$ 223,000
Subtotal				***$ 2,338,000***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	1800	$ 150	$ 270,000
*GAC Filter Media**	LBS	565000	$ 1.5	$ 847,500
Underdrain Equipment, Troughs	EA	4	$ 180,000	$ 720,000
Filter Box Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	1200	$ 35	$ 42,000
Equipment Installation	EA	4	$ 100,000	$ 400,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	4000	$ 40	$ 160,000
Pipe Gallery Piping/Valving	EA	4	$ 125,000	$ 500,000
42" Steel Effluent Line	LF	200	$ 300	$ 60,000
Electrical and I&C Improvements	LS	1	$ 496,400	$ 496,400
Subtotal				***$ 3,825,900***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	6,000	$ 200	$ 1,200,000
Maintenance Shop	SF	1,500	$ 125	$ 187,500
Subtotal				***$ 1,387,500***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	1	$ 300,000	$ 300,000
Concrete Pad	CY	10	$ 600	$ 6,000
Chemical Feed Pumps	EA	2	$ 25,500	$ 51,000
Alum Bulk Tanks - 20,000 gallon	EA	2	$ 40,000	$ 80,000
Chemical Feed Pumps	EA	2	$ 25,000	$ 50,000
Polymer Feed System	EA	2	$ 100,000	$ 200,000
Polymer Feed Pumps	EA	4	$ 25,000	$ 100,000
Caustic Bulk Tanks - 10,000 gallon	EA	2	$ 25,000	$ 50,000
Caustic Feed Pumps	EA	2	$ 25,000	$ 50,000
Hypo Bulk Storage Tank (20,000 gallons)	EA	3	$ 40,000	$ 120,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	2	$ 30,000	$ 60,000
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Corrosion Inhibitor Feed Pump	EA	2	$ 15,000	$ 30,000
Fluoride Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Fluoride Feed Pumps	EA	2	$ 15,000	$ 30,000
Chemical Building	SF	15000	$ 150	$ 2,250,000
Electrical and I&C Improvements	LS	1	$ 531,300	$ 531,300
Equipment Installation	LS	1	*$ 101,250*	*$ 101,250*
Subtotal				***$ 4,174,550***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	2	$ 350,000	$ 700,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	2	$ 500,000	$ 1,000,000
Dewatering Building	SF	2,000	$ 150	$ 300,000
Thickening Polymer System	LS	1	$ 65,000	$ 65,000
Centrifuge Pumps	EA	2	$ 40,000	$ 80,000
Thickened Sludge Storage	CY	250	$ 550	$ 137,500
Thickened Sludge Storage Mixer	EA	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 814,000	$ 814,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 407,000	$ 407,000
Subtotal				***$ 5,291,000***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	4,000,000	$ 0.60	$ 2,400,000
Electrical and I&C Improvements	LS	1	$ 240,000	$ 240,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 240,000	$ 240,000
Subtotal				***$ 2,880,000***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	3	$ 125,000	$ 375,000
Pumping Station Building	SF	3,500	$ 150	$ 525,000
Electrical and I&C Improvements	LS	1	$ 180,000	$ 180,000
Miscellanous (Piping, etc.)	LS	1	$ 450,000	$ 450,000
Subtotal				***$ 1,530,000***
Subtotal for Construction				$ 25,268,215
Site/Civil (3%)				$ 758,046
Subtotal				$ 26,026,261
Yard Piping (5%)				$ 1,263,411
Subtotal				$ 27,289,672
Contingency (25%)				$ 6,822,418
Subtotal				$ 34,112,090
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 6,822,418
Subtotal				$ 40,934,508
Escalation - None				$ 40,934,508
Engineer's Design and Construction Admin Fee (15%)				$ 6,140,176
Phase 1 Estimated WTP Total				**$ 47,074,685**

20 MGD Facility, Phase 2

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Cost of Raney Well	EA	1	$ 7,500,000	7,500,000
Permitting Cost	LS	0	$ 50,000	0
Intake	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 150	$ -
8 MGD Vertical Turbine Pumps	EA	2	$ 170,000	$ 340,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	0	$ 500,000	$ -
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 93,000	$ 93,000
Subtotal				**$ 8,058,000**
Subtotal for Construction				**$ 8,058,000**
Site/Civil (3%)				**$ 241,740**
Subtotal				**$ 8,299,740**
Contingency (25%)				**$ 2,074,935**
Subtotal				**$ 10,374,675**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 2,074,935**
Subtotal				**$ 12,449,610**
Escalation (0%)				**$ 12,449,610**
Engineer's Design and Construction Admin Fee (15%)				**$ 1,867,442**
Phase 2 Estimated Raw Water PS & Intake Improvements Total				**$ 14,317,052**

Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	0	$ 60,000	$ -
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 35	$ -
Equipment Installation	LS	0	$ -	$ -
42" Influent Line	LF	0	$ 300	$ -
Slide Gates	EA	0	$ 25,000	$ -
Electrical and I&C Improvements	L S	0	$ -	$ -
Subtotal				***$ -***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
Subtotal				***$ 1,699,068***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	180	$ 50	$ 9,000
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	1	$ 35,000	$ 35,000
Sluice Gates	EA	2	$ 25,000	$ 50,000
42" DIP Effluent Line	LF	50	$ 300	$ 15,000
42" DIP Influent Line	LF	25	$ 300	$ 7,500
Electrical and I&C Improvements	LS	1	$ 98,300	$ 98,300
Subtotal				***$ 1,089,800***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
Subtotal				***$ 1,913,700***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
Subtotal				***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	1	$ 40,000	$ 40,000
Hypo Feed Pumps	EA	0	$ 25,000	$ -
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 21,000	$ 21,000
Equipment Installation	LS	1	*$ 18,750*	*$ 18,750*
Subtotal				***$ 179,750***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
Subtotal				***$ 2,681,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
Subtotal				***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
Subtotal				***$ 425,000***
Subtotal for Construction				$ 7,988,568
Site/Civil (3%)				$ 239,657
Subtotal				$ 8,228,225
Yard Piping (5%)				$ 399,428
Subtotal				$ 8,627,653
Contingency (25%)				$ 2,156,913
Subtotal				$ 10,784,566
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 2,156,913
Subtotal				$ 12,941,479
Escalation (0%)				$ 12,941,479
Engineer's Design and Construction Admin Fee (15%)				$ 1,941,222
Phase 2 Estimated WTP Total				**$ 14,882,701**

(*CONTINUED*) ALTERNATIVE 4 (Option B): Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

28 MGD Facility, Phase 3

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Cost of Raney Well	EA	1	$ 7,500,000	7,500,000
Permitting Cost	LS	0	$ 50,000	0
Intake	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 150	$ -
8 MGD Vertical Turbine Pumps	EA	2	$ 170,000	$ 340,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 193,000	$ 193,000
			Subtotal	**$ 8,658,000**
			Subtotal for Construction	**$ 8,658,000**
			Site/Civil (3%)	**$ 259,740**
			Subtotal	**$ 8,917,740**
			Contingency (25%)	**$ 2,229,435**
			Subtotal	**$ 11,147,175**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 2,229,435**
			Subtotal	**$ 13,376,610**
			Escalation (0%)	**$ 13,376,610**
Engineer's Design and Construction Admin Fee (15%)				**$ 2,006,492**
Phase 3 Estimated Raw Water PS & Intake Improvements Total				**$ 15,383,102**
			Phase 1-3 Total	**$ 45,886,346**
Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 60,000	$ 60,000
Tank Construction	CY	40	$ 550	$ 22,000
Excavation and Backfill	CY	70	$ 35	$ 2,450
Equipment Installation	LS	1	$ 40,000	$ 40,000
42" Influent Line	LF	30	$ 300	$ 9,000
Slide Gates	EA	2	$ 25,000	$ 50,000
Electrical and I&C Improvements	L S	1	$ 36,690	$ 36,690
			Subtotal	***$ 220,140***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
			Subtotal	***$ 1,699,068***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 50	$ -
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	0	$ 35,000	$ -
Sluice Gates	EA	0	$ 25,000	$ -
42" DIP Effluent Line	LF	0	$ 300	$ -
42" DIP Influent Line	LF	0	$ 300	$ -
Electrical and I&C Improvements	LS	1	$ 20,000	$ 20,000
			Subtotal	***$ 620,000***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
			Subtotal	***$ 1,913,700***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
			Subtotal	***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	2	$ 40,000	$ 80,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	0	$ 35,000	$ -
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 36,750	$ 36,750
Equipment Installation	LS	1	*$ 45,000*	*$ 45,000*
			Subtotal	***$ 326,750***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
			Subtotal	***$ 2,681,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
			Subtotal	***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
			Subtotal	***$ 425,000***
			Subtotal for Construction	$ 7,885,908
			Site/Civil (3%)	$ 236,577
			Subtotal	$ 8,122,485
			Yard Piping (5%)	$ 394,295
			Subtotal	$ 8,516,780
			Contingency (25%)	$ 2,129,195
			Subtotal	$ 10,645,975
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 2,129,195
			Subtotal	$ 12,775,170
			Escalation (0%)	$ 12,775,170
Engineer's Design and Construction Admin Fee (15%)				$ 1,916,276
			Phase 3 Estimated WTP Total	**$ 14,691,446**
			Phase 1-3 Total	**$ 76,648,831**

ALTERNATIVE 5 (Option A): Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

12 MGD Facility, Phase 1

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Cost of Dam 3'x3'x200' + 2860 CF Intake Structure	LS	1	$ 7,500,000	7,500,000
cost of permitting	LS	0	$ 50,000	50,000
Flat Screen Intake	LS	1	$ 100,000	$ 100,000
Raw Water Pumping Station	SF	2000	$ 200	$ 400,000
6 MGD Vertical Turbine Pumps	EA	2	$ 125,000	$ 250,000
12 MGD Vertical Turbine Pumps	EA	1	$ 250,000	$ 250,000
Installation	LS	1	$ 150,000	$ 150,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 150,000	$ 150,000
Electrical and I&C Improvements	LS	1	$ 340,000	$ 340,000
Subtotal				$ 9,690,000
Subtotal for Construction				$ 9,690,000
Site/Civil (3%)				$ 290,700
Subtotal				$ 9,980,700
Contingency (25%)				$ 2,495,175
Subtotal				$ 12,475,875
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 2,495,175
Subtotal				$ 14,971,050
Escalation - None				$ 14,971,050
Engineer's Design and Construction Admin Fee (15%)				$ 2,245,658
Phase 1 Estimated Raw Water PS & Intake Improvements Total				**$ 17,216,708**

Treatment Plant Processes	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 60,000	$ 120,000
Tank Construction	CY	80	$ 550	$ 44,000
Excavation and Backfill	CY	140	$ 35	$ 4,900
Equipment Installation	LS	1	$ 110,000	$ 110,000
42" Influent Line	LF	150	$ 300	$ 45,000
Slide Gates	EA	4	$ 25,000	$ 100,000
Electrical and I&C Improvements	L S	1	$ 84,780	$ 84,780
Subtotal				*$ 508,680*
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 690,000	$ 1,380,000
Tank Construction	CY	1857	$ 550	$ 1,021,350
Excavation and Backfill	CY	930	$ 35	$ 32,550
Equipment Installation	LS	1	$ 414,000	$ 414,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Electrical and I&C Improvements	LS	1	$ 434,685	$ 434,685
Subtotal				*$ 3,332,585*
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 1,000,000	$ 1,000,000
Tank Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	360	$ 50	$ 18,000
Equipment Installation	LS	1	$ 250,000	$ 250,000
Miscellanous Metals	LS	1	$ 65,000	$ 65,000
Sluice Gates	EA	4	$ 25,000	$ 100,000
42" DIP Effluent Line	LF	380	$ 300	$ 114,000
42" DIP Influent Line	LF	60	$ 300	$ 18,000
Electrical and I&C Improvements	LS	1	$ 223,000	$ 223,000
Subtotal				*$ 2,338,000*
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	1800	$ 150	$ 270,000
GAC Filter Media*	LBS	565000	$ 1.5	$ 847,500
Underdrain Equipment, Troughs	EA	4	$ 180,000	$ 720,000
Filter Box Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	1200	$ 35	$ 42,000
Equipment Installation	EA	4	$ 100,000	$ 400,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	4000	$ 40	$ 160,000
Pipe Gallery Piping/Valving	EA	4	$ 125,000	$ 500,000
42" Steel Effluent Line	LF	200	$ 300	$ 60,000
Electrical and I&C Improvements	LS	1	$ 496,400	$ 496,400
Subtotal				*$ 3,825,900*
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	6,000	$ 200	$ 1,200,000
Maintenance Shop	SF	1,500	$ 125	$ 187,500
Subtotal				*$ 1,387,500*
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	1	$ 300,000	$ 300,000
Concrete Pad	CY	10	$ 600	$ 6,000
Chemical Feed Pumps	EA	2	$ 25,500	$ 51,000
Alum Bulk Tanks - 20,000 gallon	EA	2	$ 40,000	$ 80,000
Chemical Feed Pumps	EA	2	$ 25,000	$ 50,000
Polymer Feed System	EA	2	$ 100,000	$ 200,000
Polymer Feed Pumps	EA	4	$ 25,000	$ 100,000
Caustic Bulk Tanks - 10,000 gallon	EA	2	$ 25,000	$ 50,000
Caustic Feed Pumps	EA	2	$ 25,000	$ 50,000
Hypo Bulk Storage Tank (20,000 gallons)	EA	3	$ 40,000	$ 120,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	2	$ 30,000	$ 60,000
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Corrosion Inhibitor Feed Pump	EA	2	$ 15,000	$ 30,000
Fluoride Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Fluoride Feed Pumps	EA	2	$ 15,000	$ 30,000
Chemical Building	SF	15000	$ 150	$ 2,250,000
Electrical and I&C Improvements	LS	1	$ 531,300	$ 531,300
Equipment Installation	LS	1	$ 101,250	$ 101,250
Subtotal				*$ 4,174,550*
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	2	$ 350,000	$ 700,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	2	$ 500,000	$ 1,000,000
Dewatering Building	SF	2,000	$ 150	$ 300,000
Thickening Polymer System	LS	1	$ 65,000	$ 65,000
Centrifuge Pumps	EA	2	$ 40,000	$ 80,000
Thickened Sludge Storage	CY	250	$ 550	$ 137,500
Thickened Sludge Storage Mixer	EA	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 814,000	$ 814,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 407,000	$ 407,000
Subtotal				*$ 5,291,000*
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	4,000,000	$ 0.60	$ 2,400,000
Electrical and I&C Improvements	LS	1	$ 240,000	$ 240,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 240,000	$ 240,000
Subtotal				*$ 2,880,000*
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	3	$ 125,000	$ 375,000
Pumping Station Building	SF	3,500	$ 150	$ 525,000
Electrical and I&C Improvements	LS	1	$ 180,000	$ 180,000
Miscellanous (Piping, etc.)	LS	1	$ 450,000	$ 450,000
Subtotal				*$ 1,530,000*
Terminal Reservoir	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Topsoil Stripping	CY	99000	$ 7.5	$ 742,500
Clearing and Grubbing	AC	90	$ 6,125	$ 551,250
Terminal Reservoir Earthwork Cut	CY	2204500	$ 6	$ 13,227,000
Terminal Reservoir Earthwork Fill	CY	2204500	$ 3	$ 6,613,500
Terminal Reservoir Liner	SF	2071371	$ 0.8	$ 1,553,528
Subtotal				*$ 22,687,778*
Subtotal for Construction				$ 47,955,993
Site/Civil (3%)				$ 1,438,680
Subtotal				$ 49,394,673
Yard Piping (5%)				$ 2,397,800
Subtotal				$ 51,792,473
Contingency (25%)				$ 12,948,118
Subtotal				$ 64,740,591
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 12,948,118
Subtotal				$ 77,688,709
Escalation - None				$ 77,688,709
Engineer's Design and Construction Admin Fee (15%)				$ 11,653,306
Phase 1 Estimated WTP Total				**$ 89,342,015**

20 MGD Facility, Phase 2

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 150	$ -
12 MGD Vertical Turbine Pumps	EA	1	$ 250,000	$ 250,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	0	$ 500,000	$ -
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 75,000	$ 75,000
Subtotal				$ 450,000
Subtotal for Construction				$ 450,000
Site/Civil (3%)				$ 13,500
Subtotal				$ 463,500
Contingency (25%)				$ 115,875
Subtotal				$ 579,375
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 115,875
Subtotal				$ 695,250
Escalation (0%)				$ 695,250
Engineer's Design and Construction Admin Fee (15%)				$ 104,288
Phase 2 Estimated Raw Water PS & Intake Improvements Total				**$ 799,538**

Treatment Plant Processes	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	0	$ 60,000	$ -
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 35	$ -
Equipment Installation	LS	0	$ -	$ -
42" Influent Line	LF	0	$ 300	$ -
Slide Gates	EA	0	$ 25,000	$ -
Electrical and I&C Improvements	L S	0	$ -	$ -
Subtotal				*$ -*
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
Subtotal				*$ 1,699,068*
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	180	$ 50	$ 9,000
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	1	$ 35,000	$ 35,000
Sluice Gates	EA	2	$ 25,000	$ 50,000
42" DIP Effluent Line	LF	50	$ 300	$ 15,000
42" DIP Influent Line	LF	25	$ 300	$ 7,500
Electrical and I&C Improvements	LS	1	$ 98,300	$ 98,300
Subtotal				*$ 1,089,800*
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
GAC Filter Media*	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
Subtotal				*$ 1,913,700*
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
Subtotal				*$ -*
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	1	$ 40,000	$ 40,000
Hypo Feed Pumps	EA	0	$ 25,000	$ -
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 21,000	$ 21,000
Equipment Installation	LS	1	$ 18,750	$ 18,750
Subtotal				*$ 179,750*
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
Subtotal				*$ 2,681,250*
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
Subtotal				*$ -*
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
Subtotal				*$ 425,000*
Terminal Reservoir	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Topsoil Stripping	CY		$ 7.5	$ -
Clearing and Grubbing	AC		$ 6,125	$ -
Terminal Reservoir Earthwork Cut	CY		$ 6	$ -
Terminal Reservoir Earthwork Fill	CY		$ 3	$ -
Terminal Reservoir Liner	SF		$ 0.5	$ -
Subtotal				*$ -*
Subtotal for Construction				$ 7,988,568
Site/Civil (3%)				$ 239,657
Subtotal				$ 8,228,225
Yard Piping (5%)				$ 399,428
Subtotal				$ 8,627,653
Contingency (25%)				$ 2,156,913
Subtotal				$ 10,784,566
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 2,156,913
Subtotal				$ 12,941,479
Escalation (0%)				$ 12,941,479
Engineer's Design and Construction Admin Fee (15%)				$ 1,941,222
Phase 2 Estimated WTP Total				**$ 14,882,701**

(*CONTINUED*) ALTERNATIVE 5 (Option A): Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

28 MGD Facility, Phase 3

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 150	$ -
12 MGD Vertical Turbine Pumps	EA	1	$ 250,000	$ 250,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 175,000	$ 175,000
			Subtotal	**$ 1,050,000**
			Subtotal for Construction	**$ 1,050,000**
			Site/Civil (3%)	**$ 31,500**
			Subtotal	**$ 1,081,500**
			Contingency (25%)	**$ 270,375**
			Subtotal	**$ 1,351,875**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 270,375**
			Subtotal	**$ 1,622,250**
			Escalation (0%)	**$ 1,622,250**
Engineer's Design and Construction Admin Fee (15%)				**$ 243,338**
Phase 3 Estimated Raw Water PS & Intake Improvements Total				**$ 1,865,588**
			Phase 1-3 Total	**$ 19,881,833**

Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 60,000	$ 60,000
Tank Construction	CY	40	$ 550	$ 22,000
Excavation and Backfill	CY	70	$ 35	$ 2,450
Equipment Installation	LS	1	$ 40,000	$ 40,000
42" Influent Line	LF	30	$ 300	$ 9,000
Slide Gates	EA	2	$ 25,000	$ 50,000
Electrical and I&C Improvements	L S	1	$ 36,690	$ 36,690
			Subtotal	***$ 220,140***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
			Subtotal	***$ 1,699,068***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 50	$ -
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	0	$ 35,000	$ -
Sluice Gates	EA	0	$ 25,000	$ -
42" DIP Effluent Line	LF	0	$ 300	$ -
42" DIP Influent Line	LF	0	$ 300	$ -
Electrical and I&C Improvements	LS	1	$ 20,000	$ 20,000
			Subtotal	***$ 620,000***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
			Subtotal	***$ 1,913,700***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
			Subtotal	***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	2	$ 40,000	$ 80,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	0	$ 35,000	$ -
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 36,750	$ 36,750
Equipment Installation	LS	1	*$ 45,000*	*$ 45,000*
			Subtotal	***$ 326,750***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
			Subtotal	***$ 2,681,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
			Subtotal	***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
			Subtotal	***$ 425,000***
Terminal Reservoir	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Topsoil Stripping	CY		$ 7.5	$ -
Clearing and Grubbing	AC		$ 6,125	$ -
Terminal Reservoir Earthwork Cut	CY		$ 6	$ -
Terminal Reservoir Earthwork Fill	CY		$ 3	$ -
Terminal Reservoir Liner	SF		$ 0.5	$ -
			Subtotal	***$ -***
			Subtotal for Construction	$ 7,885,908
			Site/Civil (3%)	$ 236,577
			Subtotal	$ 8,122,485
			Yard Piping (5%)	$ 394,295
			Subtotal	$ 8,516,780
			Contingency (25%)	$ 2,129,195
			Subtotal	$ 10,645,975
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 2,129,195
			Subtotal	$ 12,775,170
			Escalation (0%)	$ 12,775,170
Engineer's Design and Construction Admin Fee (15%)				$ 1,916,276
			Phase 3 Estimated WTP Total	**$ 14,691,446**
			Phase 1-3 Total	**$ 118,916,162**

ALTERNATIVE 5 (Option B): Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

12 MGD Facility, Phase 1

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Cost of Raney Well	EA	1	$ 7,500,000	7,500,000
Permitting Cost	LS	0	$ 50,000	50,000
Intake	LS	0	$ 1,000,000	$ -
Raw Water Pumping Station	SF	0	$ 200	$ -
6 MGD Vertical Turbine Pumps	EA	0	$ 125,000	$ -
12 MGD Vertical Turbine Pumps	EA	2	$ 250,000	$ 500,000
Installation	LS	1	$ 150,000	$ 150,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 150,000	$ 150,000
Electrical and I&C Improvements	LS	1	$ 260,000	$ 260,000
Subtotal				**$ 9,110,000**
Subtotal for Construction				**$ 9,110,000**
Site/Civil (3%)				**$ 273,300**
Subtotal				**$ 9,383,300**
Contingency (25%)				**$ 2,345,825**
Subtotal				**$ 11,729,125**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 2,345,825**
Subtotal				**$ 14,074,950**
Escalation - None				**$ 14,074,950**
Engineer's Design and Construction Admin Fee (15%)				**$ 2,111,243**
Phase 1 Estimated Raw Water PS & Intake Improvements Total				**$ 16,186,193**
Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 60,000	$ 120,000
Tank Construction	CY	80	$ 550	$ 44,000
Excavation and Backfill	CY	140	$ 35	$ 4,900
Equipment Installation	LS	1	$ 110,000	$ 110,000
42" Influent Line	LF	150	$ 300	$ 45,000
Slide Gates	EA	4	$ 25,000	$ 100,000
Electrical and I&C Improvements	LS	1	$ 84,780	$ 84,780
Subtotal				***$ 508,680***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 690,000	$ 1,380,000
Tank Construction	CY	1857	$ 550	$ 1,021,350
Excavation and Backfill	CY	930	$ 35	$ 32,550
Equipment Installation	LS	1	$ 414,000	$ 414,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Electrical and I&C Improvements	LS	1	$ 434,685	$ 434,685
Subtotal				***$ 3,332,585***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 1,000,000	$ 1,000,000
Tank Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	360	$ 50	$ 18,000
Equipment Installation	LS	1	$ 250,000	$ 250,000
Miscellanous Metals	LS	1	$ 65,000	$ 65,000
Sluice Gates	EA	4	$ 25,000	$ 100,000
42" DIP Effluent Line	LF	380	$ 300	$ 114,000
42" DIP Influent Line	LF	60	$ 300	$ 18,000
Electrical and I&C Improvements	LS	1	$ 223,000	$ 223,000
Subtotal				***$ 2,338,000***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	1800	$ 150	$ 270,000
*GAC Filter Media**	LBS	565000	$ 1.5	$ 847,500
Underdrain Equipment, Troughs	EA	4	$ 180,000	$ 720,000
Filter Box Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	1200	$ 35	$ 42,000
Equipment Installation	EA	4	$ 100,000	$ 400,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	4000	$ 40	$ 160,000
Pipe Gallery Piping/Valving	EA	4	$ 125,000	$ 500,000
42" Steel Effluent Line	LF	200	$ 300	$ 60,000
Electrical and I&C Improvements	LS	1	$ 496,400	$ 496,400
Subtotal				***$ 3,825,900***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	6,000	$ 200	$ 1,200,000
Maintenance Shop	SF	1,500	$ 125	$ 187,500
Subtotal				***$ 1,387,500***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	1	$ 300,000	$ 300,000
Concrete Pad	CY	10	$ 600	$ 6,000
Chemical Feed Pumps	EA	2	$ 25,500	$ 51,000
Alum Bulk Tanks - 20,000 gallon	EA	2	$ 40,000	$ 80,000
Chemical Feed Pumps	EA	2	$ 25,000	$ 50,000
Polymer Feed System	EA	2	$ 100,000	$ 200,000
Polymer Feed Pumps	EA	4	$ 25,000	$ 100,000
Caustic Bulk Tanks - 10,000 gallon	EA	2	$ 25,000	$ 50,000
Caustic Feed Pumps	EA	2	$ 25,000	$ 50,000
Hypo Bulk Storage Tank (20,000 gallons)	EA	3	$ 40,000	$ 120,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	2	$ 30,000	$ 60,000
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Corrosion Inhibitor Feed Pump	EA	2	$ 15,000	$ 30,000
Fluoride Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Fluoride Feed Pumps	EA	2	$ 15,000	$ 30,000
Chemical Building	SF	15000	$ 150	$ 2,250,000
Electrical and I&C Improvements	LS	1	$ 531,300	$ 531,300
Equipment Installation	LS	1	*$ 101,250*	*$ 101,250*
Subtotal				***$ 4,174,550***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	2	$ 350,000	$ 700,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	2	$ 500,000	$ 1,000,000
Dewatering Building	SF	2,000	$ 150	$ 300,000
Thickening Polymer System	LS	1	$ 65,000	$ 65,000
Centrifuge Pumps	EA	2	$ 40,000	$ 80,000
Thickened Sludge Storage	CY	250	$ 550	$ 137,500
Thickened Sludge Storage Mixer	EA	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 814,000	$ 814,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 407,000	$ 407,000
Subtotal				***$ 5,291,000***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	4,000,000	$ 0.60	$ 2,400,000
Electrical and I&C Improvements	LS	1	$ 240,000	$ 240,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 240,000	$ 240,000
Subtotal				***$ 2,880,000***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	3	$ 125,000	$ 375,000
Pumping Station Building	SF	3,500	$ 150	$ 525,000
Electrical and I&C Improvements	LS	1	$ 180,000	$ 180,000
Miscellanous (Piping, etc.)	LS	1	$ 450,000	$ 450,000
Subtotal				***$ 1,530,000***
Subtotal for Construction				$ 25,268,215
Site/Civil (3%)				$ 758,046
Subtotal				$ 26,026,261
Yard Piping (5%)				$ 1,263,411
Subtotal				$ 27,289,672
Contingency (25%)				$ 6,822,418
Subtotal				$ 34,112,090
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 6,822,418
Subtotal				$ 40,934,508
Escalation - None				$ 40,934,508
Engineer's Design and Construction Admin Fee (15%)				$ 6,140,176
Phase 1 Estimated WTP Total				**$ 47,074,685**

20 MGD Facility, Phase 2

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Cost of Raney Well	EA	1	$ 7,500,000	7,500,000
Permitting Cost	LS	0	$ 50,000	0
Intake	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 150	$ -
8 MGD Vertical Turbine Pumps	EA	2	$ 170,000	$ 340,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	0	$ 500,000	$ -
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 93,000	$ 93,000
Subtotal				**$ 8,058,000**
Subtotal for Construction				**$ 8,058,000**
Site/Civil (3%)				**$ 241,740**
Subtotal				**$ 8,299,740**
Contingency (25%)				**$ 2,074,935**
Subtotal				**$ 10,374,675**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 2,074,935**
Subtotal				**$ 12,449,610**
Escalation (0%)				**$ 12,449,610**
Engineer's Design and Construction Admin Fee (15%)				**$ 1,867,442**
Phase 2 Estimated Raw Water PS & Intake Improvements Total				**$ 14,317,052**
Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	0	$ 60,000	$ -
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 35	$ -
Equipment Installation	LS	0	$ -	$ -
42" Influent Line	LF	0	$ 300	$ -
Slide Gates	EA	0	$ 25,000	$ -
Electrical and I&C Improvements	L S	0	$ -	$ -
Subtotal				***$ -***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
Subtotal				***$ 1,699,068***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	180	$ 50	$ 9,000
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	1	$ 35,000	$ 35,000
Sluice Gates	EA	2	$ 25,000	$ 50,000
42" DIP Effluent Line	LF	50	$ 300	$ 15,000
42" DIP Influent Line	LF	25	$ 300	$ 7,500
Electrical and I&C Improvements	LS	1	$ 98,300	$ 98,300
Subtotal				***$ 1,089,800***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
Subtotal				***$ 1,913,700***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
Subtotal				***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	1	$ 40,000	$ 40,000
Hypo Feed Pumps	EA	0	$ 25,000	$ -
Ammonia Bulk Storage Tank (1000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 21,000	$ 21,000
Equipment Installation	LS	*1*	*$ 18,750*	*$ 18,750*
Subtotal				***$ 179,750***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
Subtotal				***$ 2,681,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
Subtotal				***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
Subtotal				***$ 425,000***
Subtotal for Construction				$ 7,988,568
Site/Civil (3%)				$ 239,657
Subtotal				$ 8,228,225
Yard Piping (5%)				$ 399,428
Subtotal				$ 8,627,653
Contingency (25%)				$ 2,156,913
Subtotal				$ 10,784,566
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 2,156,913
Subtotal				$ 12,941,479
Escalation (0%)				$ 12,941,479
Engineer's Design and Construction Admin Fee (15%)				$ 1,941,222
Phase 2 Estimated WTP Total				**$ 14,882,701**

(*CONTINUED*) ALTERNATIVE 5 (Option B): Raw Water Intake, Pump Station and Water Treatment Plant Conceptual Cost Opinion, by Alternative (not including land easement acquisition and raw water transmission costs)

28 MGD Facility, Phase 3

Raw Water Pump Station & Intake Improvements				
	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Cost of Raney Well	EA	1	$ 7,500,000	7,500,000
Permitting Cost	LS	0	$ 50,000	0
Intake	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 150	$ -
8 MGD Vertical Turbine Pumps	EA	2	$ 170,000	$ 340,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	1	$ 500,000	$ 500,000
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 193,000	$ 193,000
Subtotal				**$ 8,658,000**
Subtotal for Construction				**$ 8,658,000**
Site/Civil (3%)				**$ 259,740**
Subtotal				**$ 8,917,740**
Contingency (25%)				**$ 2,229,435**
Subtotal				**$ 11,147,175**
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				**$ 2,229,435**
Subtotal				**$ 13,376,610**
Escalation (0%)				**$ 13,376,610**
Engineer's Design and Construction Admin Fee (15%)				**$ 2,006,492**
Phase 3 Estimated Raw Water PS & Intake Improvements Total				**$ 15,383,102**
			Phase 1-3 Total	**$ 45,886,346**

Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 60,000	$ 60,000
Tank Construction	CY	40	$ 550	$ 22,000
Excavation and Backfill	CY	70	$ 35	$ 2,450
Equipment Installation	LS	1	$ 40,000	$ 40,000
42" Influent Line	LF	30	$ 300	$ 9,000
Slide Gates	EA	2	$ 25,000	$ 50,000
Electrical and I&C Improvements	L S	1	$ 36,690	$ 36,690
			Subtotal	***$ 220,140***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 690,000	$ 690,000
Tank Construction	CY	980	$ 550	$ 539,000
Excavation and Backfill	CY	470	$ 35	$ 16,450
Equipment Installation	LS	1	$ 207,000	$ 207,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 221,618	$ 221,618
			Subtotal	***$ 1,699,068***
Ozone Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment (pumps, generators, etc.)	EA	1	$ 500,000	$ 500,000
Tank Construction	CY	0	$ 550	$ -
Excavation and Backfill	CY	0	$ 50	$ -
Equipment Installation	LS	1	$ 100,000	$ 100,000
Miscellanous Metals	LS	0	$ 35,000	$ -
Sluice Gates	EA	0	$ 25,000	$ -
42" DIP Effluent Line	LF	0	$ 300	$ -
42" DIP Influent Line	LF	0	$ 300	$ -
Electrical and I&C Improvements	LS	1	$ 20,000	$ 20,000
			Subtotal	***$ 620,000***
BioFilters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	283000	$ 1.5	$ 424,500
Underdrain Equipment, Troughs	EA	2	$ 180,000	$ 360,000
Filter Box Construction	CY	500	$ 550	$ 275,000
Excavation and Backfill	CY	600	$ 35	$ 21,000
Equipment Installation	EA	2	$ 100,000	$ 200,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Canopy	SF	2000	$ 40	$ 80,000
Pipe Gallery Piping/Valving	EA	2	$ 125,000	$ 250,000
42" Steel Effluent Line	LF	100	$ 300	$ 30,000
Electrical and I&C Improvements	LS	1	$ 248,200	$ 248,200
			Subtotal	***$ 1,913,700***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
			Subtotal	***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	0	$ 300,000	$ -
Concrete Pad	CY	0	$ 600	$ -
Chemical Feed Pumps	EA	0	$ 25,500	$ -
Alum Bulk Tanks - 20,000 gallon	EA	1	$ 40,000	$ 40,000
Chemical Feed Pumps	EA	0	$ 25,000	$ -
Polymer Feed System	EA	0	$ 100,000	$ -
Polymer Feed Pumps	EA	0	$ 25,000	$ -
Caustic Bulk Tanks - 10,000 gallon	EA	1	$ 25,000	$ 25,000
Caustic Feed Pumps	EA	0	$ 25,000	$ -
Hypo Bulk Storage Tank (20,000 gallons)	EA	2	$ 40,000	$ 80,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (1000 gallons)	EA	0	$ 35,000	$ -
Ammonia Feed System	EA	0	$ 30,000	$ -
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Fluoride Feed Pumps	EA	0	$ 15,000	$ -
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 36,750	$ 36,750
Equipment Installation	LS	*1*	*$ 45,000*	*$ 45,000*
			Subtotal	***$ 326,750***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	1,000	$ 550	$ 550,000
Backwash Settling Units	EA	1	$ 350,000	$ 350,000
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	0	$ 500,000	$ -
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	0	$ 40,000	$ -
Thickened Sludge Storage	CY	0	$ 550	$ -
Thickened Sludge Storage Mixer	EA	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	1	$ 412,500	$ 412,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 206,250	$ 206,250
			Subtotal	***$ 2,681,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
			Subtotal	***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	1	$ 250,000	$ 250,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 50,000	$ 50,000
Miscellanous (Piping, etc.)	LS	1	$ 125,000	$ 125,000
			Subtotal	***$ 425,000***
Subtotal for Construction				$ 7,885,908
Site/Civil (3%)				$ 236,577
Subtotal				$ 8,122,485
Yard Piping (5%)				$ 394,295
Subtotal				$ 8,516,780
Contingency (25%)				$ 2,129,195
Subtotal				$ 10,645,975
Contractor Overhead, Profit, General Conditions, and Mobilization (20%)				$ 2,129,195
Subtotal				$ 12,775,170
Escalation (0%)				$ 12,775,170
Engineer's Design and Construction Admin Fee (15%)				$ 1,916,276
Phase 3 Estimated WTP Total				**$ 14,691,446**
			Phase 1-3 Total	**$ 76,648,831**

ALTERNATIVE 6: CRWSP Expansion (Catawba) Raw Water Intake, Pump Station and Water Treatment Plant Expansion Conceptual Cost Opinion

18 MGD Facility, Phase 1

	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Raw Water Pump Station & Intake Improvements				
	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake, Screens and Appurtenances	LS	1	$ 1,400,000	$ 1,400,000
Raw Water Pumping Station	SF	2000	$ 200	$ 400,000
23 MGD Vertical Turbine Pumps	EA	2	$ 200,000	$ 400,000
Installation	LS	1	$ 150,000	$ 150,000
Emergency Generator	LS	1	$ 750,000	$ 750,000
Piping and Valving	LS	1	$ 300,000	$ 300,000
Electrical and I&C Improvements	LS	1	$ 400,000	$ 400,000
48-Inch Raw Water Transmission Main	LF	2000	$ 400	$ 800,000
			Subtotal	**$ 4,600,000**
Reservoir Pump Station & Transmission Improvements				
33 MGDTurbine Pumps	EA	1	$ 300,000	$ 300,000
Piping and Valving	LS	1	$ 150,000	$ 150,000
Installation	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 105,000	$ 105,000
48-Inch Raw Water Transmission Main	LF	200	$ 400	$ 80,000
			Subtotal	***$ 710,000***
Subtotal for Construction				**$ 5,310,000**
Site/Civil (3%)				**$ 159,300**
Subtotal				**$ 5,469,300**
Contingency (15%)				**$ 820,395**
Subtotal				**$ 6,289,695**
Contractor Overhead, Profit and Mobilization (20%)				**$ 1,257,939**
Subtotal				**$ 7,547,634**
Escalation (none)				**$ -**
Engineer's Design and Construction Admin Fee (15%)				**$ 1,132,145**
Phase 1 Estimated Raw Water PS & Intake Improvements Total				**$ 8,679,779**
Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 60,000	$ 120,000
Tank Construction	CY	120	$ 550	$ 66,000
Excavation and Backfill	CY	210	$ 35	$ 7,350
Equipment Installation	LS	1	$ 110,000	$ 110,000
48" Influent Line	LF	150	$ 400	$ 60,000
Slide Gates	EA	4	$ 25,000	$ 100,000
Electrical and I&C Improvements	L S	1	$ 92,670	$ 92,670
			Subtotal	***$ 556,020***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 690,000	$ 1,380,000
Tank Construction	CY	1960	$ 550	$ 1,078,000
Excavation and Backfill	CY	940	$ 35	$ 32,900
Equipment Installation	LS	1	$ 414,000	$ 414,000
Piping	EA	2	$ 250,000	$ 500,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 514,485	$ 514,485
			Subtotal	***$ 3,944,385***
GAC Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	10000	$ 150	$ 1,500,000
GAC Filter Media $1.55 per pound	LBS	312500	$ 1.6	$ 484,375
Underdrain Equipment, Troughs	EA	4	$ 180,000	$ 720,000
Filter Box Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	1200	$ 35	$ 42,000
Equipment Installation	EA	4	$ 100,000	$ 400,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	0	$ 40	$ -
Pipe Gallery Piping/Valving	EA	4	$ 125,000	$ 500,000
48" Steel Effluent Line	LF	200	$ 400	$ 80,000
Electrical and I&C Improvements	LS	1	$ 468,400	$ 468,400
			Subtotal	***$ 4,794,775***
Filters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	10000	$ 150	$ 1,500,000
*Filter Media**	LBS	320000	$ 0.5	$ 160,000
Underdrain Equipment, Troughs	EA	6	$ 180,000	$ 1,080,000
Filter Box Construction	CY	1500	$ 550	$ 825,000
Excavation and Backfill	CY	1800	$ 35	$ 63,000
Equipment Installation	EA	6	$ 100,000	$ 600,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	0	$ 40	$ -
Pipe Gallery Piping/Valving	EA	6	$ 125,000	$ 750,000
48" Steel Effluent Line	LF	100	$ 400	$ 40,000
Electrical and I&C Improvements	LS	1	$ 681,600	$ 681,600
			Subtotal	***$ 5,749,600***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF		$ 200	$ -
Maintenance Shop	SF	5,000	$ 125	$ 625,000
			Subtotal	***$ 625,000***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	1	$ 300,000	$ 300,000
Concrete Pad	CY	10	$ 600	$ 6,000
Chemical Feed Pumps	EA	2	$ 25,500	$ 51,000
Alum Bulk Tanks - 20,000 gallon	EA	2	$ 40,000	$ 80,000
Chemical Feed Pumps	EA	2	$ 25,000	$ 50,000
Polymer Feed System	EA	2	$ 100,000	$ 200,000
Polymer Feed Pumps	EA	4	$ 25,000	$ 100,000
Caustic Bulk Tanks - 10,000 gallon	EA	2	$ 25,000	$ 50,000
Caustic Feed Pumps	EA	2	$ 25,000	$ 50,000
Hypo Bulk Storage Tank (20,000 gallons)	EA	2	$ 40,000	$ 80,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (4000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	2	$ 30,000	$ 60,000
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Corrosion Inhibitor Feed Pump	EA	2	$ 15,000	$ 30,000
Fluoride Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Fluoride Feed Pumps	EA	2	$ 15,000	$ 30,000
Chemical Building	SF	17500	$ 150	$ 2,625,000
Electrical and I&C Improvements	LS	1	$ 581,550	$ 581,550
Equipment Installation	LS	1	*$ 91,250*	*$ 91,250*
			Subtotal	***$ 4,549,800***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	0	$ 550	$ -
Backwash Settling Units	EA	0	$ 350,000	$ -
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	2	$ 500,000	$ 1,000,000
Dewatering Building	SF	3,500	$ 150	$ 525,000
Thickening Polymer System	LS	1	$ 100,000	$ 100,000
Centrifuge Pumps	EA	3	$ 40,000	$ 120,000
Thickened Sludge Storage	CY	250	$ 550	$ 137,500
Thickened Sludge Storage Mixer	EA	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 624,000	$ 624,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 312,000	$ 312,000
			Subtotal	***$ 4,056,000***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL		$ 0.60	$ -
Electrical and I&C Improvements	LS		$ -	$ -
Miscellanous (Yard Piping, etc.)	LS		$ -	$ -
			Subtotal	***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	2	$ 200,000	$ 400,000
Generator	LS	1	$ 1,000,000	$ 1,000,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 80,000	$ 80,000
Miscellanous (Piping, etc.)	LS	1	$ 200,000	$ 200,000
			Subtotal	***$ 1,680,000***
Subtotal for Construction				$ 25,955,580
Site/Civil (3%)				$ 778,667
Yard Piping (5%)				$ 1,297,779
Subtotal				$ 28,032,026
Contingency (25%)				$ 7,008,007
Subtotal				$ 35,040,033
Contractor Overhead, Profit, General Conditions and Mobilization (20%)				$ 7,008,007
Subtotal				$ 42,048,040
Escalation (none)				$ -
Engineer's Design and Construction Admin Fee (15%)				$ 6,307,206
Phase 1 Estimated WTP Total				**$ 48,355,246**

18 MGD Facility, Phase 2

	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Raw Water Pump Station & Intake Improvements				
	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake, Screens and Appurtenances	LS	0	$ 850,000	$ -
Raw Water Pumping Station	SF	0	$ 150	$ -
23 MGD Vertical Turbine Pumps	EA	1	$ 300,000	$ 300,000
Installation	LS	1	$ 50,000	$ 50,000
Emergency Generator	LS	0	$ 750,000	$ -
Piping and Valving	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 85,000	$ 85,000
48-Inch Raw Water Transmission Main	LF	2000	$ 400	$ 800,000
			Subtotal	**$ 1,310,000**
Reservoir Pump Station & Transmission Improvements				
33 MGDTurbine Pumps	EA	0	$ 300,000	$ -
Piping and Valving	LS	0	$ 150,000	$ -
Installation	LS	0	$ 75,000	$ -
Electrical and I&C Improvements	LS	0	$ -	$ -
48-Inch Raw Water Transmission Main	LF	200	$ 400	$ 80,000
			Subtotal	***$ 80,000***
Subtotal for Construction				**$ 1,390,000**
Site/Civil (3%)				**$ 41,700**
Subtotal				**$ 1,431,700**
Contingency (15%)				**$ 214,755**
Subtotal				**$ 1,646,455**
Contractor Overhead, Profit and Mobilization (20%)				**$ 329,291**
Subtotal				**$ 1,975,746**
Escalation (none)				**$ -**
Engineer's Design and Construction Admin Fee (15%)				**$ 296,362**
Phase 3 Estimated Raw Water PS & Intake Improvements Total				**$ 2,272,108**
Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 60,000	$ 60,000
Tank Construction	CY	60	$ 550	$ 33,000
Excavation and Backfill	CY	105	$ 35	$ 3,675
Equipment Installation	LS	1	$ 55,000	$ 55,000
48"	LF	150	$ 400	$ 60,000
Slide Gates	EA	2	$ 25,000	$ 50,000
Electrical and I&C Improvements	L S	1	$ 52,335	$ 52,335
			Subtotal	***$ 314,010***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 690,000	$ 1,380,000
Tank Construction	CY	1960	$ 550	$ 1,078,000
Excavation and Backfill	CY	940	$ 35	$ 32,900
Equipment Installation	LS	1	$ 414,000	$ 414,000
Piping	EA	2	$ 250,000	$ 500,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 514,485	$ 514,485
			Subtotal	***$ 3,944,385***
GAC Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*GAC Filter Media**	LBS	312500	$ 1.6	$ 484,375
Underdrain Equipment, Troughs	EA	4	$ 180,000	$ 720,000
Filter Box Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	1200	$ 35	$ 42,000
Equipment Installation	EA	4	$ 100,000	$ 400,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	0	$ 40	$ -
Pipe Gallery Piping/Valving	EA	4	$ 125,000	$ 500,000
48" Steel Effluent Line	LF	200	$ 400	$ 80,000
Electrical and I&C Improvements	LS	1	$ 468,400	$ 468,400
			Subtotal	***$ 3,294,775***
Filters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*Filter Media**	LBS	320000	$ 0.5	$ 160,000
Underdrain Equipment, Troughs	EA	6	$ 180,000	$ 1,080,000
Filter Box Construction	CY	1500	$ 550	$ 825,000
Excavation and Backfill	CY	1800	$ 35	$ 63,000
Equipment Installation	EA	6	$ 100,000	$ 600,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	0	$ 40	$ -
Pipe Gallery Piping/Valving	EA	6	$ 125,000	$ 750,000
48" Steel Effluent Line	LF	100	$ 400	$ 40,000
Electrical and I&C Improvements	LS	1	$ 681,600	$ 681,600
			Subtotal	***$ 4,249,600***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF	0	$ 150	$ -
Maintenance Shop	SF	0	$ 125	$ -
			Subtotal	***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	1	$ 300,000	$ 300,000
Concrete Pad	CY	10	$ 600	$ 6,000
Chemical Feed Pumps	EA	2	$ 25,500	$ 51,000
Alum Bulk Tanks - 20,000 gallon	EA	2	$ 40,000	$ 80,000
Chemical Feed Pumps	EA	2	$ 25,000	$ 50,000
Polymer Feed System	EA	1	$ 100,000	$ 100,000
Polymer Feed Pumps	EA	2	$ 25,000	$ 50,000
Caustic Bulk Tanks - 10,000 gallon	EA	2	$ 25,000	$ 50,000
Caustic Feed Pumps	EA	2	$ 25,000	$ 50,000
Hypo Bulk Storage Tank (20,000 gallons)	EA	2	$ 40,000	$ 80,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (4000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	1	$ 30,000	$ 30,000
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Fluoride Feed Pumps	EA	1	$ 15,000	$ 15,000
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 151,800	$ 151,800
Equipment Installation	LS	1	*$ 68,750*	*$ 68,750*
			Subtotal	***$ 1,232,550***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	0	$ 550	$ -
Backwash Settling Units	EA	0	$ 350,000	$ -
Gravity Thickener Eq. and Thickened Sludge PS	LS	0	$ 750,000	$ -
Gravity Thickener Tank	CY	0	$ 550	$ -
Centrifuges	EA	2	$ 750,000	$ 1,500,000
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	0	$ 65,000	$ -
Centrifuge Pumps	EA	3	$ 50,000	$ 150,000
Thickened Sludge Storage	CY	250	$ 550	$ 137,500
Thickened Sludge Storage Mixer	EA	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 372,500	$ 372,500
Miscellanous (Yard Piping, etc.)	LS	1	$ 186,250	$ 186,250
			Subtotal	***$ 2,421,250***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	0	$ 0.60	$ -
Electrical and I&C Improvements	LS	1	$ -	$ -
Miscellanous (Yard Piping, etc.)	LS	1	$ -	$ -
			Subtotal	***$ -***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	2	$ 200,000	$ 400,000
Generator	LS	1	$ 1,000,000	$ 1,000,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 80,000	$ 80,000
Miscellanous (Piping, etc.)	LS	1	$ 200,000	$ 200,000
			Subtotal	***$ 1,680,000***
Subtotal for Construction				$ 17,136,570
Site/Civil (3%)				$ 514,097
Yard Piping (5%)				$ 856,829
Subtotal				$ 18,507,496
Contingency (25%)				$ 4,626,874
Subtotal				$ 23,134,370
Contractor Overhead, Profit and Mobilization (20%)				$ 4,626,874
Subtotal				$ 27,761,243
Escalation (0%)				$ -
Engineer's Design and Construction Admin Fee (15%)				$ 4,164,187
Phase 2 Estimated WTP Total				**$ 31,925,430**

(CONTINUED) ALTERNATIVE 6: CRWSP Expansion (Catawba) Raw Water Intake, Pump Station and Water Treatment Plant Expansion Conceptual Cost Opinion

18 MGD Facility, Phase 2

Raw Water Pump Station & Intake Improvements	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Intake, Screens and Appurtenances	LS	1	$ 1,400,000	$ 1,400,000
Raw Water Pumping Station	SF	2000	$ 200	$ 400,000
23 MGD Vertical Turbine Pumps	EA	2	$ 200,000	$ 400,000
Installation	LS	1	$ 150,000	$ 150,000
Emergency Generator	LS	1	$ 750,000	$ 750,000
Piping and Valving	LS	1	$ 300,000	$ 300,000
Electrical and I&C Improvements	LS	1	$ 400,000	$ 400,000
48-Inch Raw Water Transmission Main	LF	2000	$ 400	$ 800,000
			Subtotal	**$ 4,600,000**
Reservoir Pump Station & Transmission Improvements				
33 MGDTurbine Pumps	EA	1	$ 300,000	$ 300,000
Piping and Valving	LS	1	$ 150,000	$ 150,000
Installation	LS	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 105,000	$ 105,000
48-Inch Raw Water Transmission Main	LF	200	$ 400	$ 80,000
			Subtotal	***$ 710,000***
			Subtotal for Construction	**$ 5,310,000**
			Site/Civil (3%)	**$ 159,300**
			Subtotal	**$ 5,469,300**
			Contingency (15%)	**$ 820,395**
			Subtotal	**$ 6,289,695**
			Contractor Overhead, Profit and Mobilization (20%)	**$ 1,257,939**
			Subtotal	**$ 7,547,634**
			Escalation (none)	**$ -**
			Engineer's Design and Construction Admin Fee (15%)	**$ 1,132,145**
			Phase 3 Estimated Raw Water PS & Intake Improvements Total	**$ 8,679,779**
			Phase 1-3 Total	**$ 19,631,666**

$10,179,382

Prorated raw water pump station,intake , reservoir pump station and raw water transmission improvements for 28 MGD YRWSP 2050 demand (28 MGD out of total 54 MGD expansion to WTP)

Treatment Plant Processes				
Rapid Mix	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	1	$ 60,000	$ 60,000
Tank Construction	CY	60	$ 550	$ 33,000
Excavation and Backfill	CY	105	$ 35	$ 3,675
Equipment Installation	LS	1	$ 55,000	$ 55,000
48" Influent Line	LF	150	$ 400	$ 60,000
Slide Gates	EA	2	$ 25,000	$ 50,000
Electrical and I&C Improvements	L S	1	$ 52,335	$ 52,335
			Subtotal	***$ 314,010***
Superpulsators	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equipment	EA	2	$ 690,000	$ 1,380,000
Tank Construction	CY	1960	$ 550	$ 1,078,000
Excavation and Backfill	CY	940	$ 35	$ 32,900
Equipment Installation	LS	1	$ 414,000	$ 414,000
Piping	EA	2	$ 250,000	$ 500,000
Miscellanous Metals	LS	1	$ 25,000	$ 25,000
Electrical and I&C Improvements	LS	1	$ 514,485	$ 514,485
			Subtotal	***$ 3,944,385***
GAC Contactors	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
GAC Filter Media $1.55 per pound	LBS	312500	$ 1.6	$ 484,375
Underdrain Equipment, Troughs	EA	4	$ 180,000	$ 720,000
Filter Box Construction	CY	1000	$ 550	$ 550,000
Excavation and Backfill	CY	1200	$ 35	$ 42,000
Equipment Installation	EA	4	$ 100,000	$ 400,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	0	$ 40	$ -
Pipe Gallery Piping/Valving	EA	4	$ 125,000	$ 500,000
48" Steel Effluent Line	LF	200	$ 400	$ 80,000
Electrical and I&C Improvements	LS	1	$ 468,400	$ 468,400
			Subtotal	***$ 3,294,775***
Filters (4 gpm/sf)	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Filter Building	SF	0	$ 150	$ -
*Filter Media**	LBS	320000	$ 0.5	$ 160,000
Underdrain Equipment, Troughs	EA	6	$ 180,000	$ 1,080,000
Filter Box Construction	CY	1500	$ 550	$ 825,000
Excavation and Backfill	CY	1800	$ 35	$ 63,000
Equipment Installation	EA	6	$ 100,000	$ 600,000
Miscellanous Metals	LS	1	$ 50,000	$ 50,000
Canopy	SF	0	$ 40	$ -
Pipe Gallery Piping/Valving	EA	6	$ 125,000	$ 750,000
48" Steel Effluent Line	LF	100	$ 400	$ 40,000
Electrical and I&C Improvements	LS	1	$ 681,600	$ 681,600
			Subtotal	***$ 4,249,600***
Buildings	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Lab/Admin Building	SF		$ 200	$ -
Maintenance Shop	SF	0	$ 125	$ -
			Subtotal	***$ -***
Chemical Feed Facilities	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
PAC Silo	EA	1	$ 300,000	$ 300,000
Concrete Pad	CY	10	$ 600	$ 6,000
Chemical Feed Pumps	EA	2	$ 25,500	$ 51,000
Alum Bulk Tanks - 20,000 gallon	EA	2	$ 40,000	$ 80,000
Chemical Feed Pumps	EA	2	$ 25,000	$ 50,000
Polymer Feed System	EA	1	$ 100,000	$ 100,000
Polymer Feed Pumps	EA	2	$ 25,000	$ 50,000
Caustic Bulk Tanks - 10,000 gallon	EA	2	$ 25,000	$ 50,000
Caustic Feed Pumps	EA	2	$ 25,000	$ 50,000
Hypo Bulk Storage Tank (20,000 gallons)	EA	2	$ 40,000	$ 80,000
Hypo Feed Pumps	EA	4	$ 25,000	$ 100,000
Ammonia Bulk Storage Tank (4000 gallons)	EA	1	$ 35,000	$ 35,000
Ammonia Feed System	EA	1	$ 30,000	$ 30,000
Corrosion Inhibitor Bulk Storage Tank (4,000 gallons)	EA	0	$ 15,000	$ -
Corrosion Inhibitor Feed Pump	EA	0	$ 15,000	$ -
Fluoride Bulk Storage Tank (4,000 gallons)	EA	1	$ 15,000	$ 15,000
Fluoride Feed Pumps	EA	1	$ 15,000	$ 15,000
Chemical Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 151,800	$ 151,800
Equipment Installation	LS	1	*$ 68,750*	*$ 68,750*
			Subtotal	***$ 1,232,550***
Residuals Handling	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Equalization Tank	CY	0	$ 550	$ -
Backwash Settling Units	EA	0	$ 350,000	$ -
Gravity Thickener Eq. and Thickened Sludge PS	LS	1	$ 750,000	$ 750,000
Gravity Thickener Tank	CY	750	$ 550	$ 412,500
Centrifuges	EA	1	$ 750,000	$ 750,000
Dewatering Building	SF	0	$ 150	$ -
Thickening Polymer System	LS	1	$ 100,000	$ 100,000
Centrifuge Pumps	EA	1	$ 50,000	$ 50,000
Thickened Sludge Storage	CY	250	$ 550	$ 137,500
Thickened Sludge Storage Mixer	EA	1	$ 75,000	$ 75,000
Electrical and I&C Improvements	LS	1	$ 455,000	$ 455,000
Miscellanous (Yard Piping, etc.)	LS	1	$ 227,500	$ 227,500
			Subtotal	***$ 2,957,500***
Clearwells	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Clearwell (120-ft diameter)	GAL	3,000,000	$ 0.60	$ 1,800,000
Electrical and I&C Improvements	LS		$ 180,000	$ -
Miscellanous (Yard Piping, etc.)	LS		$ 180,000	$ -
			Subtotal	***$ 1,800,000***
Finished Water Pump Station	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
High Service Pumps	EA	2	$ 200,000	$ 400,000
Generator	LS	1	$ 1,000,000	$ 1,000,000
Pumping Station Building	SF	0	$ 150	$ -
Electrical and I&C Improvements	LS	1	$ 80,000	$ 80,000
Miscellanous (Piping, etc.)	LS	1	$ 200,000	$ 200,000
			Subtotal	***$ 1,680,000***
			Subtotal for Construction	$ 19,472,820
			Site/Civil (3%)	$ 584,185
			Yard Piping (5%)	$ 973,641
			Subtotal	$ 21,030,646
			Contingency (25%)	$ 5,257,661
			Subtotal	$ 26,288,307
			Contractor Overhead, Profit, General Conditions and Mobilization (20%)	$ 5,257,661
			Subtotal	$ 31,545,968
			Escalation (none)	$ -
			Engineer's Design and Construction Admin Fee (15%)	$ 4,731,895
			Phase 3 Estimated WTP Total	**$ 36,277,864**
			Phase 1-3 Total	**$ 116,558,539**

$60,437,761

Prorated WTP improvements for 28 MGD YRWSP 2050 demand (28 MGD out of total 54 MGD expansion to WTP)

Alternative 7 Cost Development - Finished Water Supply From Charlotte Water

Raw Water Intake and Transmission Improvements

Intake Improvements = $9.1 M

Intake and raw water tranmission improvements to Charlotte Water's raw water intake are assumed to be required to fulfill a water supply agreement with Union County. This would equate to a capacity fee for infrastructure relative to quantity of water to be provided to Union County. For purposes of this cost estimate, these costs have been assumed to be the average cost of the lowest ($7.9 M) and highest ($10.2 M) traditional intake options developed for all other alternatives. These estimates include applicable contractor overhead, contingency, and engineering cost estimates.

Tranmission Improvements = $21.3 M

Alternative	Length [1] (miles)	Length [1] (feet)	Capacity [2] (mgd)	Capacity Ratio [3]	Cost [4] ($/LF)	Overall Cost
7	6	31,680	20.2	0.57	$336	**$10,635,300**

Notes:

[1] Raw water transmission improvement length assumed as distance from Charlotte Water's Catawba River Pump Station (Mountain Island Lake) to Franklin WTP.

[2] Raw water transmission capacity assumed to be the max day demand required from Charlotte-Water by Union County under Alternative 7.

[3] Capacity Ratio is the ratio of the Union County max day demand from Charlotte Water as a ratio of the overall Yadkin Service Area demand (35.2 MGD, max day).

[4] Cost per linear foot of transmission main is equal to the average transmission cost per foot for other alternatives (approx. $585/ft) times the Capacity Ratio.

Alternative 7

Subtotal	$	10,635,300
Contingency (15%)	$	1,595,295
Extended Subtotal	$	12,230,595
Conditions, and Mobilization (20%)	$	2,446,119
Extended Subtotal	$	14,676,714
Fee (15%)	$	2,201,507
Estimated Project Total - Transmission	**$**	**16,878,221**

Water Treatment Plant Improvements

Water treatment facility improvements to Charlotte Water's WTP(s) are assumed to be required to fulfill a water supply agreement with Union County. This would equate to a capacity fee for infrastructure relative to quantity of water to be provided to Union County. For purposes of this cost estimate, these costs have been assumed to be the average cost of the Yadkin River WTP options ($76.6 M) and the CRWTP Expansion option ($60.4 M), as developed for other alternatives. Additionally, costs for the required expansion of the CRWTP to meet the additional demand under this alternative are included. These estimates include applicable contractor overhead, contingency, and engineering cost estimates.

Alternative	WTP	Capacity [2] (mgd)	Capacity Ratio [3]	Cost [4] ($M)	Overall Cost ($M)
7	Charlotte-Water	20.2	0.57	$ 39.3	**$ 65.0**
	CRWTP	15.0	0.43	$ 25.7	

Finished Water Transmission Main Take-off to WTP Site Area C and D, by Alternative (not including land easement acquisition)[1]

For Alternative 7, finished water distribution improvements to Charlotte Water's WTP(s) are assumed to be required to fulfill a water supply agreement with Union County. This would equate to a capacity fee for infrastructure relative to quantity of water to be provided to Union County.

Alternative	From WTP	Length [1] (miles)	Length [1] (feet)	Capacity [2] (mgd)	Capacity Ratio [3]	Cost [4] ($/LF)	Overall Cost	
6	CRWTP	37	195,360	35.2	1.00	$585	**$114,285,600**	**Alt 6 Total**
7	Charlotte Water	33	174,240	20.2	0.57	$336	**$58,494,150**	**Alt 7 Total**
	CRWTP	37	195,360	15	0.43	$249	**$48,701,250**	**$107,195,400**

Notes:

[1] Finished water transmission improvement length assumed as distance from applicable WTP to average of YRWSP proposed WTP Site Area C and D, to give an approximation to the center of the service area.

[2] Finished water transmission capacity assumed to be the max day demand Union County in the Yadkin Service Area under the applicable alternative.

[3] Capacity Ratio is the ratio of the Union County max day demand from the applicable WTP, as a ratio of the overall Yadkin Service Area demand (35.2 MGD, max day).

[4] Cost per linear foot of transmission main is equal to the average transmission cost per foot for raw water tranmission for other alternatives (approx. $585/ft) times the Capacity Ratio.

Alternative 6

Subtotal	$	114,285,600
Contingency (15%)	$	17,142,840
Extended Subtotal	$	131,428,440
Conditions, and Mobilization (20%)	$	26,285,688
Extended Subtotal	$	157,714,128
Fee (15%)	$	23,657,119
Estimated Project Total - Transmission	**$**	**181,371,247**

Alternative 7

Subtotal	$	107,195,400
Contingency (15%)	$	16,079,310
Extended Subtotal	$	123,274,710
Mobilization (20%)	$	24,654,942
Extended Subtotal	$	147,929,652
)	$	22,189,448
Estimated Project Total - Transmission	**$**	**170,119,100**

Summary of Project Water Treatment Plant Land Acquisition Costs

WTP Site Area	Parcel Market value	Parcel Size (acres)	Cost per Acre	WTP Area Needed (acres)	Prorated WTP Land Cost	WTP Cost plus Land	Terminal Reservoir Land Cost (Alt 4a)[1]	Terminal Reservoir Land Cost (Alt 5a)[2]
Site A	$ 837,400	102	$ 8,210	50	$ 410,490	$ 77,059,322	$ 492,588	$ 738,882
Site B	$ 882,820	56	$ 15,765	50	$ 788,232	$ 77,437,064	$ 945,879	$ 1,418,818
Site C	$ 696,630	50	$ 13,933	50	$ 696,630	$ 77,345,461	$ 835,956	$ 1,253,934
Site D	$ 1,058,330	158	$ 6,700	50	$ 334,999	$ 76,983,831	$ 401,999	$ 602,999

Notes:

[1] Terminal reservoir land cost for Alternative 4 (option A) based on estimated 60 acre reservoir requirement

[2] Terminal reservoir land cost for Alternative 5 (option A) based on estimated 90 acre reservoir requirement

Summary of Project Raw Water Transmission Land/Easement Acquisition Costs

Alternative	Transmission Length (feet)[1]	Easement Width (feet)[2]	Easement Size (sq. ft)	Easement Size (acres)	Easement Land Cost ($/acre)	Total Easement Land Cost ($Million)
1	163,680	60	9,820,800	225.5	$ 8,000	$ 1.8
2A	221,760	60	13,305,600	305.5	$ 8,000	$ 2.4
2B	221,760	60	13,305,600	305.5	$ 8,000	$ 2.4
3A	190,080	60	11,404,800	261.8	$ 8,000	$ 2.1
3B	158,400	60	9,504,000	218.2	$ 8,000	$ 1.7
4	200,640	60	12,038,400	276.4	$ 8,000	$ 2.2
5	52,800	60	3,168,000	72.7	$ 8,000	$ 0.6

Notes:

[1] Transmission length based on distance from intake to WTP Site Area C, except for Alternative 3B which is to WTP Site Area D.

[2] Easement width assumed based on 10-15 feet between dual pipes and 15 feet outside of pipes, with space for 3rd future pipe if needed

D

APPENDIX D – Agency Involvement and Public Comments on Draft EIS and IBT Petition

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D.1

Interbasin Transfer Request – Notice of Intent

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OFFICE OF THE COMMISSIONERS AND MANAGER

500 N. Main St., Room 921 • Monroe, NC 28112 • Phone (704)283-3810 • Fax (704)282-0121

August 12, 2013

Mr. Benne C. Hutson, Chairman
North Carolina Environmental Management Commission
c/o EMC Recording Clerk
Director's Office – Division of Water Quality
1617 Mail Service Center
Raleigh, NC 27699-1617

Re: Union County – Notice of Intent to Request an Interbasin Transfer Certificate

Dear Mr. Hutson and EMC Members:

Union County (the County) respectfully requests that you consider this correspondence as our notification of intent to request an Interbasin Transfer (IBT) Certificate. The County is requesting a maximum daily transfer of 28 mgd from the Yadkin River Sub-Basin to the Rocky River Sub-Basin, both of which are part of the Yadkin River Basin. The requested transfer amount is based on 2050 water demand projections in the County's Yadkin River Basin service area. Exhibit 1 provides an illustration of the County's current (2012) and projected future (2050) water use, including authorized and requested IBT amounts.

The Union County Water System currently serves customers in both the Catawba River Basin and the Rocky River Sub-Basin of the Yadkin River Basin as illustrated in Exhibit 2. The County currently holds a 5 mgd authorized transfer (i.e. a grandfathered IBT amount) from the Catawba River Basin to the Rocky River Sub-Basin. To maintain compliance with the Catawba River Basin grandfathered IBT, the County currently returns a portion of the transferred water back into the Catawba River Basin via the Poplin Road wastewater pumping station. The County also has future plans to return water to the Catawba River Basin via the Crooked Creek Wastewater Treatment Plant. Additionally, the County currently holds a water purchase agreement (which is expected to expire during the planning period) with Anson County for 4 mgd of water supply that can be utilized in the County's Yadkin River Basin service area.

Union County is submitting this request in an effort to meet the water supply needs of our current and future residents, and on behalf of the wholesale communities that we serve. Exhibit 3 outlines future water demand within the County's Yadkin River Basin service area and how that demand is anticipated to be met through the year 2050. The County has seen significant population growth over the past two decades and has worked diligently to meet the increasing demands for public water supply and other services. Further, the County has completed an extensive planning effort prior to making this request, and we are excited about the opportunity to provide a long-term, sustainable water supply solution to our community.

Our leadership team has reviewed the statutory requirements for pursuing an IBT Certificate and is committed to following the required process, and to working cooperatively with the Environmental

Management Commission and others. The County will provide stakeholders an opportunity to participate in this project through an open and active public process. We are very excited about this project and look forward to working with you to provide sustainable solutions for our long-term water supply needs.

We appreciate your time and consideration of this notice. Please direct any questions, comments, or correspondence to Mrs. Amy Deyton, Union County Public Works at 704.283.3520 (amy.deyton@co.union.nc.us), or Mr. Kevin Mosteller, HDR Engineering Inc. of the Carolinas (HDR) at 704.577.3747 (kevin.mosteller@hdrinc.com).

Respectfully submitted,

Union County

Cynthia A. Coto, ICMA-CM
County Manager

Union County

Edward Goscicki, PE
Executive Director of Public Works

Attachments

cc: Mr. Tom Reeder, Director, NC-DENR Division of Water Resources
Mr. Tom Fransen, Deputy Director, NC-DENR Division of Water Resources
HDR

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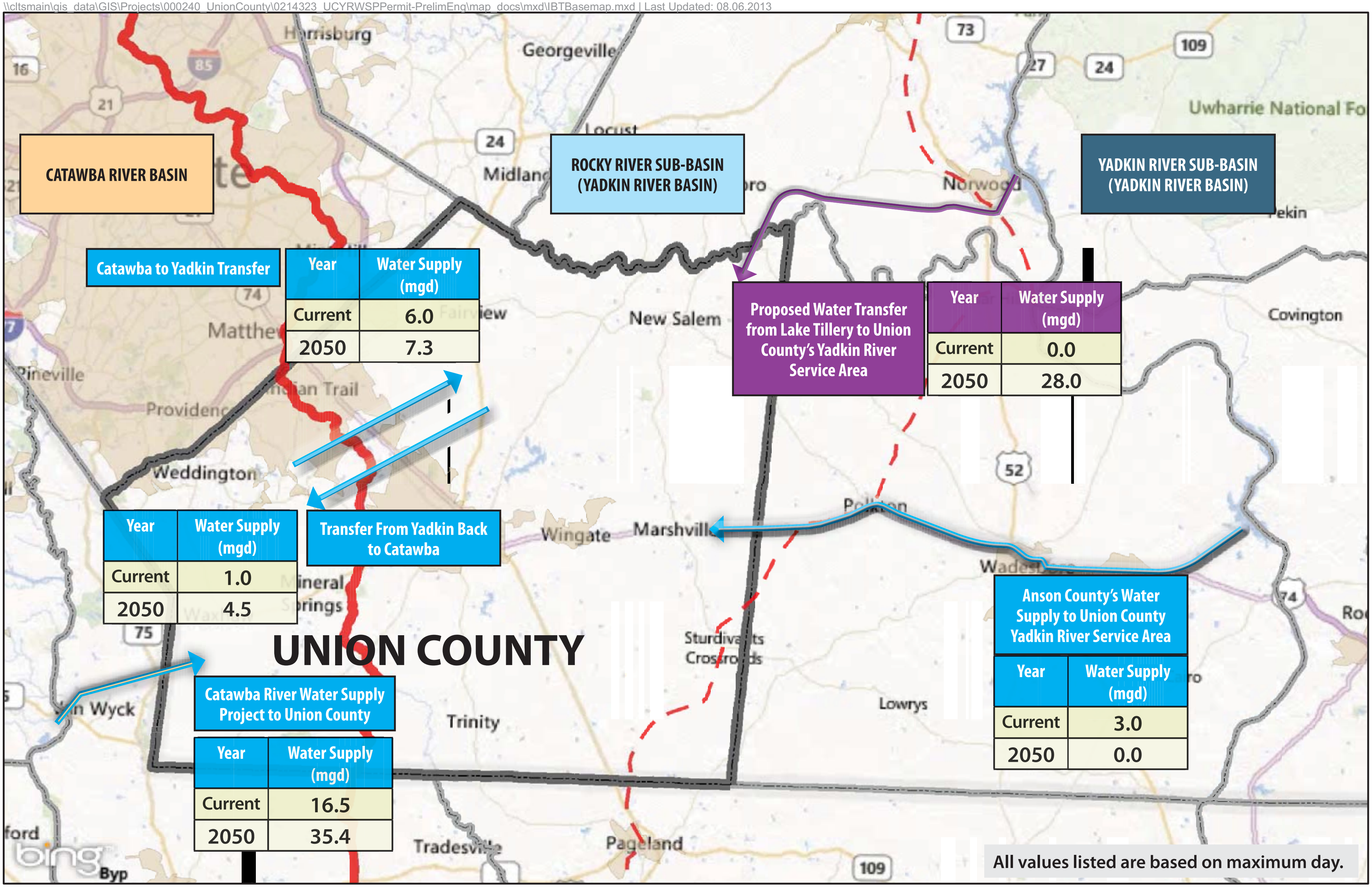

Exhibit 1

UNION COUNTY, NC – WATER SUPPLY OVERVIEW

ONE COMPANY | *Many Solutions*

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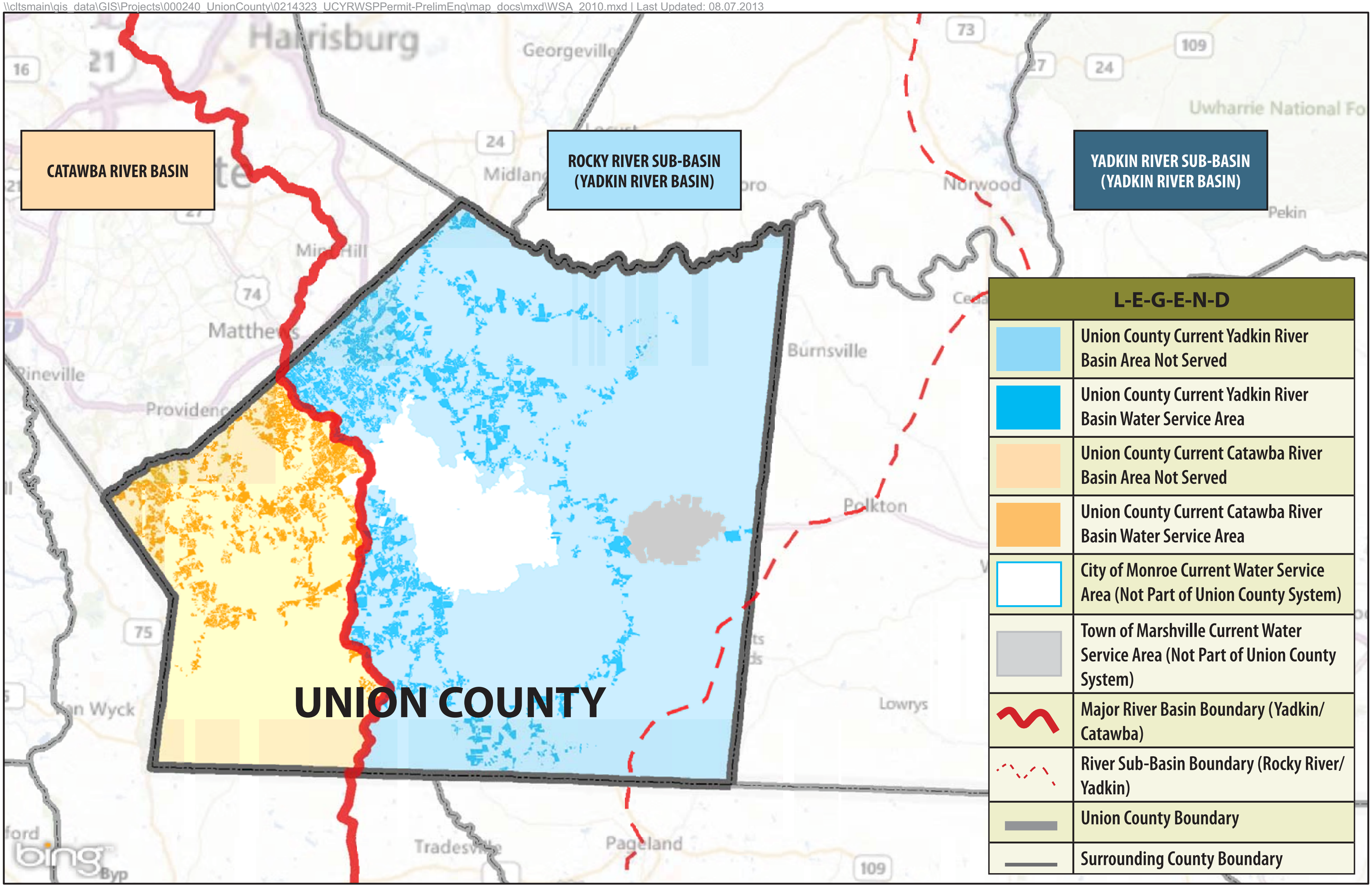

HDR ONE COMPANY | Many Solutions

Exhibit 2

UNION COUNTY, NC – WATER SUPPLY SERVICE AREAS

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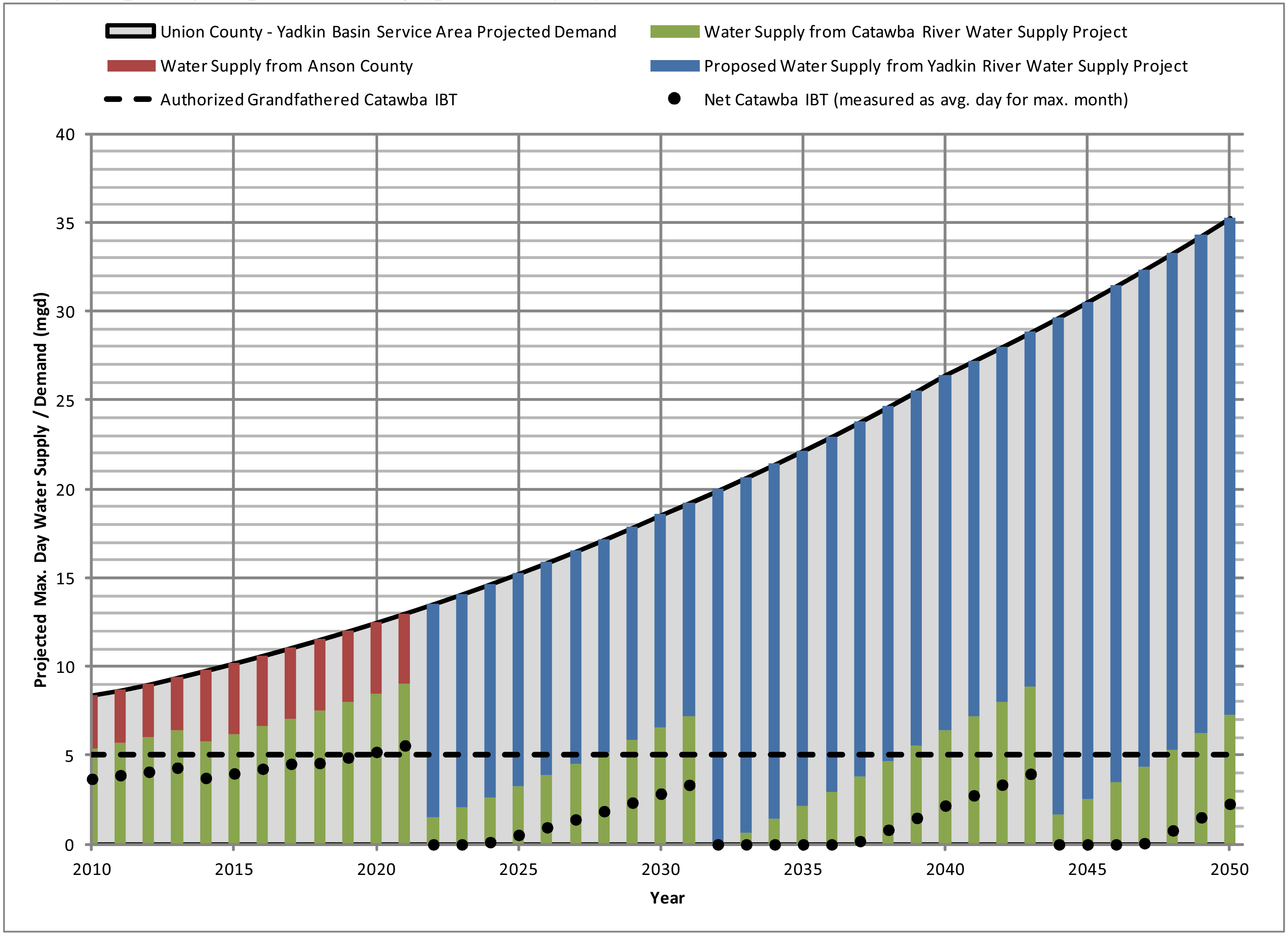

HDR ONE COMPANY | *Many Solutions*

Exhibit 3

Union County, NC - Yadkin River Basin Service Area (Rocky River Sub-Basin) Projected Maximum Day Water Supply & Demand

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D.2

Public Scoping Meetings

October, 2013

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Union County - Proposed Interbasin Transfer

NOTICE OF PUBLIC MEETINGS

October 3, 2013, 4:30 PM
Stanly County Public Library
133 East Main Street
Albemarle, NC 28001

October 14, 5:00 PM
Rowan-Cabarrus Community College – Salisbury Campus
1333 Jake Alexander Blvd. South
Salisbury, NC 28146-1595

October 15, 2013, 5:00 PM
Northeast Technical College – Cheraw Campus
1201 Chesterfield Highway
Cheraw, SC 29520

Union County will hold public meetings to receive comments on their request for an interbasin transfer (IBT) certificate from the source river basin of the Yadkin River Sub-Basin to the receiving river basin of the Rocky River Sub-Basin, both of which are part of the Yadkin River Basin. Union County currently serves customers in the Catawba River Basin and the Rocky River Sub-Basin of the Yadkin River Basin. Union County is requesting an IBT certificate for a maximum daily flow of 28 million gallons per day (mgd) from the Yadkin River Sub-Basin to the Rocky River Sub-Basin. The requested transfer amount is based on 2050 water demand projections in Union County's Yadkin River Basin service area.

These meetings are being held to provide stakeholders and the public an opportunity to participate in this project through an open and active public process, and in accordance with North Carolina General Statute 143-215.22. This statute requires that one public meeting be held in the source river basin (i.e. the Yadkin River Sub-Basin) both upstream and downstream from the proposed point of withdrawal, and that one public meeting be held in the receiving river basin (i.e. the Rocky River Sub-Basin).

The meetings will be at the times listed above. The format of the meetings will include a short overview presentation (~30 minutes) of the IBT request at the beginning and 90 minutes into the session (e.g. at 5:00 PM and 6:30 PM for meetings scheduled at 5:00 PM). The presentation will be the same at each venue. The remaining time will be utilized for public questions and comment. Based on the number of people who desire to comment, the length of the verbal presentations may be limited. All statements made at the meeting will be audio recorded, but will not be transcribed to prepare a written record of the event. Verbal comments will be given equal consideration as written comments. The North Carolina Division of Water Resources staff may be in attendance. Individuals who prefer to enter written comments need to submit these comments no later than November 15, 2013.

These meetings are being conducted as part of the scoping phase of the project where Union County, the North Carolina Department of Environment and Natural Resources, and other agencies are considering the alternatives to be evaluated, and the scope of impacts to be evaluated in an environmental impact statement (EIS).

Written comments should be mailed to:

Union County – YRWSP – IBT Comments
HDR Engineering Inc. of the Carolinas
Attn: Mr. Kevin Mosteller, PE
440 South Church Street
Charlotte, NC 28202

Comments may also be submitted electronically to unioncountyYRWSP@hdrinc.com. Mailed and emailed comments will be given equal consideration. The public comment period for this phase of the project closes on November 15, 2013. Interested parties will have future opportunities to provide input during the overall IBT certificate request process.

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Union County, North Carolina
Yadkin River Water Supply Project

Sign-In Sheet
Public Meeting #1
Thursday October 3rd 4:30 PM

Location: Stanly County Public Library
133 East Main Street
Albemarle, NC 28001

Name	Affiliation	Address	Email	Phone
Linwood Peele	NCDWR	1611 Mail Service Ctr Ral, NC 27699	linwood.peele@ncdenr.gov	(919) 707-9024
Mary Sadler	Hazen & Sawyer	4011 West Chase Blvd Suite 500, Raleigh 27607	msadler@hazenandsawyer.com	
Dwight Smith	Town of Norwood	116 S. Main St, Norwood	townofnorwood@...	704-474-3416
Kevin Mostella	HDR	440 S. Church Street Charlotte, NC 28270	kevin.mostella@hdrinc.com	704-577-3777
Ed Bruce	Duke Energy		ed.bruce@duke-energy.com	704-382-5239
Tami Styer	Duke Energy		tami.styer@duke-energy	7043820293
Jonathan Williams	HDR	440 S. Church Street Charlotte, NC 28202	jonathan.williams@hdrinc.com	704-338-6744
Amy Deyton	Union County	500 N. Main St., Suite 500 Monroe, NC 28112	Amy.Deyton@co.union.nc.us	704-283-3520
Vickie Miller	HDR	3733 National Dr Raleigh NC 27612	vickie.miller@hdrinc.com	919-785-1118
Aubrey Lofton	Union County	500 N. Main St. Ste 500 Monroe NC 28112	aubrey.lofton@co.union.nc.us	704-296-4241

Union County YRWSP – Public Scoping Meeting #1 (10-3-2013) Albemarle-Stanly County Public Library

Union County YRWSP – Public Scoping Meeting #1 (10-3-2013) Albemarle-Stanly County Public Library






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Union County, North Carolina
Yadkin River Water Supply Project

Sign-In Sheet
Public Meeting #2
Monday October 14^{th} 5:00 PM

Location: Rowan-Cabarrus Community College – Salisbury Campus
1333 Jake Alexander Blvd. South
Salisbury, NC 28146-1595

Name	Affiliation	Address	Email	Phone
Kevin Mosteller	HDR		kevin.mosteller@hdrinc.com	704.577.3747
Tami Styer	Duke		tami.styer@duke-energy.com	(704) 382 0293
Ed Bruce	Duke Energy		ed.bruce@duke-energy.com	704-382-5239
Nancy Andrews	Crane Cove High Rock Lake		weethree05@aol.com	704-633-0854
Amy Deyton	Union County		amy.deyton@co.union.nc.us	704-283-3520
Aubrey Lofton	Union County		aubrey.lofton@co.union.nc.us	704-296-4241
Mark Fowler	WSACC		mfowler@wsacc.org	704 788-4164 x11
Jonathan Williams	HDR		jonathan.williams@hdrinc.com	704-338-6744

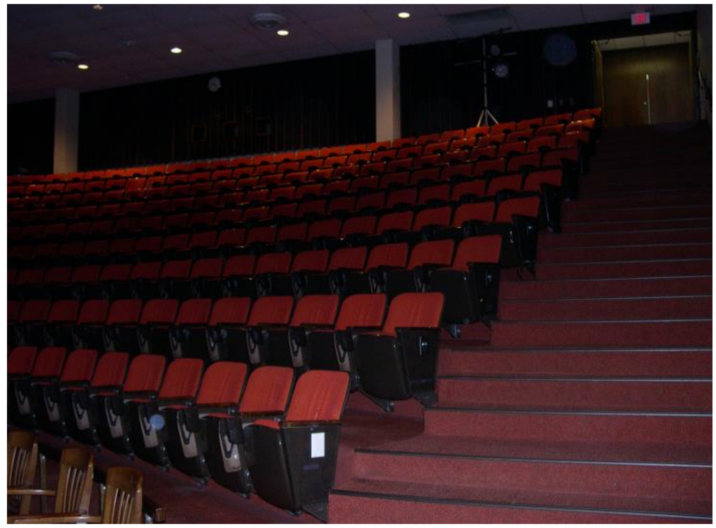

UNION COUNTY YADKIN RIVER
WATER SUPPLY PROJECT
PUBLIC MEETING TODAY - 5:00 PM
MEETING IN AUDITORIUM


UNION COUNTY YADKIN RIVER
WATER SUPPLY PROJECT
PUBLIC MEETING TODAY - 5:00 PM
MEETING IN AUDITORIUM


UNION COUNTY YADKIN RIVER
WATER SUPPLY PROJECT
PUBLIC MEETING TODAY - 5:00 PM
MEETING IN AUDITORIUM


UNION COUNTY YADKIN RIVER
WATER SUPPLY PROJECT
PUBLIC MEETING TODAY - 5:00 PM
MEETING IN AUDITORIUM

Union County YRWSP – Public Scoping Meeting #2 (10-14-2013) Rowan-Cabarrus Community College-North



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Union County, North Carolina
Yadkin River Water Supply Project

Sign-In Sheet
Public Meeting #3
Tuesday October 15th 5:00 PM

Location: Northeast Technical College – Cheraw Campus
1201 Chesterfield Highway
Cheraw, SC 29520

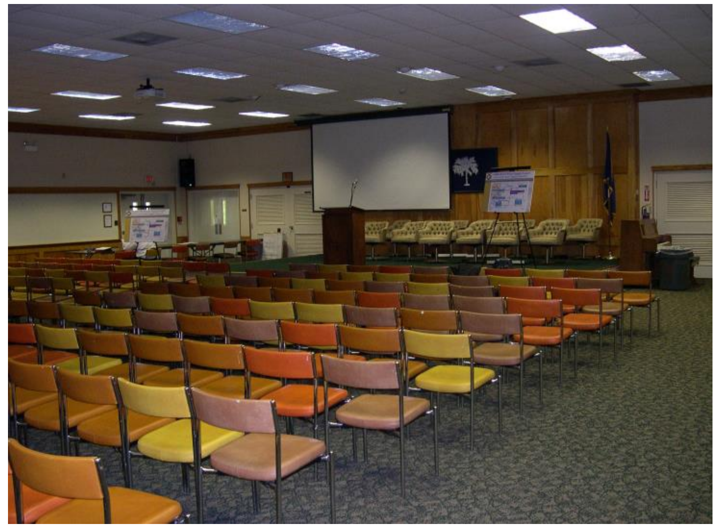
Name	Affiliation	Address	Email	Phone
Amy Deyton	Union County			704-283-3520
Aubrey Lofton	Union County			704-296-4241
Kevin Mistell	HDR			704-577-3747
Jonathan Williams	HDR			704-338-6744
HAROLD BRADY	NCDENR			919-707-9005

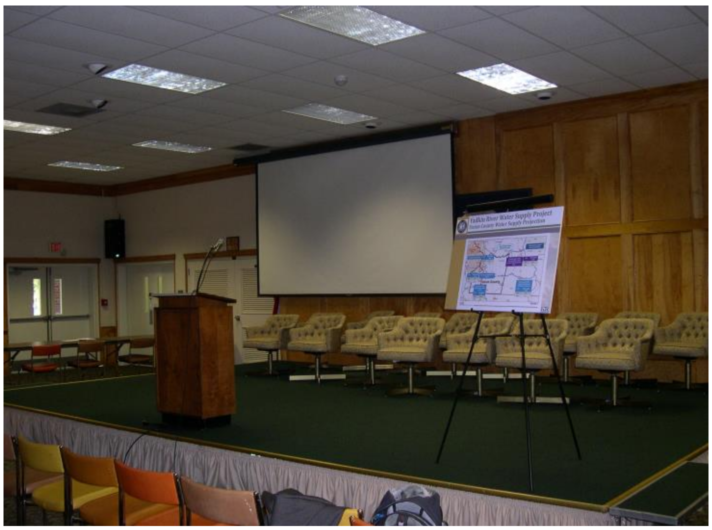

UNION COUNTY YADKIN RIVER
WATER SUPPLY PROJECT
PUBLIC MEETING TODAY - 5:00 PM
MEETING IN AUDITORIUM


UNION COUNTY YADKIN RIVER
WATER SUPPLY PROJECT
PUBLIC MEETING TODAY - 5:00 PM
MEETING IN AUDITORIUM


UNION COUNTY YADKIN RIVER
WATER SUPPLY PROJECT
PUBLIC MEETING TODAY - 5:00 PM
MEETING IN AUDITORIUM


200 HAMPTON HALL 200





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D.3

Notice of Scoping to NC State Environmental Review Clearinghouse and Agency Comments

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November 12, 2013

State Environmental Review Clearinghouse
1301 Mail Service Center
Raleigh, North Carolina 27699-1301

RE: Notice of Scoping
Union County Yadkin River Water Supply Project – Interbasin Transfer
Environmental Impact Statement
Union County, North Carolina

To All Interested Parties:

Union County (County) has retained HDR Engineering, Inc. of the Carolinas (HDR) to prepare an Environmental Impact Statement (EIS), in accordance with the State Environmental Policy Act, for the interbasin transfer (IBT) certificate request for their proposed Yadkin River Water Supply Project (the Project). The purpose of this scoping letter is to gather relevant comments on the proposed action and incorporate them into the water supply alternatives evaluation and environmental analyses for the project.

Project Background

Union County, through its Public Works Department (UCPW), has completed a Comprehensive Water and Wastewater Master Plan (Black & Veatch, December 2011). This Master Plan and subsequent water supply studies outline future needs for additional water supply in the County's current and future service areas, and presents alternative scenarios for securing new water supply from the Catawba and/or Yadkin River Basins.

UCPW understands the complexities of delivering additional water supply to its customers due to the County's geography and development patterns (i.e., population centers, proximity to water sources, and river basin boundaries) as well as the regulatory restrictions/hurdles that exist for Interbasin Transfers (IBTs).

In May 2013, the County and the Town of Norwood completed an Interlocal Intake and Transmission Agreement that provided a framework for bringing raw water supply from the Yadkin River Basin into Union County's Rocky River Basin service area, which is a sub-basin of the primary Yadkin River Basin.

The County is now moving forward with the Yadkin River Water Supply Project to ensure long-term, sustainable water supply to its current, and projected, future service areas. This effort includes securing the required regulatory permits and approvals for delivering additional water to the County's customers in the Rocky River sub-basin, including the evaluation of alternative scenarios that consider new water supply into this area from various sources. Under the current legislative and regulatory framework, the County must obtain an IBT certificate for this project.

HDR Engineering, Inc. of the Carolinas
440 S Church Street
Suite 1000
Charlotte, NC 28202-2075
Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

Purpose and Need

Union County has seen significant growth over the past two decades and is expected to continue to have steady growth and development into the foreseeable future. In response to this growth, the County has worked diligently to meet the increasing demands for public water supply and other services. Further, the County has completed an extensive water supply planning effort, and has identified opportunities to provide a long-term, sustainable water supply solution for its citizens and community.

The Union County Water System currently serves customers in both the Catawba River Basin and the Rocky River sub-basin of the Yadkin River Basin as illustrated in Exhibit 2. The ridgeline between the Catawba River Basin and Yadkin River Basin divides the County, with neither of these two major rivers flowing within the County boundaries.

The County currently holds a 5 mgd authorized transfer (i.e. a grandfathered IBT amount) from the Catawba River Basin to the Rocky River Sub-Basin. To maintain compliance with the Catawba River Basin grandfathered IBT, the County currently returns a portion of the transferred water back into the Catawba River Basin via the Poplin Road wastewater pumping station. The County also has future plans to return water to the Catawba River Basin via the Crooked Creek Wastewater Treatment Plant. Additionally, the County currently holds a water purchase agreement (which is expected to expire during the planning period) with Anson County for 4 mgd of water supply that can be utilized in the County's service area in the Rocky River sub-basin.

Water needs in the County's service area within the Rocky River sub-basin are projected to increase from a current maximum daily demand of 9 mgd to 35.3 mgd by 2050. The County's current grandfathered IBT from the Catawba River Basin and the Anson County water supply are not capable of meeting the projected future demand within the Rocky River sub-basin; and therefore, the County must secure a reliable water supply from other sources to meet its future demand in this service area.

Proposed Action

Union County is pursuing an IBT certificate to meet the water supply needs of its current and future residents, and on behalf of the wholesale communities served by the County. The County has submitted a Notice of Intent to the Environmental Management Commission regarding its request for an IBT for a maximum daily amount of 28 million gallons per day (mgd) from the Yadkin River sub-basin to the Rocky River sub-basin, both of which are part of the Yadkin River Basin. While these two sub-basins are each part of the primary Yadkin River Basin, North Carolina IBT statute considers these two sub-basins as separate, and the proposed water transfer to be an interbasin transfer. Pursuant to statutory requirements, the County has conducted three public meetings to date.

The requested amount is based on 2050 water demand projections in the County's Rocky River sub-basin service area. The intent of this IBT is to supplement the County's existing water supply sources to meet projected maximum day water demands through 2050. Exhibit 1 provides an illustration of the County's current (2012) and projected future (2050) water use, including authorized and requested IBT amounts. Exhibit 3 outlines future maximum water demand within the County's

Rocky River sub-basin service area and how that demand is anticipated to be met through the year 2050.

Area of Impact

The Project Area is dependent upon the water supply source location evaluated, but generally consists of the point of water withdrawal from the source river basin (proposed as the Yadkin River sub-basin of the Yadkin River Basin), the raw water transmission route (in both the Yadkin River sub-basin and Rocky River sub-basin of the Yadkin River Basin), and the water treatment site and route of the finished water distribution system (in Union County, within the Rocky River sub-basin of the Yadkin River Basin).

HDR is providing this information with the intent to identify the primary environmental concerns of all interested parties. Please identify any potential environmental resources or other factors that we should consider and include in the development of an Environmental Impact Statement for this project.

Proposed Alternatives

Twelve (12) alternatives have been identified for evaluation in the EIS and include the following:

1. Yadkin River raw water supply from Lake Tillery (intra-basin IBT from Yadkin River Sub-basin to Rocky River Sub-basin) with a new water treatment plant in Union County.
2. Yadkin River raw water supply from Tuckertown Reservoir (intra-basin IBT from Yadkin River Sub-Basin to Rocky River Sub-Basin) with a new water treatment plant in Union County.
3. Yadkin River raw water supply from Blewett Falls Lake (intra-basin IBT from Yadkin River Sub-Basin to Rocky River Sub-Basin) with a new water treatment plant in Union County.
4. Raw water supply from the main stem of the Yadkin River (intra-basin IBT from Yadkin River Sub-Basin to Rocky River Sub-Basin) with a new water treatment plant in Union County.
5. Raw water supply from the Rocky River within Union County with a new water treatment plant in Union County.
6. Expansion of the Catawba River Water Supply Project (modification to existing grandfathered IBT amount for a larger inter-basin IBT from the Catawba River Basin to the Rocky River Sub-Basin of the Yadkin River Basin).
7. Interconnection with CMUD (inter-basin IBT from Catawba River Basin to the Rocky River Sub-basin of the Yadkin River Basin).
8. Raw water supply through groundwater withdrawal within Union County with a new water treatment plant in Union County.
9. Demand management/conservation.
10. Direct potable reuse.
11. No Action
12. Evaluation of water returns (wastewater) from the Rocky River Sub-Basin back to the Yadkin River Sub-Basin.

These alternatives and their relative locations are illustrated in Exhibit 4. Additional alternatives for evaluation or comments related to the alternatives listed above may also be considered. It is anticipated that the CHEOPS™ water model will be used to evaluate water quantity issues for the environmental impact statement.

We look forward to your comments and appreciate your participation in this project.

Respectfully,

HDR Engineering, Inc. of the Carolinas

L. Kevin Mosteller, PE, SVP
Project Manager

cc: Ed Goscicki, Union County
Amy Deyton, Union County
Harold Brady, NCDENR – Division of Water Resources

Attachments:
Exhibit 1: Union County - Water Supply Overview
Exhibit 2: Union County - Water Supply Service Areas
Exhibit 3: Union County – Yadkin River Basin Service Area (Rocky River Sub-Basin) Projected Maximum Day Water Supply and Demand
Exhibit 4: Union County Yadkin River Water Supply Project – Preliminary Alternatives for EIS Scoping

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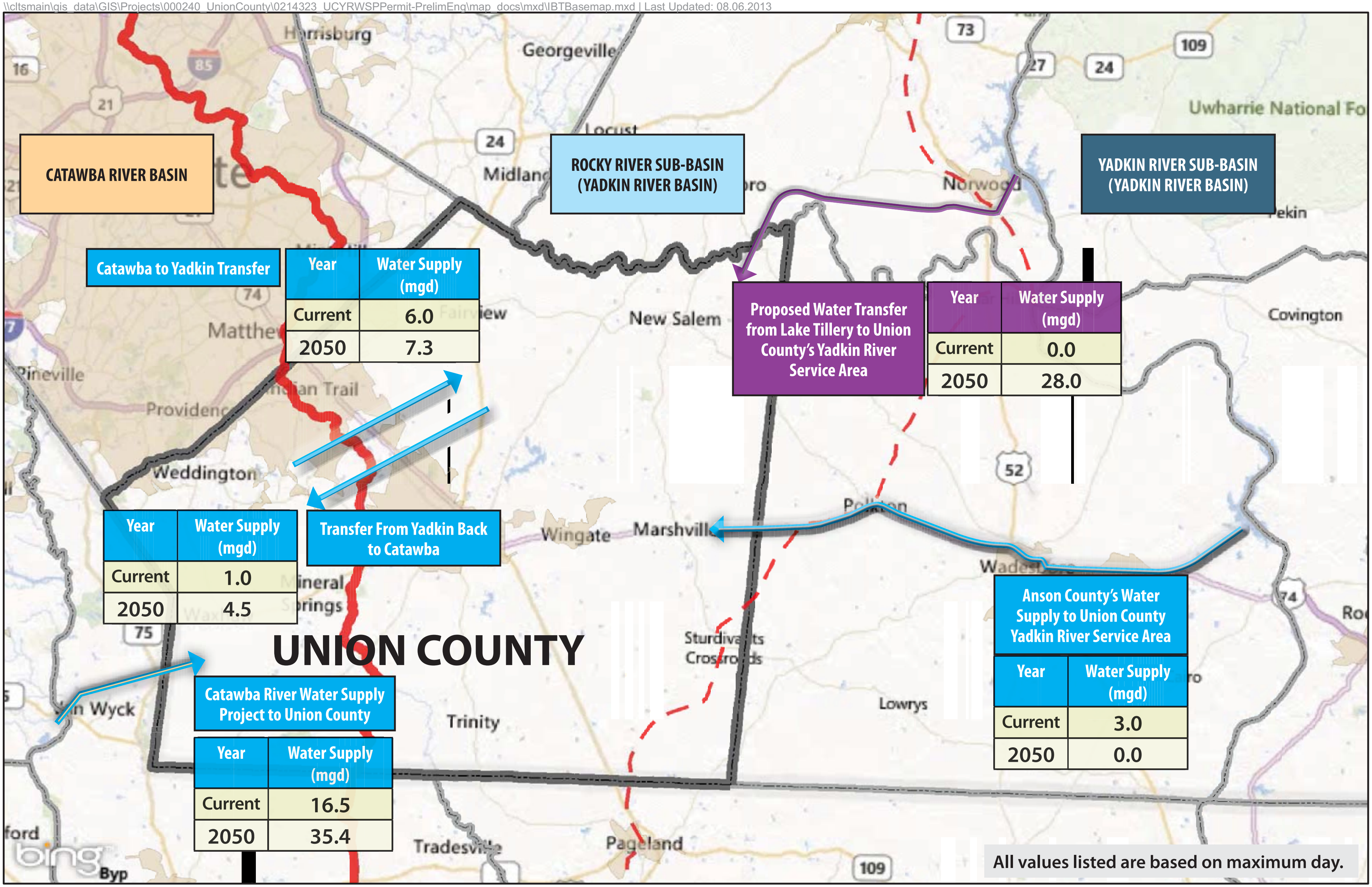

Catawba to Yadkin Transfer

Year	Water Supply (mgd)
Current	6.0
2050	7.3

Proposed Water Transfer from Lake Tillery to Union County's Yadkin River Service Area

Year	Water Supply (mgd)
Current	0.0
2050	28.0

Transfer From Yadkin Back to Catawba

Year	Water Supply (mgd)
Current	1.0
2050	4.5

Anson County's Water Supply to Union County Yadkin River Service Area

Year	Water Supply (mgd)
Current	3.0
2050	0.0

Catawba River Water Supply Project to Union County

Year	Water Supply (mgd)
Current	16.5
2050	35.4

HDR ONE COMPANY | *Many Solutions*

Exhibit 1

UNION COUNTY, NC – WATER SUPPLY OVERVIEW

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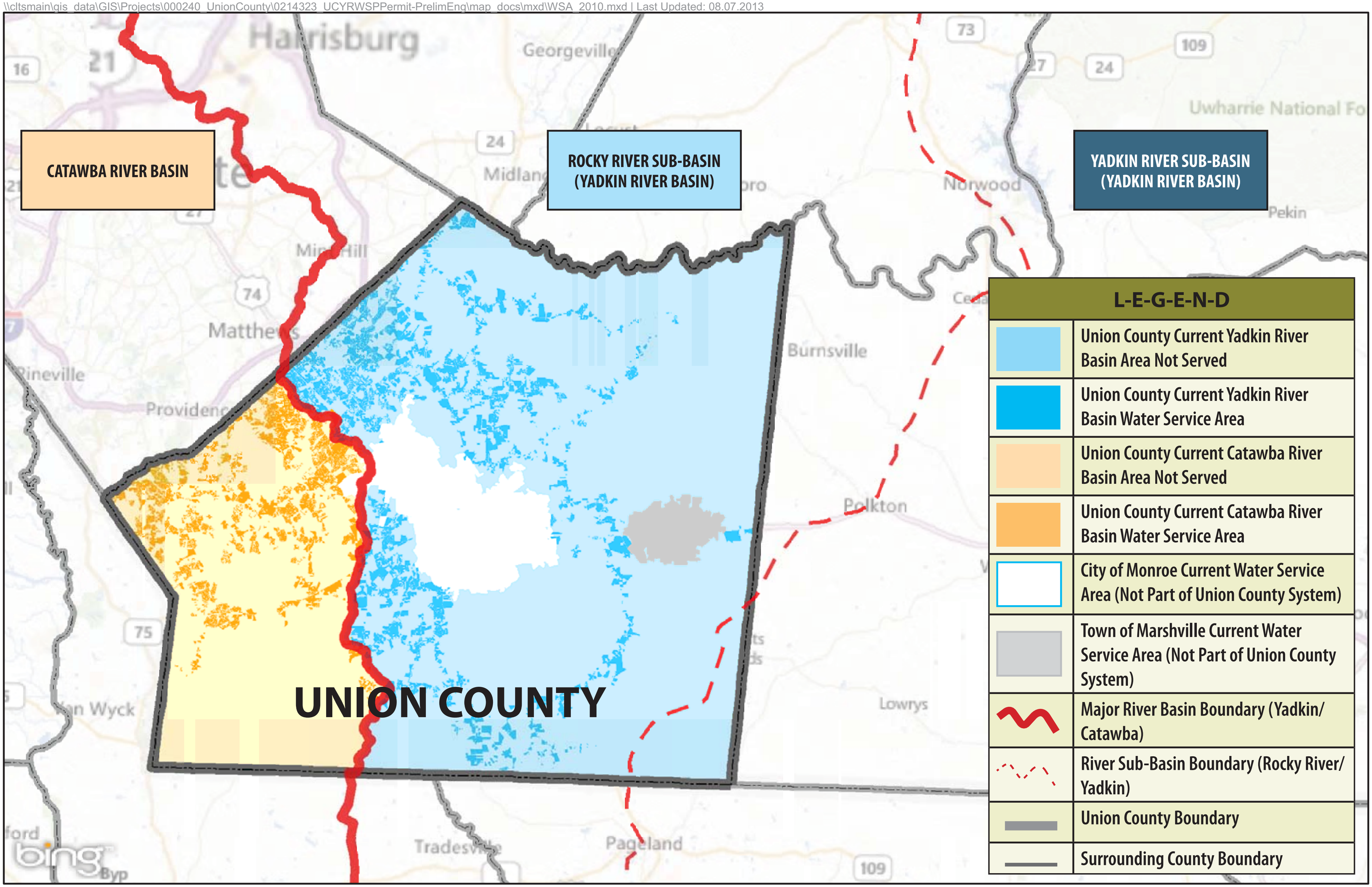

HDR ONE COMPANY | Many Solutions

Exhibit 2

UNION COUNTY, NC – WATER SUPPLY SERVICE AREAS

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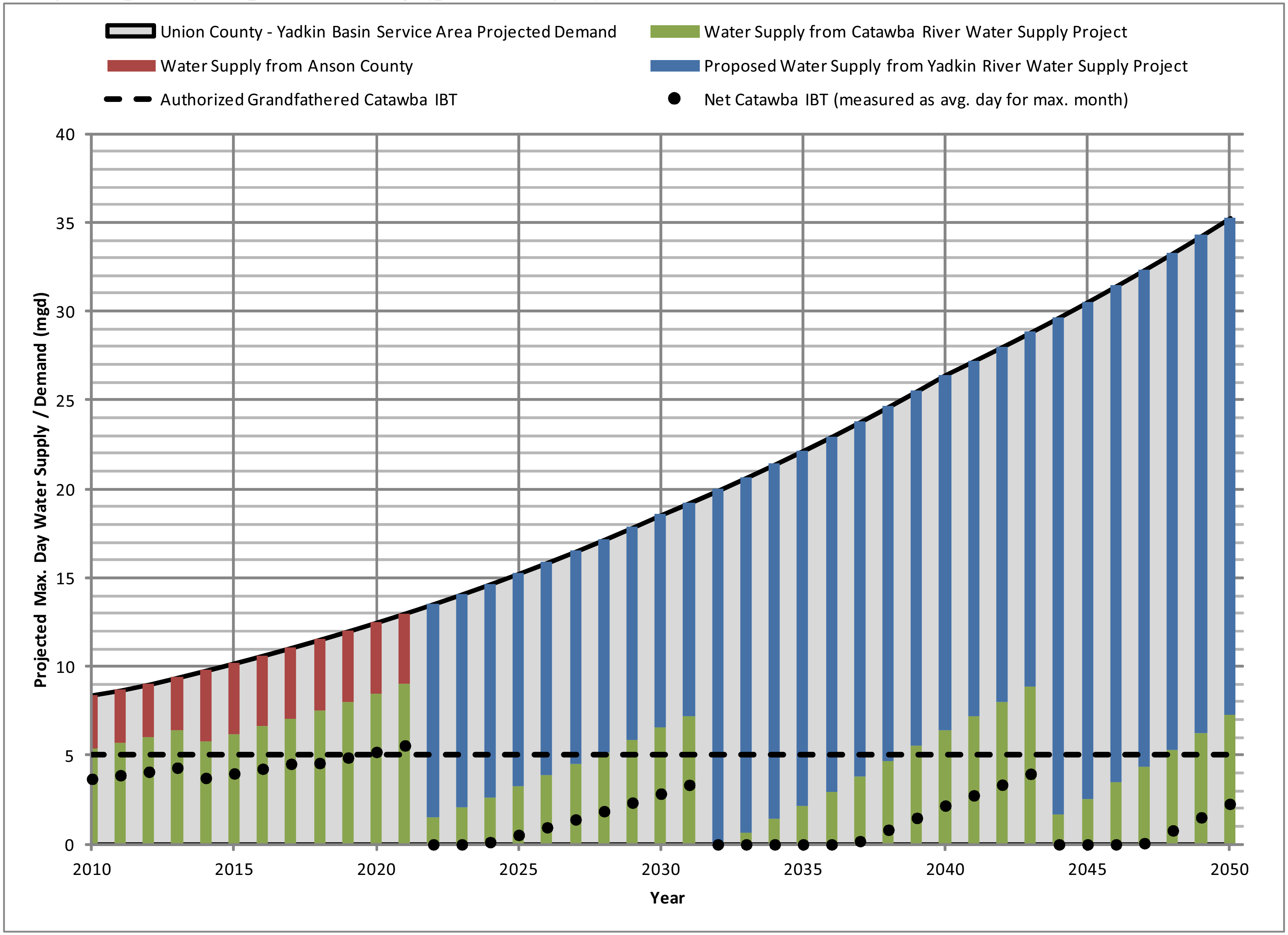

HDR ONE COMPANY | Many Solutions

Exhibit 3

Union County, NC - Yadkin River Basin Service Area (Rocky River Sub-Basin) Projected Maximum Day Water Supply & Demand

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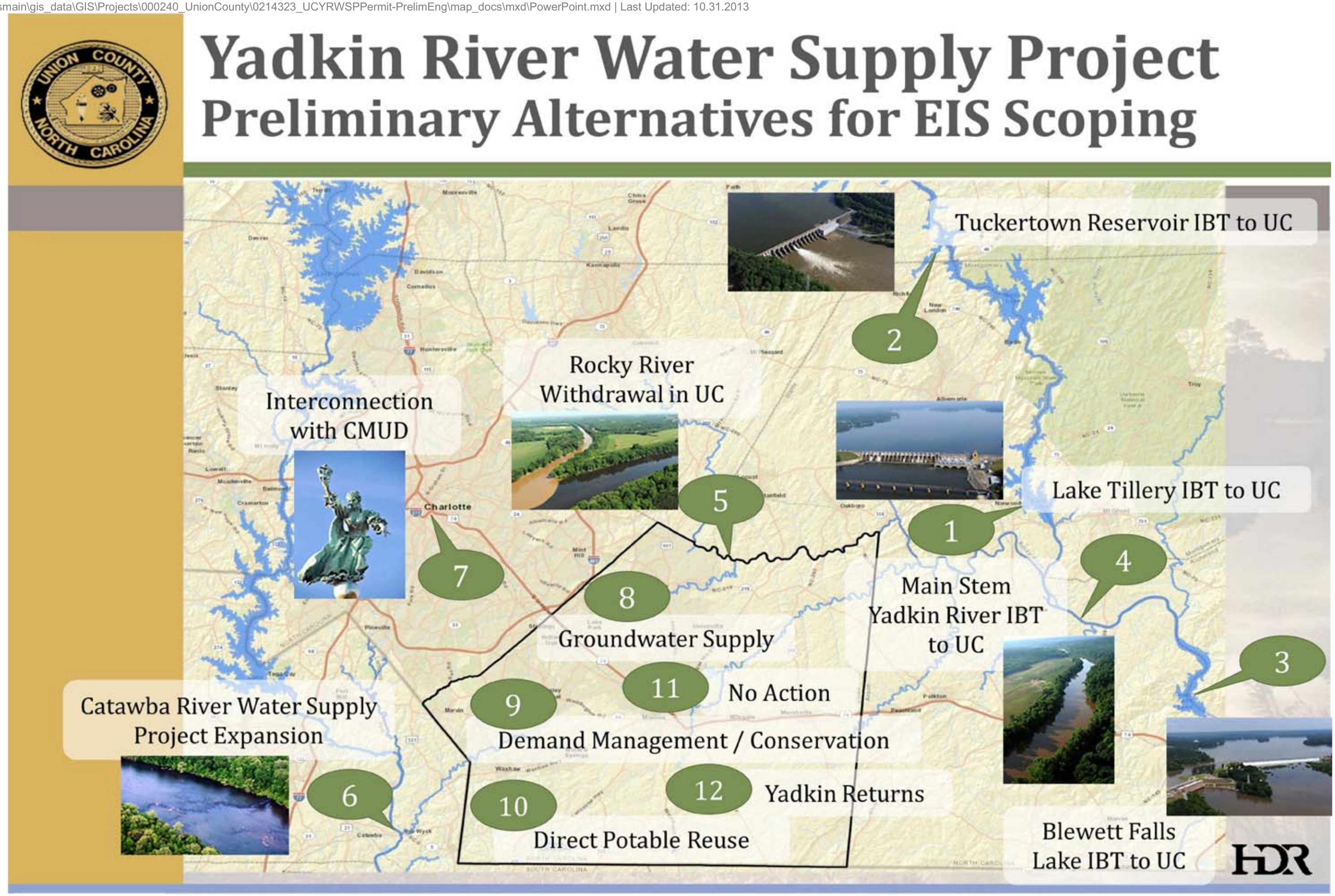

Yadkin River Water Supply Project
Preliminary Alternatives for EIS Scoping
Tuckertown Reservoir IBT to UC
2
Rocky River Withdrawal in UC
Interconnection with CMUD
5
Lake Tillery IBT to UC
1
7
4
8
Main Stem Yadkin River IBT to UC
Groundwater Supply
3
11
No Action
Catawba River Water Supply Project Expansion
9
Demand Management / Conservation
6
12
Yadkin Returns
10
Direct Potable Reuse
Blewett Falls Lake IBT to UC
HDR

Exhibit 4

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North Carolina
Department of Administration

Pat McCrory, Governor

Bill Daughtridge, Jr., Secretary

December 27, 2013

Mr. Kevin Mosteller
Union County
c/o HDR Engineering, Inc.
440 S. Church Street, Suite 1000
Charlotte, North Carolina 28202-2075

Re: SCH File # 14-E-0000-0212; SCOPING; Proposed project is for interbasin transfer certificate for the Yadkin River Water Supply project.

Dear Mr. Mosteller:

The above referenced environmental impact information has been reviewed through the State Clearinghouse under the provisions of the North Carolina Environmental Policy Act.

Attached to this letter are reviewer comments which identify issues to be addressed in the environmental review document. The appropriate document should be forwarded to the State Clearinghouse for compliance with State Environmental Policy Act. Should you have any questions, please do not hesitate to call me at (919) 807-2425.

Sincerely,

Crystal Best
State Environmental Review Clearinghouse

Attachments

cc: Region F

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail state.clearinghouse@doa.nc.gov

Location Address:
116 West Jones Street
Raleigh, North Carolina

North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

John E. Skvarla, III
Secretary

MEMORANDUM

To: Crystal Best
State Clearinghouse

From: Lyn Hardison
Division of Environmental Assistance and Customer Service
Environmental Assistance and Project Review Coordinator

RE: 14-0212
Scoping – Proposed project is for interbasin transfer certificate for the Yadkin River Water Supply Project
Union County

Date: December 19, 2013

The Department of Environment and Natural Resources has reviewed the proposal for the referenced project. Based on the information provided, several of the agencies have identified permits that may be required and provided guidance to help the applicant in preparation of the environmental document. These comments are attached for the applicant review.

The Department will provide more specific comments during the environmental review process.

Thank you for the opportunity to respond.

Attachments

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-707-8600 \ Internet: www.ncdenr.gov

NCDENR

North Carolina Department of Environment and Natural Resources

Office of Conservation, Planning, and Community Affairs

Pat McCrory
Governor

Linda Pearsall
Director

John E. Skvarla, III
Secretary

MEMORANDUM

Date: 17 December 2013

To: Lyn Hardison, Environmental Coordinator
Office of Legislative and Intergovernmental Affairs

From: Andrea Leslie, Freshwater Ecologist
North Carolina Natural Heritage Program (NHP)

Subject: Scoping for interbasin transfer certificate for the Union County Yadkin River Water Supply Project, Project Number 14-0212

Union County is pursuing an interbasin transfer (IBT) certificate to withdraw 28 million gallons per day from the Yadkin River subbasin to the Rocky River subbasin. This IBT is meant to supplement the County's existing water supply to meet water demands expected with significant projected future growth in the County.

The Natural Heritage Program (NHP) maintains information on rare species and natural communities in the State of North Carolina. As no service area has yet been determined for this project, we have provided a list of the element occurrences (rare species and natural communities) for Union County in the attached table. NHP has also completed *An Inventory of the Significant Natural Areas of Union County* in 2012, which describes the significant natural communities that were surveyed for the effort. This inventory is not a comprehensive list of significant natural communities in the county, as only a subset of properties in the county were surveyed. Please contact me or John Finnegan at john.finnegan@ncdenr.gov for a copy of this document.

If in the development of information on direct, secondary, and cumulative impacts NHP can be of assistance, please let us know. NHP appreciates the opportunity to provide input on this project.

If you have any questions, I can be reached at (828) 296-4720 or andrea.leslie@ncdenr.gov. Additionally, the mailing address for this office is 2090 US 70, Swannanoa, NC 28778.

Attachment (1)

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-707-8600 \ Internet: www.ncdenr.gov

Natural Heritage Program Element Occurrences for Union County							
TAXONOMIC GROUP	SCIENTIFIC NAME	COMMON NAME	STATE STATUS	FEDERAL STATUS	STATE RANK	GLOBAL RANK	COUNTY STATUS
Vertebrate animals							
Amphibian	Ambystoma talpoideum	Mole Salamander	SC		S2S3	G5	Current
Animal Assemblage	Colonial Wading Bird Colony				S3	G5	Current
Bird	Haliaeetus leucocephalus	Bald Eagle	T	BGPA	S3B,S3N	G5	Current
Bird	Ammodramus savannarum	Grasshopper Sparrow	W1,W5		S3B,S1N	G5	Current
Bird	Falco sparverius	American Kestrel	W1,W5		S3B,S5N	G5	Current
Bird	Lanius ludovicianus	Loggerhead Shrike	W2,SC		S3B,S3N	G4	Current
Bird	Tyrannus forficatus	Scissor-tailed Flycatcher	W3		SNA	G5	Historical
Mammal	Sciurus niger	Eastern Fox Squirrel	W2		S3	G5	Current
Mammal	Mustela frenata	Long-tailed Weasel	W3		S3S4	G5	Current
Freshwater Fish	Moxostoma robustum	Robust Redhorse	E	FSC	S1	G1	Historical
Freshwater Fish	Etheostoma collis	Carolina Darter	SC	FSC	S3	G3	Current
Reptile	Crotalus horridus	Timber Rattlesnake	SC		S3	G4	Obscure
Reptile	Masticophis flagellum	Coachwhip	SR		S3	G5	Current
Reptile	Apalone spinifera aspera	Gulf Coast Spiny Softshell	W2		S3	G5T5	Current
Reptile	Virginia valeriae	Smooth Earth Snake	W2		S3	G5	Current
Invertebrate animals							
Freshwater Bivalve	Lasmigona decorata	Carolina Heelsplitter	E	E	S1	G1	Current
Freshwater Bivalve	Fusconaia masoni	Atlantic Pigtoe	E	FSC	S1	G2	Current
Freshwater Bivalve	Toxolasma pullus	Savannah Lilliput	E	FSC	S1	G2	Current
Freshwater Bivalve	Villosa vaughaniana	Carolina Creekshell	E	FSC	S2	G2	Current
Freshwater Bivalve	Villosa constricta	Notched Rainbow	SC		S3	G3	Current
Freshwater Bivalve	Villosa delumbis	Eastern Creekshell	SR		S3	G4	Current
Freshwater Bivalve	Lampsilis radiata	Eastern Lampmussel	T		S1S2	G5	Current
Freshwater Bivalve	Strophitus undulatus	Creeper	T		S2	G5	Current
Freshwater Bivalve	Elliptio congaraea	Carolina Slabshell	W2,W5		S3	G3	Current
Freshwater or Terrestrial Gastropod	Xolotrema caroliniense	Blunt Wedge	W3		S3?	G4	Historical
Mayfly	Choroterpes basalis	a mayfly	SR		S2	G5	Current
Butterfly	Hesperia leonardus	Leonard's Skipper	W2		S3	G4	Current

TAXONOMIC GROUP	SCIENTIFIC NAME	COMMON NAME	STATE STATUS	FEDERAL STATUS	STATE RANK	GLOBAL RANK	COUNTY STATUS
Dragonfly or Damselfly	Gomphus septima	Septima's Clubtail	SR	FSC	S2	G2	Current
Dragonfly or Damselfly	Gomphus abbreviatus	Spine-crowned Clubtail	SR		S3	G4	Current
Dragonfly or Damselfly	Ophiogomphus incurvatus	Appalachian Snaketail	W2		S3	G3	Current
Dragonfly or Damselfly	Erpetogomphus designatus	Eastern Ringtail	W3		S3	G5	Current
Natural communities							
Natural Community	Dry Basic Oak--Hickory Forest				S2S3	G2G3	Current
Natural Community	Dry Oak--Hickory Forest (Piedmont Subtype)				S4	G4G5	Current
Natural Community	Dry-Mesic Basic Oak--Hickory Forest (Piedmont Subtype)				S3	G3G4	Current
Natural Community	Dry-Mesic Oak--Hickory Forest (Piedmont Subtype)				S4	G4G5	Current
Natural Community	Mesic Mixed Hardwood Forest (Piedmont Subtype)				S4	G3G4	Current
Natural Community	Piedmont Alluvial Forest				S4	G4	Current
Natural Community	Piedmont Basic Glade (Typic Subtype)				S2	G2	Current
Natural Community	Piedmont Bottomland Forest (Typic Low Subtype)				S2	G2?	Current
Natural Community	Piedmont Cliff (Basic Subtype)				S1	G2?	Current
Natural Community	Piedmont Levee Forest (Typic Subtype)				S3S4	G3G4	Current
Natural Community	Xeric Hardpan Forest (Acidic Hardpan Subtype)				S1	G2	Current
Plants							
Moss	Orthotrichum exiguum	Small Wood-bark Moss	SR-O		SH	G3?	Historical
Vascular Plant	Symphyotrichum georgianum	Georgia Aster	T	C	S3	G3	Current
Vascular Plant	Helianthus schweinitzii	Schweinitz's Sunflower	E	E	S3	G3	Current

TAXONOMIC GROUP	SCIENTIFIC NAME	COMMON NAME	STATE STATUS	FEDERAL STATUS	STATE RANK	GLOBAL RANK	COUNTY STATUS
Vascular Plant	Rhus michauxii	Michaux's Sumac	E	E	S2	G2G3	Historical
Vascular Plant	Delphinium exaltatum	Tall Larkspur	E	FSC	S2	G3	Historical
Vascular Plant	Acmispon helleri	Carolina Birdfoot-trefoil	SC-V	FSC	S3	G3	Current
Vascular Plant	Isoetes virginica	Virginia Quillwort	SR-L	FSC	S1	G1	Historical
Vascular Plant	Carex impressinervia	Ravine Sedge	SR-T	FSC	S2	G2	Current
Vascular Plant	Eurybia mirabilis	Piedmont Aster	SR-T	FSC	S3	G3	Current
Vascular Plant	Buchnera americana	American Bluehearts	E		S1	G5?	Current
Vascular Plant	Paspalum dissectum	Mudbank Crown Grass	E		S2	G4?	Current
Vascular Plant	Coelorachis cylindrica	Carolina Jointgrass	SC-H		SH	G4G5	Current
Vascular Plant	Boechera missouriensis	Missouri Rockcress	SC-V		S1	G5	Current
Vascular Plant	Cardamine dissecta	Dissected Toothwort	SC-V		S2	G4?	Current
Vascular Plant	Dichanthelium aciculare ssp. neuranthum	Nerved Witch Grass	SC-V		S1	G5T3	Current
Vascular Plant	Helianthus laevigatus	Smooth Sunflower	SC-V		S3	G4	Current
Vascular Plant	Callitriche terrestris	Terrestrial Water-starwort	SR-O		S2?	G5	Current
Vascular Plant	Ilex longipes	Georgia Holly	SR-P		S1	G5	Current
Vascular Plant	Isolepis carinata	Keeled Beakrush	SR-P		S1	G5	Current
Vascular Plant	Pseudognaphalium helleri	Heller's Rabbit-Tobacco	SR-P		S3	G3G4	Current
Vascular Plant	Solidago rigida var. glabrata	Southeastern Bold Goldenrod	SR-P		S2	G5T4	Current
Vascular Plant	Asclepias purpurascens	Purple Milkweed	SR-T		S1?	G5?	Obscure
Vascular Plant	Baptisia alba	Thick-pod White Wild Indigo	T		S2	G5	Current
Vascular Plant	Gillenia stipulata	Indian Physic	T		S2	G5	Current
Vascular Plant	Primula meadia	Shooting-star	T		S2S3	G5	Current
Vascular Plant	Symphyotrichum laeve var. concinnum	Narrow-leaf Aster	T		S2	G5T4	Current
Vascular Plant	Baptisia albescens	Thin-pod White Wild Indigo	W1		S3	G4	Current
Vascular Plant	Chasmanthium sessiliflorum	Longleaf Spikegrass	W1		S2S3	G5	Current
Vascular Plant	Frangula caroliniana	Carolina Buckthorn	W1		S3	G5	Current
Vascular Plant	Manfreda virginica	Eastern Agave	W1		S3	G5	Current
Vascular Plant	Parthenium integrifolium var. mabryanum	Mabry's Wild Quinine	W1		S3	G5T3	Historical
Vascular Plant	Endodeca serpentaria	Virginia Snakeroot	W5B		S4	G4	Current

TAXONOMIC GROUP	SCIENTIFIC NAME	COMMON NAME	STATE STATUS	FEDERAL STATUS	STATE RANK	GLOBAL RANK	COUNTY STATUS
Vascular Plant	Endodeca serpentaria	Virginia Snakeroot	W5B		S4	G4	Current
Vascular Plant	Berchemia scandens	Supple-jack	W6		S5	G5	Historical
Vascular Plant	Berchemia scandens	Supple-jack	W6		S5	G5	Historical
Vascular Plant	Schoenoplectus pungens	Three-square Bulrush	W6		SNR	G5	Historical
Vascular Plant	Schoenoplectus pungens	Three-square Bulrush	W6		SNR	G5	Historical
Vascular Plant	Calycanthus floridus var. floridus	Eastern Sweetshrub	W7		S2?	G5T4	Current
Vascular Plant	Heuchera caroliniana	Carolina Alumroot	W7		S3	G3	Historical
Vascular Plant	Juncus brachycarpus	Whiteroot Rush	W7		S2?	G4G5	Current
Vascular Plant	Juncus longii	Long's Rush	W7		S1S2	G3Q	Historical
Vascular Plant	Juncus secundus	Nodding Rush	W7		S1S2	G5?	Current
Vascular Plant	Prunus umbellata	Hog Plum	W7		S2	G4G5	Historical
Vascular Plant	Sagittaria platyphylla	Delta Arrowhead	W7		S1	G5	Historical
Vascular Plant	Scutellaria ovata ssp. bracteata	A Heartleaf Skullcap	W7		S2?	G5T3T5	Current
Vascular Plant	Silene caroliniana var. caroliniana	Rock Catchfly	W7		S2S3	G5T4	Current

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

MEMORANDUM

TO: Lyn Hardison, Environmental Assistance Coordinator
NCDENR Division of Environmental Assistance and Outreach

FROM: Shari L. Bryant, Piedmont Region Coordinator
Habitat Conservation Program

DATE: 17 December 2013

SUBJECT: Scoping for Environmental Impact Statement for Union County Yadkin River Water Supply Project – Interbasin Transfer, Union County. DENR Project No. 14-0212.

Biologists with the North Carolina Wildlife Resources Commission (NCWRC) have reviewed the subject document and we are familiar with the habitat values of the area. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e), North Carolina Environmental Policy Act (G.S. 113A-1 through 113A-10; 1 NCAC 25) and North Carolina General Statutes (G.S. 113-131 et seq.).

Union County (County) is requesting an Interbasin Transfer (IBT) certificate for a maximum daily transfer of 28 million gallons per day (mgd) from the Yadkin River sub-basin to the Rocky River sub-basin. The Union County Water System currently serves customers in the Catawba River basin and the Rocky River sub-basin of the Yadkin River basin. The County currently holds a 5 mgd authorized transfer (i.e., a grandfathered amount) from the Catawba River basin to the Rocky River sub-basin. The IBT certificate is needed to meet the water supply needs of the County's current and future residents, and the wholesale communities served by the County.

Twelve alternatives will be evaluated in the Environmental Impact Statement (EIS) including a raw water supply from Lake Tillery, Tuckertown Reservoir, Blewett Falls Lake, and main stem Yadkin River; a Rocky River raw water supply, an expansion of the Catawba River Water Supply Project (i.e., modification of the Catawba River IBT); an interconnection with Charlotte-Mecklenburg Utilities Department (CMUD), groundwater withdrawal; demand management and conservation; potable reuse; no action; and the evaluation of water returns (wastewater) from Rocky River sub-basin to Yadkin River sub-basin,

The proposed project is located within the Yadkin River sub-basin and Rocky River sub-basin of the Yadkin-Pee Dee River basin. The lakes and streams within the proposed project and service areas support diverse aquatic communities including several federal and state listed species.

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

The EIS should include a description of the water quality of the source river and receiving river; aquatic habitat for rare, threatened, and endangered species; in-stream flow data for segments of the source and receiving rivers that may be affected by the transfer; and any impaired streams on the State's 303(d) list. Also, the EIS should include a demonstration that the proposed transfer would not impair existing uses, or existing and planned consumptive and non-consumptive uses of the water in the source river basin. If the proposed transfer would impact a reservoir within the source river basin, the demonstration should include a finding that the transfer would not result in a water level in the reservoir that is inadequate to support existing uses of the reservoir, including recreational uses.

To facilitate our review of the project's impacts, we request the following information is included in the EIS:

- Description of the aquatic and terrestrial wildlife resources in the Yadkin River and Rocky River watersheds, and any watersheds that would be within the project's service area. More specifically the description should include a list of
  - Wildlife, fish and mussel species
  - Federal and state listed aquatic and terrestrial wildlife species
  - Diadromous species (Note: the NCWRC is working with the U.S. Fish and Wildlife Service (USFWS), the S.C. Department of Natural Resources (SCDNR), Duke Energy and others to restore American eel (*Anguilla rostrata*) and American shad (*Alosa sapidissima*) in the Yadkin-Pee Dee River watershed.)
- Impingement/entrainment at the water intake structure. NCWRC recommends that intake structures use passive screens with openings not to exceed 1 centimeter (1 millimeter in waters supporting diadromous fish species) and with a maximum intake velocity of 0.5 fps (feet per second).
- Description of the location of the return(s) for each alternative (i.e., will water be returned to the Rocky River or another stream) and the amount of flow at each return.
- Amount/distance (river miles) of streams with reduced flows because of withdrawal.
- Amount/distance (river miles) of streams with increased flows due to returns.
- Analysis of change in hydrology of both source and receiving basins. This analysis should include impacts to flow magnitude, timing, duration, frequency, and rate of change.
- Details on how the water need projections were derived from:
  - population data and trends
  - per capita water use
  - trends in sector demand (i.e., residential, commercial, industrial)
- Description of water conservation practices within the service area. Water conservation practices include the installation of indoor plumbing fixtures that save water or retrofitting existing features, water reuse or recycling, promotion of xeriscape landscaping, education about water use habits, and rate structures that reward conservation and reduced use.
- Description of drought management protocols, water conservation measures, tiered withdrawal provisions, and trigger points.

- Description of the secondary and cumulative impacts of the project and measures to address these impacts. NCWRC's *Guidance Memorandum to Address and Mitigate Secondary and Cumulative Impacts to Aquatic and Terrestrial Wildlife Resources and Water Quality* (August 2002; http://www.ncwildlife.org/Portals/0/Conserving/documents/2002_GuidanceMemorandumforSecondaryandCumulativeImpacts.pdf) details measures to minimize secondary and cumulative impacts to aquatic and terrestrial wildlife resources. If the service area for the project includes the Goose Creek watershed, then the "Specific Mitigation Measures for Waters Containing Federally Listed Species" would apply due to the presence of the federal and state endangered Carolina heelsplitter (*Lasmigona decorata*) in Goose Creek and Duck Creek. Also, the Green Growth Toolbox (http://216.27.39.101/greengrowth/) provides information on nature-friendly planning.

In addition to addressing the concerns outlined above, the EIS should include a detailed assessment of existing natural resources within the project area and should discuss the potential of mitigating impacts to wetlands, waters, and high quality upland habitat. We encourage the applicant to consult the Department of Environment and Natural Resources *Guidance for Preparing SEPA Documents and Addressing Secondary and Cumulative Impacts* in preparing the EIS. To facilitate our review of proposed project impacts on aquatic and terrestrial wildlife resources, we request the following information is included in the EIS. Although some of the information, requests and comments may not be applicable to this project, these should facilitate preparation of an environmental document that addresses impacts to aquatic and terrestrial wildlife resources.

1. Include descriptions of aquatic and terrestrial wildlife resources within the project area, and a listing of federally or state designated threatened, endangered or special concern species. A listing of designated species can be found on the N.C. Natural Heritage Program's website at http://www.ncnhp.org.

2. Surveys should be conducted by biologists with both state and federal endangered species permits.

3. Include descriptions of any streams or wetlands affected by the project.

4. Include project maps identifying wetland areas. Identification of wetlands may be accomplished through coordination with the U.S. Army Corps of Engineers (USACE). If the USACE is not consulted, the person delineating wetlands should be identified and criteria listed.

5. Provide information on existing, planned, and projected sewer and water infrastructure service throughout the service area. A map showing the location of the existing and projected lines and areas containing special resources should be included.

6. Define the service area for the project, including any ETJs (extra-territorial jurisdiction), and provide a map of the service area.

7. Provide a description of project activities that will occur within wetlands, such as fill or channel alteration. Acreage of wetlands impacted by alternative project designs should be listed.

8. Provide a description and a cover type map showing acreage of upland wildlife habitat impacted by the project.

9. Discuss the extent to which the project will result in loss, degradation or fragmentation of wildlife habitat (wetlands and uplands).

10. Discuss any measures proposed to avoid or reduce impacts of the project or to mitigate unavoidable habitat losses.

11. Discuss the cumulative impacts of secondary development facilitated by the proposed project. Such discussion should weigh the economic benefits of such growth against the costs of associated environmental impact.
    (a) Include specific measures (e.g., local ordinances) that will be used to address stormwater and sedimentation at the source. Include specific requirements for both residential and industrial developments and Best Management Practices (BMPs) that will be required.
    (b) Include specific measures (e.g., local ordinances) that will be used to protect stream corridors, riparian habitat, and a minimum of the 100-year floodplain from filling and development. Commitments by the project sponsors to protect area streams with riparian buffers through purchase or conservation easement are of particular interest.

12. Include a list of document preparers that shows each individual's professional background and qualifications.

The information provided is not sufficient for our staff to make definitive recommendations or conclusions concerning this project. Thank you for the opportunity to provide input in the early planning stages for this project. If we can be of further assistance, please contact our office at (336) 449-7625 or shari.bryant@ncwildlife.org.

ec: Chris Goudreau, NCWRC
Vann Stancil, NCWRC

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Waste Management

Pat McCrory Governor	Dexter R. Matthews Director	John E. Skvarla, III Secretary

December 13, 2013

To: Dexter Matthews, Director
Division of Waste Management

From: Brent Burch, Supervisor MW for BB
Western Region Compliance Branch

RE: RCRA comments on Union County's Interbasin Transfer Certificate - #14 -0212

The Hazardous Waste Section has reviewed the proposal consisting of Union County's request for an interbasin transfer for a maximum daily amount of 28 million gallons per day from the Yadkin River sub-basin to the Rocky River sub-basin.

Union County is reminded if during the project, a solid waste is generated, they are required to determine if the waste is a hazardous waste. Additionally, if >220 pounds of hazardous waste is generated in a calendar month the Hazardous Waste Section must be notified and the generator must comply with the small quantity generator requirements. If ≥2200 pounds are generated in a calendar month the Hazardous Waste Section must be notified and the generator must comply with the large quantity generator requirements.

The Hazardous Waste Section has no objection to the proposal.

Should any questions arise, please contact me at 828-321-9585.

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Waste Management

Pat McCrory
Governor

Dexter R. Matthews
Director

John E. Skvarla, III
Secretary

Date: December 13, 2013

To: Kathleen Lance
Division of Waste Management

From: Qu Qi, central Unit Supervisor
Inactive Hazardous Site Branch
Superfund Section

Subject: Project #14-0212, Union County Yadkin River Water Supply Project – Interbasin Transfer Environmental Impact Statement

A review of the Union County Water Supply Project – Interbasin Transfer Environmental Impact Statement has been completed. The referenced project involves water withdrawal from the source river basin - Yadkin River Basin (Anson County or Stanly County), the raw water transmission route (from Anson County or Stanly County to Union County), and the water treatment site and route of finished water distribution system in Union County. However, at this stage the locations of the water intake, transmission rout, and water treatment plant and distribution system are not determined.

In order to provide information of potential environmental impact of the project, all incident sites in Union County, Anson County and Stanly County under the jurisdiction of the Superfund Section are listed in the attached tables. Table 1 contains all open IHSB sites, Table 2 includes PRL sites, and Table 3 lists all DSCA sites in these three counties.

Files for the site(s) listed in the tables can be accessed by following the "Access File Records Online" link on the Superfund Section website: http://portal.ncdenr.org/web/wm/sf.

Please contact me at 919.707.8213 if you have any questions.

cc: Jim Bateson
Charlotte Jesneck
Peter Doorn

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-707-8200 \ Internet: http://portal.ncdenr.org/web/wm

Table 1		IHSB Sites				
SITE COUNTY	SITE ID	SITE NAME	SITE ADDRRESS	SITE CITY	Lat	Long
UNION						
	NONCD0001225	ADA MC GEE	5212 LEE MASSEY RD	WAXHAW	34.927591	-80.690613
	NONCD0001292	ASSOCIATED ENGINEERING	3512 FAITH CHURCH RD	INDIAN TRAIL	35.079582	-80.634303
	NONCD0001355	BLOOMSBURG MILLS PLANT - SOLVENT	3000 STITT ST	MONROE	34.98459	-80.494
	NONCD0001516	CLONTZ RESIDENCE	5304 LANDSFORD RD	MARSHVILLE	34.865958	-80.363885
	NONCD0002395	CONCRETE SERVICE CO/CEMEX/READY MIX	4206 W UNIONVILLE INDIAN TRAIL	INDIAN TRAIL	35.07651	-80.63448
	NONCD0002923	COOPER TOOLS, LLC	3012 MASON ST	MONROE	34.99013	-80.48995
	NONCD0001604	DIAMOND OAK DEVELOPMENT SITE	HOWIE MINE CHURCH RD	WAXHAW	34.95985	-80.72
	NONCD0001102	ENQUIRER JOURNAL	500 W JEFFERSON ST	MONROE	34.983186	-80.554323
	NONCD0001717	FIRST CITIZENS BANK	2743 W. ROOSEVELT BLVD	MONROE	35.019078	-80.577
	NONCD0002039	MASON RESIDENCE	409 BIVENS RD	MONROE	34.9905	-80.4837
	NONCD0002054	MCGEE BROS.-CARRIKER RD - SOLVENT	4608 CARRIKER RD	MONROE	35.123049	-80.473766
	NONCD0002092	MONROE ICE AND FUEL (SOLVENTS)	601 NORTH CHARLOTTE AVE	MONROE	34.98641	-80.55348
	NONCD0002093	MONROE MUNICIPAL SERVICE	2401 WALKUP AVE	MONROE	34.99044	-80.50833
	NONCD0002157	NCDOT ASPHALT SITE #12 / BOGGS	2318 CONCORD HWY	MONROE	35.013667	-80.540477
	NONCD0002329	PRICES PHILLIPS 66	1601 ROOSEVELT AVE	MONROE	34.99678	-80.54617
	NCD986176030	RHODERIA DRIVE WELLS	LAKEWOOD & RHODERA DRIVE	STALLINGS	35.08908174	-80.69426512
	NONCD0002919	ROCKY RIVER RD PCE	3501 N ROCKY RIVER RD	MONROE	35.05786	-80.59383
	NCD981863228	SCHERER, R.P.	2021 E. ROOSEVELT BLVD.	MONROE	34.97883	-80.493855
	NCD095458709	SCHRADER AUTOMOTIVE PRODUCTS DIV.	1609 AIRPORT ROAD	MONROE	35.022939	-80.622923
	NCD003155587	SCOTT AVIATION OF MONROE/TOOL SERV	309 W. CROWELL ST	MONROE	35.00570935	-80.55366665
	NCD000616516	SCOVILL INC/SECURITY PRODUCTS	HWY 74 E	MONROE	34.97839	-80.48635
	NONCD0002928	SKYWAY DR PCE	1012 SKYWAY DR	MONROE	34.9899	-80.54846
	NONCD0002527	SQUARE D - CATCH BASIN	1809 AIRPORT RD	MONROE	35.02819	-80.62173
	NCSFN0406894	STALLINGS SALVAGE	SECREST AVE	MONROE	34.98259	-80.49705
	NCD986191484	STOUT INTERNATIONAL OF NC, INC	HIGHWAY 74 EAST	MONROE	34.97892	-80.48863
	NCD986232213	SUMMIT RESOURCE MANAGEMENT	3501 GRIBBLE ROAD	STALLINGS	35.084853	-80.67906
	NONCD0002380	SUTTON PARK GROCERY	2701 WALKUP AVE	MONROE	34.99076	-80.50217
	NCD070619911	TELEDYNE ALLVAC MONROE PLANT	2020 ASHCRAFT AVE	MONROE	34.98416	-80.52142
	NCN000410585	UNIONVILLE-INDIAN TRAIL DRUM	RIDGE RD & UNIONVILLE-INDIAN	MONROE	35.08466	-80.56523
ANSON						
	NONCD0001046	B&H RECYCLERS	7256 US 74 W	POLKTON	35.002976	-80.195971
	NONCD0001187	COFFING HOISTS	2020 COUNTRY CLUB RD	WADESBORO	34.943908	-80.052539
	NONCD0001544	COOKSON FIBERS	HIGHWAY 52 NORTH	ANSONVILLE	35.11995	-80.10484
	NONCD0001142	FLYNT/WANSONA	ONE WANSONA PLACE	WADESBORO	34.97586	-80.06973
	NONCD0001779	GLENN MANUFACTURING/DECORATIVE HOME ACCE	HWY 52 & RATLIFF GIN ROAD	MORVEN	34.85387	-79.99573
	NCSFN0406924	VC CHEMICAL	STANBACK FERRY RD	WADESBORO	34.97277778	-80.05722222

STANLY						
	NONCD0001238	ALBEMARLE CITY HALL EXPANSION	144 NORTH SECOND STREET	ALBEMARLE	35.351184	-80.197922
	NONCD0001094	ALLISON MANUFACTURING CO	930 OLD CHARLOTTE ROAD	ALBEMARLE	35.34555556	-80.20583333
	NONCD0001287	AREY/TAYLOR WELLS	24459 HIGHWAY 52	ALBEMARLE	35.323722	-80.17904
	NONCD0001319	BAREFOOT-CAROLINA OIL	850 SOUTH SECOND STREET	ALBEMARLE	35.343	-80.19747
	NONCD0001388	BROOKWOOD INDUSTRIAL	CHARTER ROAD		35.35084	-80.15486
	NONCD0000053	CAROLINA MARBLE CO.	INDIAN MOUND ROAD	ALBEMARLE	35.27852	-80.11719
	NONCD0001536	CONCORD TELEPHONE	250 N 1ST ST	ALBEMARLE	35.354083	-80.198844
	NONCD0002936	CONCRETE SUPPLY COMPANY	115 AQUADALE DR	ALBERMARLE	35.34104	-80.19877
	NONCD0001120	EATON AEROQUIP, INC (FORMER)	680 LANIER RD	NORWOOD	35.214214	-80.109087
	NONCD0001137	FABCO FASTENING SYSTEMS/DIXIE YARNS	614 NC HWY 200 S	STANFIELD	35.22425	-80.41403
	NONCD0002242	FLAME REFRACTORIES, INC	152 AMERICAN DR	OAKBORO	35.21529	-80.31617
	NONCD0001888	HYDROLABS, INC. (ALLIED COLLOIDS)	2028 KINGSLEY DRIVE	ALBEMARLE	35.352164	-80.220142
	NONCD0001955	KIKER HOSIERY	BROWNS HILL RD	LOCUST	35.24401	-80.45801
	NONCD0002018	LOVE LUMBER COMPANY #3	301 WEST STANLY STREET	STANFIELD	35.232686	-80.428558
	NONCD0002026	MAIN STREET SOLVENT SITE	WEST MAIN STREET	LOCUST	35.25452	-80.44151
	NONCD0002098	MORGAN MILLS (DAWSON PLANT #6)	200 HWY 24/27	ALBEMARLE	35.340296	-80.201393
	NONCD0002100	MORTON RESIDENCE	HWY 200, S OF STANFIELD	STANFIELD	35.194361	-80.399208
	NONCD0002358	RACHEL PITTMAN RESIDENCE	OLD SALISBURY RD	ALBEMARLE	35.378896	-80.2163
	NONCD0002812	RANDALLS FERRY RD SUPPLY WELLS	17586 RANDALLS FERRY RD	NORWOOD	35.26181	-80.10104
	NONCD0002384	REEVES BROTHERS, INC.	1135 MONTGOMERY AVE	ALBEMARLE	35.35589	-80.1814
	NONCD0000001	STANLY NEWS & PRESS	237 W NORTH STREET	ALBEMARLE	35.352155	-80.200239
	NONCD0002651	UNITED SCREEN PRINTERS, INC.	BROWNS HILL ROAD	LOCUST	35.245061	-80.457304
	NONCD0002749	WISCASSETT MILLS	233 MONTGOMERY AVENUE	ALBEMARLE	35.356646	-80.195898
	NONCD0002770	YADKIN BRICK COMPANY	44052 YADKIN BRICK ROAD	NEW LONDON	35.4502	-80.156382
Table 2.		**Pre -Regualtory Landfill Inventory**				
ANSON	Site ID	Site Name		City	State Plane (meters)	
	NONCD0000119	BRONSON SAND & GRAVEL LANDFILL		LILESVILLE	524388	135
	NONCD0000116	MORVEN DUMP		MORVEN	514351	126
	NONCD0000118	PEACHLAND DUMP		PEACHLAND	492874	140
	NONCD0000115	POLKTON DUMP		POLKTON	498976	142
	NONCD0000772	W R BONSAL #1		LILESVILLE	523567	132
	NONCD0000774	W R BONSAL #2		LILESVILLE	523655	131
	NONCD0000117	WADESBORO LANDFILL		WADESBORO	510664	136
STANLY						
	NONCD0000571	ALBEMARLE DUMP		ALBEMARLE	497189	182
	NONCD0000568	AQUADALE DUMP		AQUADALE	495530	162

	NONCD0000751	CITY OF ALBEMARLE DUMP		ALBEMARLE	499167	176
	NONCD0000570	NORWOOD DUMP		NORWOOD	508364	161
	NONCD0000569	OAKBORO DUMP		OAKBORO	485344	165
	NONCD0000566	RICHFIELD DUMP		RICHFIELD	494369	191
	NONCD0000567	STANFIELD DUMP		STANFIELD		
UNION						
	NONCD0000600	MARSHVILLE DUMP		MARSHEVILLE	486481	136
	NONCD0000599	MONROE LANDFILL		MONROE	471262	138
	NCD980503163	UNION COUNTY LF		MONROE	476308	143
	NONCD0000598	WAXHAW DUMP		WAXHAW	448282	129
Table 3		**DSCA Sites**				
	Site ID	Site Name	Site Address	City	Lat	Long
STANLY						
	DC840001	DRY CLEAN EXPRESS	636 E Highway 24/27 Byp	Albemarle	35.34183884	-80.17272
	DC840002	GARMENT CARE CENTER	560 Fork Road	Norwood	35.21665955	-80.11107

NCDENR

North Carolina Department of Environment and Natural Resources
Division of Parks and Recreation

Pat McCrory, Governor | Lewis R. Ledford, Director | John E. Skvarla, III, Secretary

December 9, 2013

MEMORANDUM

To: Lyn Hardison, DENR Environmental Assistance and SEPA Coordinator

From: Justin Williamson, DENR, Division of Parks and Recreation

SUBJECT: Project # 14-0212. Scoping/Start of Study - Interbasin Transfer Certificate for the Yadkin Water Supply Project.

The North Carolina Division of Parks and Recreation (DPR) has reviewed the project area using available Geographic Information System (GIS) data of the proposed Yadkin River Water Supply Project. DPR biologists have indicated potential impacts to the State Park system. However, the current maps and descriptions associated with this project are not sufficient enough for DPR to make comments at this time. DPR is requesting more detailed maps and descriptions of the proposed alternative areas.

Please contact me if you have questions.

Sincerely,

Justin Williamson
Land Protection Specialist, GIS
Division of Parks and Recreation
North Carolina Department of Environment and Natural Resources
(919) 707-9328 / Justin.Williamson@ncparks.gov

Department of Environment and Natural Resources
Project Review Form

Project Number: 14-0212 **County: Union** **Date Received: 11/25/2013**

Due Date: 12/18/2013

Project Description: Environmental Review - Proposed project is for interbasin transfer certificate for the Yadkin River Water Supply project.

Scoping Review

This Project is being reviewed as indicated below:

Regional Office	Regional Office Area	In-House Review	
___ Asheville	✓ Air [illegible] 12/16/2013	___ Air Quality	___ Coastal Management
___ Fayetteville	✓ DWR-Surface Water	✓ Parks & Recreation	✓ DCM-Marine Fisheries
✓ Mooresville	✓ DWR-Aquifer AHP 12.13.13	✓ Waste Mgmt	___ Military Affairs
___ Raleigh	✓ DEMLR (LQ & SW) [illegible] 12/17/13	✓ Water Resources Mgmt	___ DMF-Shellfish Sanitation
___ Washington	✓ UST RAT 12/17/13	✓ DWR-Public Water	✓ Wildlife Shari Bryant
___ Wilmington	✓ DWR-Public Water BLS 12/17/13	✓ DWR-Water Quality Program	___ Wildlife - DOT
___ Winston-Salem		___ DWR-Transportation Unit	

Manager Sign-Off/Region:	Date:	In-House Reviewer/Agency:
Angela W Edwards	12/17/13	

Response (check all applicable)

___ No objection to project as proposed. ___ No Comment

___ Insufficient information to complete review ✓ Other (specify or attach comments)

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MOORESVILLE REGIONAL OFFICE

If you have any questions, please contact:
Lyn Hardison at lyn.hardison@ncdenr.gov or (252) 948-3842
943 Washington Square Mall Washington NC 27889
Courier No. 16-04-01

State of North Carolina
Department of Environment and Natural Resources

Reviewing Office: **Mooresville Regional Office**

INTERGOVERNMENTAL REVIEW - PROJECT COMMENTS

Project Number: 14-0212 Due Date: 12/18/2013

After review of this project it has been determined that the ENR permit(s) and/or approvals indicated may need to be obtained in order for this project to comply with North Carolina Law. Questions regarding these permits should be addressed to the Regional Office indicated on the reverse of the form. All applications, information and guidelines relative to these plans and permits are available from the same Regional Office.

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐	Permit to construct & operate wastewater treatment facilities, sewer system extensions & sewer systems not discharging into state surface waters.	Application 90 days before begin construction or award of construction contracts. On-site inspection. Post-application technical conference usual.	30 days (90 days)
☐	NPDES - permit to discharge into surface water and/or permit to operate and construct wastewater facilities discharging into state surface waters.	Application 180 days before begin activity. On-site inspection. Pre-application conference usual. Additionally, obtain permit to construct wastewater treatment facility-granted after NPDES. Reply time, 30 days after receipt of plans or issue of NPDES permit-whichever is later.	90-120 days (N/A)
☐	Water Use Permit	Pre-application technical conference usually necessary	30 days (N/A)
☐	Well Construction Permit	Complete application must be received and permit issued prior to the installation of a well.	7 days (15 days)
☐	Dredge and Fill Permit	Application copy must be served on each adjacent riparian property owner. On-site inspection. Pre-application conference usual. Filling may require Easement to Fill from N.C. Department of Administration and Federal Dredge and Fill Permit.	55 days (90 days)
☐	Permit to construct & operate Air Pollution Abatement facilities and/or Emission Sources as per 15 A NCAC (2Q.0100 thru 2Q.0300)	Application must be submitted and permit received prior to construction and operation of the source. If a permit is required in an area without local zoning, then there are additional requirements and timelines (2Q.0113).	90 days
☐	Permit to construct & operate Transportation Facility as per 15 A NCAC (2D.0800, 2Q.0601)	Application must be submitted at least 90 days prior to construction or modification of the source.	90 days
☑	Any open burning associated with subject proposal must be in compliance with 15 A NCAC 2D.1900	N/A	60 days (90 days)
☐	Demolition or renovations of structures containing asbestos material must be in compliance with 15 A NCAC 20.1110 (a) (1) which requires notification and removal prior to demolition. Contact Asbestos Control Group 919-707-5950.		
☐	Complex Source Permit required under 15 A NCAC 2D.0800		
☑	The Sedimentation Pollution Control Act of 1973 must be properly addressed for any land disturbing activity. An erosion & sedimentation control plan will be required if one or more acres to be disturbed. Plan filed with proper Regional Office (Land Quality Section) At least 30 days before beginning activity. A fee of $65 for the first acre or any part of an acre. An express review option is available with additional fees.		20 days (30 days)
☐	Sedimentation and erosion control must be addressed in accordance with NCDOT's approved program. Particular attention should be given to design and installation of appropriate perimeter sediment trapping devices as well as stable stormwater conveyances and outlets.		(30 days)
☐	Mining Permit	On-site inspection usual. Surety bond filed with ENR Bond amount varies with type mine and number of acres of affected land. Any are mined greater than one acre must be permitted. The appropriate bond must be received before the permit can be issued.	30 days (60 days)
☐	North Carolina Burning permit	On-site inspection by N.C. Division Forest Resources if permit exceeds 4 days	1 day (N/A)
☐	Special Ground Clearance Burning Permit - 22 counties in coastal N.C. with organic soils	On-site inspection by N.C. Division Forest Resources required "if more than five acres of ground clearing activities are involved. Inspections should be requested at least ten days before actual burn is planned."	1 day (N/A)
☐	Oil Refining Facilities	N/A	90-120 days (N/A)
☐	Dam Safety Permit	If permit required, application 60 days before begin construction. Applicant must hire N.C. qualified engineer to: prepare plans, inspect construction, certify construction is according to ENR approved plans. May also require permit under mosquito control program. And a 404 permit from Corps of Engineers. An inspection of site is necessary to verify Hazard Classification. A minimum fee of $200.00 must accompany the application. An additional processing fee based on a percentage or the total project cost will be required upon completion.	30 days (60 days)

~~Intergovernmental form September 2013~~

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐	Permit to drill exploratory oil or gas well	File surety bond of $5,000 with ENR running to State of NC conditional that any well opened by drill operator shall, upon abandonment, be plugged according to ENR rules and regulations.	10 days N/A
☐	Geophysical Exploration Permit	Application filed with ENR at least 10 days prior to issue of permit. Application by letter. No standard application form.	10 days N/A
☐	State Lakes Construction Permit	Application fee is charged based on structure size. Must include descriptions & drawings of structure & proof of ownership of riparian property.	15-20 days N/A
☐	401 Water Quality Certification	N/A	60 days (130 days)
☐	CAMA Permit for MAJOR development	$250.00 fee must accompany application	55 days (150 days)
☐	CAMA Permit for MINOR development	$50.00 fee must accompany application	22 days (25 days)
☐	Several geodetic monuments are located in or near the project area. If any monument needs to be moved or destroyed, please notify: N.C. Geodetic Survey, Box 27687 Raleigh, NC 27611		
☐	Abandonment of any wells, if required must be in accordance with Title 15A. Subchapter 2C.0100.		
☒	Notification of the proper regional office is requested if "orphan" underground storage tanks (USTS) are discovered during any excavation operation.		
☐	Compliance with 15A NCAC 2H 1000 (Coastal Stormwater Rules) is required.		45 days (N/A)
☐	Tar Pamlico or Neuse Riparian Buffer Rules required.		
☑	Plans and specifications for the construction, expansion, or alteration of a public water system must be approved by the Division of Water Resources/Public Water Supply Section prior to the award of a contract or the initiation of construction as per 15A NCAC 18C .0300 et. seq. Plans and specifications should be submitted to 1634 Mail Service Center, Raleigh, North Carolina 27699-1634. All public water supply systems must comply with state and federal drinking water monitoring requirements. For more information, contact the Public Water Supply Section, (919) 707-9100.		30 days
☐	If existing water lines will be relocated during the construction, plans for the water line relocation must be submitted to the Division of Water Resources/Public Water Supply Section at 1634 Mail Service Center, Raleigh, North Carolina 27699-1634. For more information, contact the Public Water Supply Section, (919) 707-9100.		30 days

* Other comments (attach additional pages as necessary, being certain to cite comment authority)

UST see attached comments 12/5/13
DAQ - follow open burning rules for land clearing. 12/16/2013
DEMLR: E & S Control Permit required for Land Disturbance of 1 acre or More.
Storm Water Permit required for Treatment Plant. Zahid S. Khan 12/17/13
DWR-PWSS - Any intake location must have WS I, II, III or IV designation
And approval by PWS Section for intake location.

REGIONAL OFFICES

Questions regarding these permits should be addressed to the Regional Office marked below.

☐ **Asheville Regional Office**
2090 US Highway 70
Swannanoa, NC 28778
(828) 296-4500

☒ **Mooresville Regional Office**
610 East Center Avenue, Suite 301
Mooresville, NC 28115
(704) 663-1699

☐ **Wilmington Regional Office**
127 Cardinal Drive Extension
Wilmington, NC 28405
(910) 796-7215

☐ **Fayetteville Regional Office**
225 North Green Street, Suite 714
Fayetteville, NC 28301-5043
(910) 433-3300

☐ **Raleigh Regional Office**
3800 Barrett Drive, Suite 101
Raleigh, NC 27609
(919) 791-4200

☐ **Winston-Salem Regional Office**
585 Waughtown Street
Winston-Salem, NC 27107
(336) 771-5000

☐ **Washington Regional Office**
943 Washington Square Mall
Washington, NC 27889
(252) 946-6481

NCDENR

North Carolina Department of Environment and Natural Resources

Division of Waste Management

Pat McCrory Governor	Dexter R. Matthews Director	John E. Skvarla, III Secretary

TO: Lyn Hardison, Environmental Coordinator

FROM: Ron Taraban, Regional UST Supervisor

DATE: December 4, 2013

RE: Project Review Form: 14-0212

I have read the Notice of Scoping report for the proposed interbasin transfer for the Yadkin River Water Supply Project in Union County. Due to the number of proposed alternatives, it is possible for unknown USTs to be in or near the proposed pathway. The following comments are pertinent to my review:

1. The Mooresville Regional Office (MRO) UST Section recommends removal of any abandoned or out-of-use petroleum USTs or petroleum above ground storage tanks (ASTs) within the project area. The UST Section should be contacted regarding use of any proposed or on-site petroleum USTs or ASTs. We may be reached at 704-663-1699.

2. Any petroleum spills must be contained and the area of impact must be properly restored. Petroleum spills of significant quantity must be reported to the North Carolina Department of Environment & Natural Resources – Division of Waste Management Underground Storage Tank Section in the Mooresville Regional Office at 704-663-1699.

3. Any soils excavated during demolition or construction that show evidence of petroleum contamination, such as stained soil, odors, or free product must be reported immediately to the local Fire Marshall to determine whether explosion or inhalation hazards exist. Also, notify the UST Section of the Mooresville Regional Office at 704-663-1699. Petroleum contaminated soils must be handled in accordance with all applicable regulations.

If you have any questions or need additional information, please contact me at Ron.Taraban@ncdenr.gov or by phone at 704-235-2167.

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Water Resources
Water Quality Programs

Pat McCrory
Governor

Thomas A. Reeder
Director

John E. Skvarla, III
Secretary

December 18, 2013

MEMORANDUM

TO: Lyn Hardison, Environmental Assistance Coordinator
Department of Environment and Natural Resources

FROM: Harold M. Brady, SEPA Review Coordinator

SUBJECT: Scoping - Proposal for Interbasin Transfer Certificate from the Yadkin River to the Rocky River.
DENR#14-0212

Thank you for providing the Division of Water Resources (DWR) an opportunity to provide comments regarding a proposed interbasin transfer certificate from Yadkin River to the Rocky River.

DWR has no objection to the proposed project, but offer the following comments from Dennis Ramsey of the Water Supply Planning Branch and Andrew Pitner of the DWR Mooresville Regional Office:

1. Although it is not apparent in the Scoping document, various combinations of the proposed alternatives should be evaluated in order to provide the best solution. One area that needs additional attention is the volume of unaccounted-for losses from the Union County Water System. In the 2012 Local Water Supply Plan that was submitted, the loss in 2012 was reported as 1.412 MGD or 13% of the Total Demand. If this % loss is not reduced, based on the Total Demand for 2060 as shown in the 2012 Plan (40.340 MGD), the volume of unaccounted-for water in 2060 could be as high as 5.240 MGD. This should be addressed in Alternative 9, Demand management/conservation. While this obviously would not result in sufficient savings to meet the future needs, it could result in a reduction in the volume of the needed IBT.

2. Please be aware that due to recent changes in statute, proposed IBT volumes should be calculated as the daily average of a calendar month.

3. In general, it is likely that water transmission lines, water treatment plant construction, groundwater withdrawal, water reuse, and the evaluation of wastewater returns all noted in the proposed alternatives may necessitate a wide variety of permitting interactions that may mean applying for new or modifying existing permits with the Division of Water Resources.

If you have any questions about this comment, please contact me at (919) 707-9005 or harold.m.brady@ncdenr.gov. Thank you.

1617 Mail Service Center, Raleigh, North Carolina 27699-1617
Location: 512 N. Salisbury St. Raleigh, North Carolina 27604
Phone: 919-807-6300 \ Fax: 919-807-6492
Internet:: www.ncwaterquality.org

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: UNION

H01: WATER SUPPLY SYSTEMS

STATE NUMBER: 14-E-0000-0212
DATE RECEIVED: 11/21/2013
AGENCY RESPONSE: 12/18/2013
REVIEW CLOSED: 12/23/2013

MS CAROLYN PENNY
CLEARINGHOUSE COORDINATOR
CC&PS - DIV OF EMERGENCY MANAGEMENT
FLOODPLAIN MANAGEMENT PROGRAM
MSC # 4719
RALEIGH NC

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DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION

PROJECT INFORMATION

APPLICANT: Union County
TYPE: State Environmental Policy Act
Environmental Review

DESC: Proposed project is for interbasin transfer certificate for the Yadkin River Water Supply project.

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: [x] NO COMMENT [ ] COMMENTS ATTACHED

SIGNED BY: David Herling DATE: 12/5/13

Not in SFHA.

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NC Floodplain Mapping Program

Reuben Crummy

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: UNION

H01: WATER SUPPLY SYSTEMS

STATE NUMBER: 14-E-0000-0212
DATE RECEIVED: 11/21/2013
AGENCY RESPONSE: 12/18/2013
REVIEW CLOSED: 12/23/2013

DEC 2013 RECEIVED Secretary's Office DOA

DEC 2013

MS CARRIE ATKINSON
CLEARINGHOUSE COORDINATOR
DEPT OF TRANSPORTATION
STATEWIDE PLANNING - MSC #1554
RALEIGH NC

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DEPT OF CULTURAL RESOURCES
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If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☐ NO COMMENT ☑ COMMENTS ATTACHED

SIGNED BY: Reuben C Summy DATE: 12-9-13

PAT MCCRORY
GOVERNOR

ANTHONY J. TATA
SECRETARY

December 9, 2013

DEC 2013 RECEIVED Secretary's Office DOA

MEMORANDUM

SUBJECT: Clearinghouse 14-E-0000-0212
Water Supply Project in Union County

FROM: Mr. Reuben Crummy RQC
Planning Engineer
Transportation Planning Branch

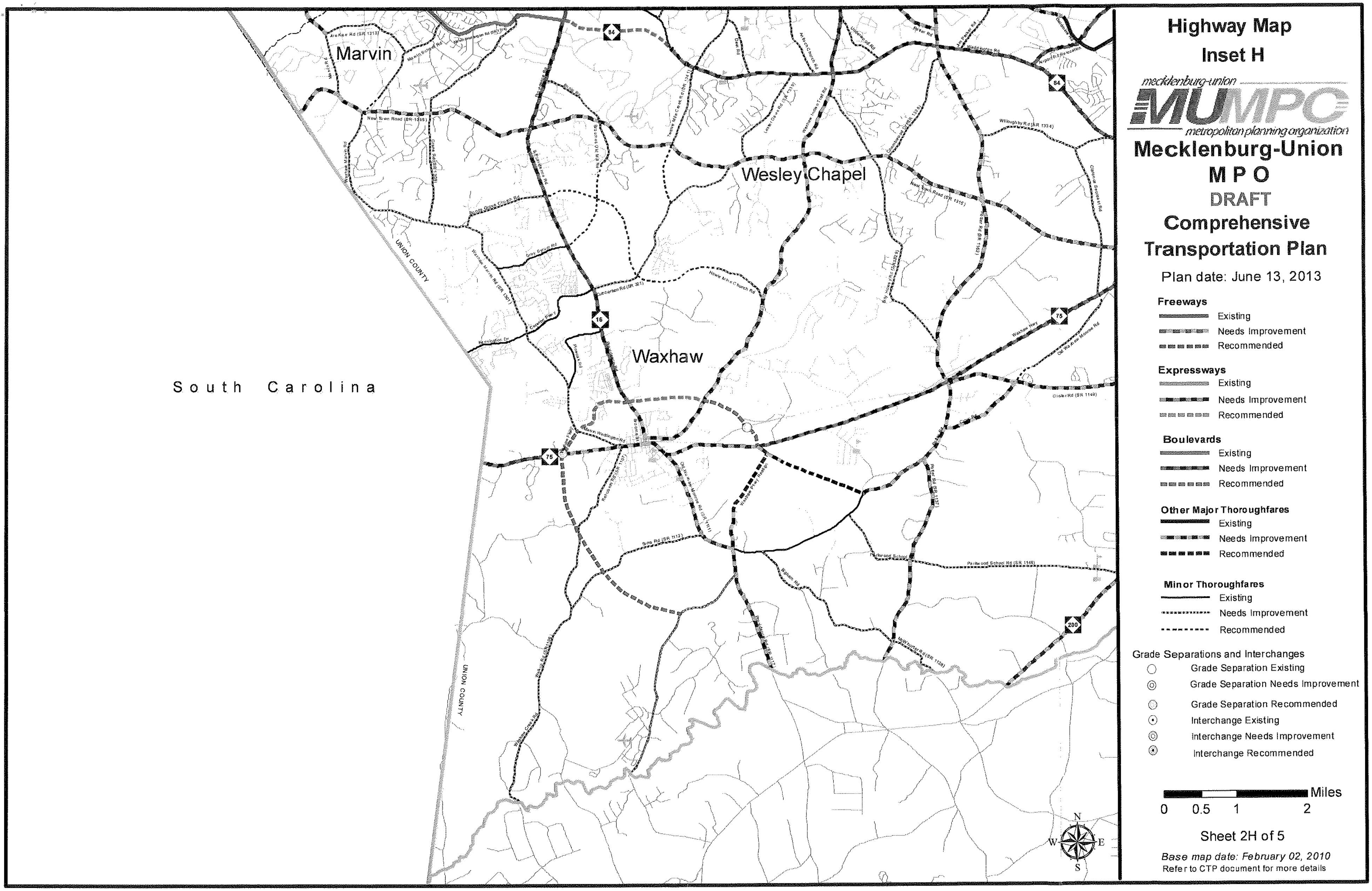
The Clearinghouse project referenced above proposed project is for the interbasin certificate for the Yadkin River Water Supply project.

Please note that both the Draft 2013 CRTPO (former name: MUMPO – Charlotte Regional Transportation Planning Organization) and the 2010 Union County CTP (Rural) recommend improvements along both borders: NC 200, NC 522, NC 207, South Potter Road (SR 1137), Griffith Road (SR 2139), Plyler Mill Road (SR 2164), Stack Road (SR 2115), Austin Road (SR 2156), and the proposed Southern Connector I. Any design improvements along these intersections and/or within the vicinity of this area should take those recommendations into account and be coordinated with the NCDOT Division 10 Office in Albemarle, NC and the Division 12 Office in Shelby, NC.

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING BRANCH
1554 MAIL SERVICE CENTER
RALEIGH NC 27699-1554

NCDOT TPB TRANSPORTATION PLANNING BRANCH
https://connect.ncdot.gov/projects/planning/

LOCATION:
TRANSPORTATION BUILDING
1 SOUTH WILMINGTON STREET
RALEIGH, NC 27601
Phone: 919-707-0900
Fax: 919-733-9794


Highway Map
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Transportation Plan
Plan date: June 13, 2013
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Miles
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Sheet 2H of 5
Base map date: February 02, 2010
Refer to CTP document for more details
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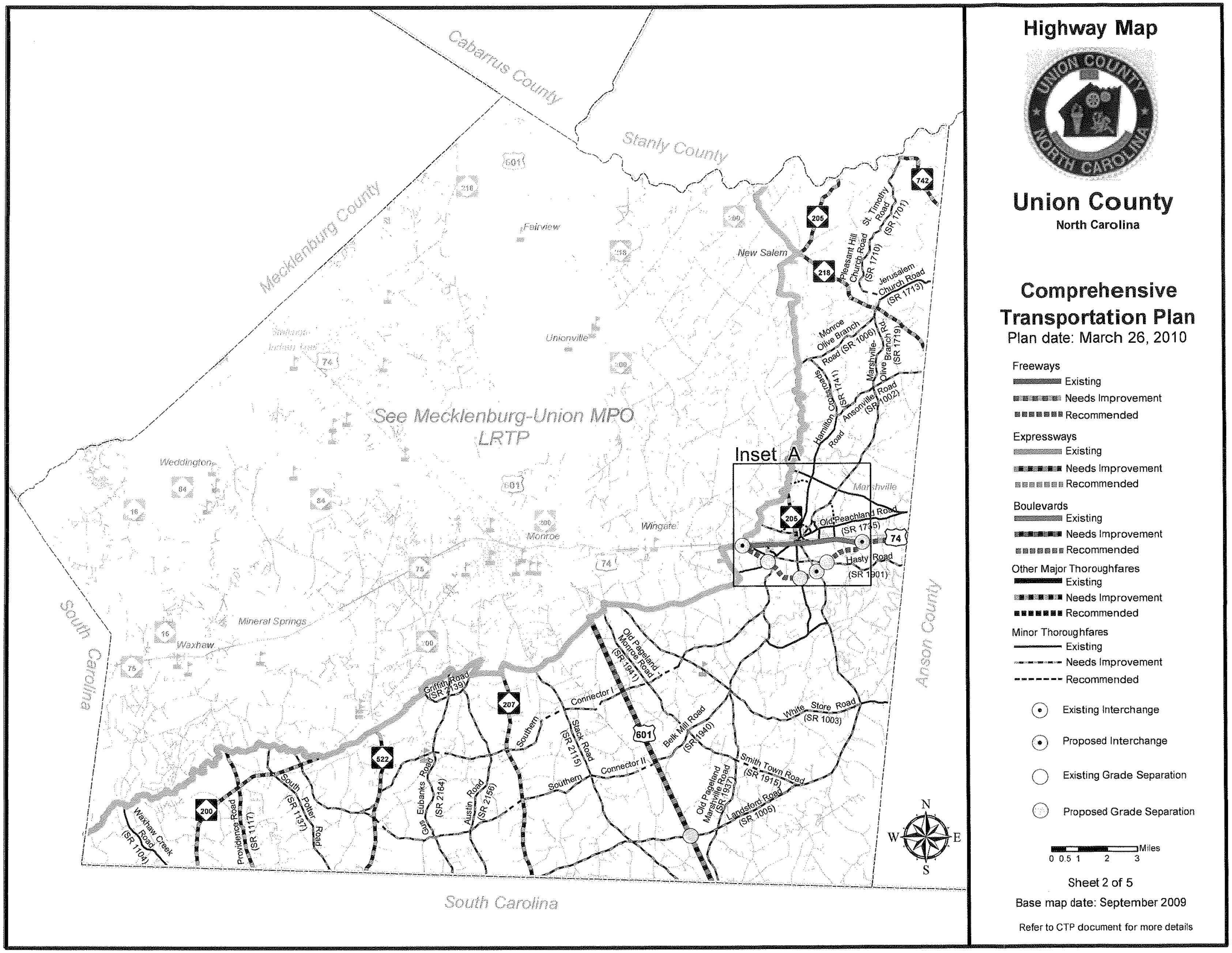
Highway Map
Union County
North Carolina
Comprehensive Transportation Plan
Plan date: March 26, 2010
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Cabarrus County
Stanly County
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Inset A
Fairview
New Salem
Unionville
Weddington
Monroe
Wingate
Marshville
Mineral Springs
Waxhaw
St Timothy Road (SR 1701)
Pleasant Hill Church Road (SR 1710)
Jerusalem Church Road (SR 1713)
Monroe Olive Branch Road (SR 1006)
Marshville-Olive Branch Rd. (SR 1719)
Hamilton Crossroads Road (SR 1741)
Ansonville Road (SR 1002)
Old Peachland Road (SR 1735)
Hasty Road (SR 1901)
Old Pageland Monroe Road (SR 1941)
Griffith Road (SR 2139)
Connector I
Connector II
Southern
Stack Road (SR 2115)
Belk Mill Road (SR 1940)
White Store Road (SR 1003)
Smith Town Road (SR 1915)
Old Pageland Marshville Road (SR 1937)
Landsford Road (SR 1005)
Gus Eubanks Road (SR 2164)
Austin Road (SR 2156)
South Potter Road (SR 1137)
Providence Road (SR 1117)
Waxhaw Creek Road (SR 1104)
N
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W

North Carolina
Department of Administration

Pat McCrory, Governor | Bill Daughtridge, Jr., Secretary

December 30, 2013

Mr. Kevin Mosteller
Union County
c/o HDR Engineering, Inc.
440 S. Church Street, Suite 1000
Charlotte, North Carolina 28202-2075

Re: SCH File # 14-E-0000-0212; SCOPING; Proposed project is for interbasin transfer certificate for the Yadkin River Water Supply project.

Dear Mr. Mosteller:

The above referenced environmental impact information has been reviewed through the State Clearinghouse under the provisions of the North Carolina Environmental Policy Act.

Attached to this letter are **additional comments** made in the review of this document. The appropriate document should be forwarded to the State Clearinghouse for compliance with State Environmental Policy Act. Should you have any questions, please do not hesitate to call me at (919) 807-2425.

Sincerely,

Crystal Best
State Environmental Review Clearinghouse

Attachments

cc: Region F

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail state.clearinghouse@doa.nc.gov

Location Address:
116 West Jones Street
Raleigh, North Carolina

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: UNION

H01: WATER SUPPLY SYSTEMS

STATE NUMBER: 14-E-0000-0212
DATE RECEIVED: 11/21/2013
AGENCY RESPONSE: 12/18/2013
REVIEW CLOSED: 12/23/2013

MS RENEE GLEDHILL-EARLEY
CLEARINGHOUSE COORDINATOR
DEPT OF CULTURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
MSC 4617 - ARCHIVES BUILDING
RALEIGH NC

ER 13-2841

REVIEW DISTRIBUTION

CC&PS - DIV OF EMERGENCY MANAGEMENT
CENTRALINA COG
DENR LEGISLATIVE AFFAIRS
DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION

Due 12/6/13 A- 7m 12/9/13

PROJECT INFORMATION

APPLICANT: Union County
TYPE: State Environmental Policy Act
Environmental Review

Due ~~12/18/13~~ 12/20/13 $ H RHE 12/18/13

DESC: Proposed project is for interbasin transfer certificate for the Yadkin River Water Supply project.

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☐ NO COMMENT ☒ COMMENTS ATTACHED

SIGNED BY: Renee Gledhill-Earley DATE: 12-19-13

North Carolina Department of Cultural Resources
State Historic Preservation Office
Ramona M. Bartos, Administrator

Governor Pat McCrory
Secretary Susan Kluttz

Office of Archives and History
Deputy Secretary Kevin Cherry

December 20, 2013

MEMORANDUM

TO: Crystal Best
North Carolina State Clearinghosue
Department of Administration

FROM: Ramona M. Bartos RGE for Ramona M. Bartos

SUBJECT: Yadkin River Water Supply Project, Interbasin Transfer, Union County, ER 13-2841

Thank you for your submission of November 21, 2013, transmitting the above referenced information. Based on the large and diverse aerial footprint of the proposed project, we will await the narrowing down of alternatives before offering comments about historic/cultural resources.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or renee.gledhill-earley@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Location: 109 East Jones Street, Raleigh NC 27601 **Mailing Address:** 4617 Mail Service Center, Raleigh NC 27699-4617 **Telephone/Fax:** (919) 807-6570/807-6599

North Carolina Department of Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Pat McCrory
Secretary Susan Kluttz

Office of Archives and History
Deputy Secretary Kevin Cherry

February 12, 2015

Vickie M. Miller
HDR, Inc.
3733 National Drive, Suite 207
Raleigh, NC 27612-4845

vickie.miller@hdrinc.com

Re: Yadkin River Water Supply Project, Interbasin Transfer, Union County, ER 13-2841

Dear Ms. Miller:

Thank you for your email of December 3, 2014, concerning the above-referenced undertaking. We have reviewed the materials submitted and offer the following comments.

As we stated in our letter of December 20, 2013, we will await the selection of the preferred alternative before we issue our comments detailing the need for an archaeological investigation. However, based on the additional information provided, it is extremely unlikely that our office will request an archaeological survey if the chosen alternative is confined to existing, previously disturbed right-of-way.

We understand you are considering numerous alternatives for the installation of water lines and water treatment plants. These alternatives are included below with our comments.

Alternatives 1A and B: These alternatives have the potential to adversely affect the State Study-listed **Norwood Commercial Historic District** (ST0531), which is considered eligible for listing in the National Register of Historic Places (NRHP). However, if the undertaking occurs wholly within existing DOT or utility Right-of-Ways, it is unlikely the work will adversely affect the historic district.

Alternative 2A: Although the State Study-listed **Carter House** (ST0199), determined eligible for listing in the NRHP, is located in close proximity to the work proposed along Pumphouse Road, northwest of where it intersects with Old Whitney Farm Road, the undertaking will not adversely affect the property due to the distance and trees which separate the project area from the property.

Alternative 2B: This alternative has the potential to adversely affect the State Study-listed **C.V. Ritchie House** (ST0254) and **Culp Bungalow** (ST0209) which are considered eligible for listing in the NRHP. However, if the undertaking occurs wholly within existing DOT or utility Right-of-Ways, it is unlikely the work will adversely affect the properties located along South Main Street.

Alternative 3A: Because this alternative seeks to utilize gas and power line easements to minimize possible disturbance to private property it is unlikely the work would adversely affect any historic properties located within the project Area of Potential Effect (APE). However, additional information is required in order to appropriately determine possible effects this alternative may have on historic properties.

Alternative 3B: Although a portion of the project is located within view of the National Register-listed **Wadesboro Downtown Historic District** (AN0554), it will not adversely affect the historic district, if work is performed in existing Right-of-Ways along Caswell Street. We also feel, work performed along US Highway 74 will not adversely affect the **Polkton Historic District** (AN0575), which is determined eligible for listing in the NRHP, due to the distance separating the property from the project area.

Alternative 4: The work proposed along Dunlap Road will not affect the **Bridge** (AN----), determined eligible for listing in the NRHP, due to the distance separating the bridge from the project area.

Alternative 5: Although it does not appear this alternative will adversely affect historic properties, additional information is required to appropriately determine the possible effects this alternative may have on historic properties.

Alternatives 1, 2, 3A, 4 & 5: These alternatives will not adversely affect the State Study-listed **Marshall Baucom House and Store** (UN0025), which is considered eligible for listing in the NRHP, due to the distance that separates the property from the project area.

Alternative 6: This alternative has the potential to adversely affect the State Study-listed **Broom Cotton Gin** (UN0066). However, if the work is performed in existing DOT or utility Right-of-Ways it is unlikely to adversely affect the property.

Alternative 7: This alternative will not affect the **Long House** (UN0217), which is determined eligible for listing in the NRHP due to the distance separating the property from the project area. It is unlikely the undertaking will adversely affect the State Study-listed **Uriah Tilden Belk House** (UN0038) determined eligible for listing in the NRHP if work is performed within existing DOT and utility Right-of-Ways.

Alternative 8: This alternative will not affect the State Study-listed **James Austin House** (UN0012) and the **Reverend Joseph Bennett House** (UN0041) which are determined eligible for listing in the NRHP due to the distance separating the properties from the project area. As your map demonstrates, there is a question regarding the current existence of the Bennett House. It is unlikely the undertaking will adversely affect the State Study-listed **Faulks Baptist Church and Cemetery** (UN0117) determined eligible for listing in the NRHP if work is performed within existing DOT and utility Right-of-Ways.

Alternative 11: It is unlikely this alternative would adversely affect the **James B. Garrison Bridge** (ST0688), which is determined eligible for listing in the NRHP. However, additional information is required in order to appropriately determine the possible effects this alternative may have on historic properties.

We look forward to reviewing additional information once a project alternative has been decided.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

November 25, 2014

Mrs. Renee Gledhill-Earley, Environmental Review Coordinator
North Carolina Department of Cultural Resources
State Historic Preservation Office
4617 Mail Service Center
Raleigh, North Carolina 27699-4617

RE: Supplemental Scoping Information – Union County Yadkin River Water Supply Project – Interbasin Transfer Environmental Impact Statement – ER 13-2841

Dear Mrs. Gledhill-Earley,

Union County (County) has retained HDR Engineering, Inc. of the Carolinas (HDR) to prepare an Environmental Impact Statement (EIS), in accordance with the State Environmental Policy Act, for the interbasin transfer (IBT) certificate request for their proposed Yadkin River Water Supply Project (the Project). The purpose of this supplemental scoping information letter is to provide additional alternative information in order to gather relevant comments on historic and cultural resources related to the proposed action and incorporate them into the water supply alternatives evaluation and environmental analyses for the Project.

The previously circulated scoping letter dated November 8, 2013 included information on project background, purpose and need, project action, and area of impact. Since that time, additional information regarding alternative transmission route corridors has been developed and is provided below along with mapping. HDR also reviewed historic resources documented in the HPOWEB GIS Service database and has provided that information below and on the attached mapping in order to facilitate review and comments.

Proposed Alternatives

Twelve (12) proposed alternatives have been identified for evaluation in the EIS as noted in the original scoping letter. Of the 12 alternatives proposed, nine (Alternatives 1-8 and 11) have transmission line corridors associated with them, which are discussed below. There are also several water treatment facility sites (Sites A, B, C, and D) under consideration. These locations are described below and shown on the attached mapping.

Alternative 1: Yadkin River raw water supply from Lake Tillery (intra-basin IBT from Yadkin River Sub-basin to Rocky River Sub-basin) with a new water treatment plant in Union County

There are two proposed raw water transmission main alignments being evaluated for Alternative 1. Alternative 1A predominately utilizes roadway right-of-way corridors through Stanly County, into Union County. This alignment extends approximately 24 miles from the raw water pump station on Lake Tillery to the proposed North Union County Water Treatment Plant. Alternative 1B utilizes an existing power utility easement that extends northwestward out of Norwood and then southwestward through Oakboro. This alignment length is approximately 26 miles from the raw water pump station on Lake Tillery to the

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3733 National Drive Suite 207, Raleigh NC 27612
T 919.232.6600 **F** 919.785.1187

proposed North Union Water Treatment Plant. The proposed routes are reflected as Alternative 1A and 1B on the attached Figures.

Alternative 1A: The proposed route would begin in Stanly County at the proposed Raw Water Pump Station on the shores of Lake Tillery near the intersection of Allentown Street and Bayshore Drive in Norwood. The line would extend westward along Allenton Street and then briefly travel northward along Alberta Street. The alignment would travel westward to Story Street. The transmission main would turn southward onto Vincent Street, and then westward on Lily Street. The line would then turn southwestward onto East Whitley Street, following this road out of Norwood where it becomes Whitley Road, eventually merging with Mt Zion Church Road. The line would follow Mt Zion Church Road to Hardy Road, at which it would travel northwestward along Hardy Road until reaching Plank Road. At the Hardy Road intersection with Plank Road, the line would continue in a northwestward direction along Plank Road through Cottonville and then northward toward Aquadale. At the intersection of Plank Road and Rocky Springs Road, the alignment would turn westward and briefly follow Rocky River Springs Road, then cutting overland to NC-138. The line would follow NC-138 west toward Oakboro. At the intersection of NC-138 with Richard Sandy Road, just east of Oakboro, the line would briefly travel southward on Richard Sandy Road before turning southwest and traveling overland to American Drive. The line would continue along American Drive, crossing NC-742 and continuing along an existing service drive to Rocky River Road. The line would turn southward and follow Rocky River Road to Old Sandbar Road. The line would then briefly follow Old Sandbar Road westward to NC-205, at which point it would follow NC-205 south into Union County, while crossing the Rocky River. The line would continue southward along NC-205 to the proposed Site A for the North Union County Water Treatment Plant, located just north of New Salem, near Old Kennedy Fork Road.

Alternative 1B: The proposed route would begin in Stanly County at the proposed Raw Water Pump Station on the shores of Lake Tillery near the intersection of Allentown Street and Bayshore Drive in Norwood. The line would extend westward along Allenton Street and then briefly travel northward along Alberta Street. The alignment would travel westward to Story Street. The transmission main would turn southward onto Vincent Street, and then westward on Lily Street. The line would then turn southwestward onto East Whitley Street, following this road to the intersection of North Kendall Street. The alignment would follow North Kendal Street (eventually becoming Brickyard Road) northwestward to South Stanly School Road. The alignment would briefly follow an existing railroad right-of-way to a power utility easement belonging to Pee Dee Electric. The alignment would then follow this utility easement to the northwest to a point near NC 24/27. At this point, the alignment would follow the utility easement to the southwest into Oakboro. The transmission main would continue to follow the easement through Oakboro along 7th Street and then cut overland, near the site of an existing power sub-station, to NC-205. At this point the alignment would follow NC-205 south into Union County, while crossing the Rocky River. The line would continue southward along NC-205 to the proposed Site A for the North Union County Water Treatment Plant, located just north of New Salem, near Old Kennedy Fork Road.

Alternative 2: Yadkin River raw water supply from Tuckertown Reservoir (intra-basin IBT from Yadkin River Sub-Basin to Rocky River Sub-Basin) with a new water treatment plant in Union County

Alternative 2A: The 2A proposed 35-mile route would begin in Stanly County at the City of Albemarle's existing intake on the shores of Badin Lake and would travel along the same corridor as Albemarle's existing raw water line from Badin Lake to their US-52 Water Treatment Plant, before being directed through Stanly County and into Union County to a proposed new water treatment plant location. The existing City of Albemarle intake site is located at the end of Pumphouse Road northwest of New London. The proposed Union County raw transmission main would follow the path of Albemarle's raw water line easement, which roughly follows Old Whitney Road southwest to Mountain Creek Road, and continues southwest to Airport Road. At Airport Road, the proposed alignment turns west and travels to US-52, near the City of Albemarle's US-52 Water Treatment Plant.

From the existing water treatment plant, the Union County raw water line would continue turn westward, cross US-52 and follow Bethany Road to Old Salisbury Road where it would then turn southward and travel along Old Salisbury Road to Mann Road. At this intersection, the line would briefly travel westward on Mann Road before turning southward onto Charlie Road to extend to Pennington Road. The line would follow Pennington Road (eventually becoming Laurel Street) south to the intersection with Concord Road (NC-73). The line would follow NC-73 southeast to Church Street in Albemarle and turn southward to West Main Street. The alignment would follow West Main Street southwestward to St. Martin Road (NC-1963). The line would then follow St. Martin Road south into Oakboro, where the road becomes East First Street. The line would continue to follow East First Street to the intersection of South Main Street (NC-742), where it would then cross South Main Street and briefly follow Railroad Street westward to West Second Street (NC-205). The line would then travel south along NC-205 to the Union County line where it would cross the Rocky River. The line would continue south along NC-205 in Union County to the proposed Site A for the North Union County Water Treatment Plant, located just north of New Salem, near Old Kennedy Fork Road.

Alternative 2B: The approximately 35-mile proposed 2B alternative would begin at the northernmost part of Stanly County at the site of the City of Albemarle's existing intake and Tuckertown Water Treatment Plant. This site is located near the intersection of NC-49 and NC-8 northeast of Richfield. The line would extend south along NC-8 and then follow US-52 south once NC-8 merges with US-52 in New London. The line would extend south along US-52 to the north side of the City of Albemarle and the existing City of Albemarle US-52 Water Treatment Plant and then follow the same alignment as described for Alternative 2A above.

Alternative 3: Yadkin River raw water supply from Blewett Falls Lake (intra-basin IBT from Yadkin River Sub-Basin to Rocky River Sub-Basin) with a new water treatment plant in Union County

Two options for the proposed transmission main route are considered for this alternative. One proposed route (Alternative 3A) parallels gas and power line easements in Anson County, while a second proposed route (Alternative 3B) parallels existing roadways to minimize easements.

Alternative 3A: This proposed alignment extends approximately 29 miles from the raw water pump station on Blewett Falls Lake to the proposed North Union County Water Treatment Plant. The proposed route for Alternative 3A seeks to utilize existing gas and power line easements in Anson County to minimize disturbances to private property and major traffic corridors. This alternative would begin in Anson County at the site of the existing Anson County raw water intake on the shores of Blewett Falls Lake at the end of Filtration Plant Road, northeast of Lilesville. The line would extend westward along Filtration Plant Road and then briefly travel southward along Clark Mountain Road, where would the turn westward onto a Duke Energy Progress power line easement and adjacent gas line easement. The line would continue to follow these easements in a northwest direction through Anson County, crossing NC109, US-52, and NC-742 near the northeastern corner of Union County. At Pine Log, Road, the alignment would turn westward and cross overland, crossing Bonnie Ross Road to Fish Road, where it would then continue westward along Fish Road. The alignment would continue along Fish Road towards New Salem. Just north of the intersection of NC-205 and NC-218 in New Salem, the main would briefly travel overland to NC 205 and Old Kennedy Ford Road to the proposed Site A for the North Union County Water Treatment Plant.

Alternative 3B: This proposed alignment extends approximately 30 miles beginning in Anson County at the site of the existing Anson County raw water intake on the shores of Blewett Falls Lake at the end of Filtration Plant Road, northeast of Lilesville. The proposed line would extend westward along Filtration

Plant Road and then travel southward along Clark Mountain Road to the intersection with Vintage Road. At this intersection, the line would travel west along Vintage Road to Hailey's Ferry Road, where it would briefly travel southward to meet US-74. The line would turn west at the intersection of Hailey's Ferry Road with US-74 and would then follow US 74 west in Anson County through Lilesville, Wadesboro, Polkton, and Peachland into eastern Union County. This line would briefly continue west on US-74 in Union County and then turn south at Marshville Water Plant Road. The line would follow Marshville Water Plant Road to Hasty Road. At this intersection, the line would travel west along Hasty Road to the proposed site of the East Union County Water Treatment Plant, located just southeast of Marshville.

Alternative 4: Raw water supply from the main stem of the Yadkin River (intra-basin IBT from Yadkin River Sub-Basin to Rocky River Sub-Basin) with a new water treatment plant in Union County

This proposed alignment would extend approximately 21 miles through Anson County from a new raw water intake and pump station on the Pee Dee River approximately ½ mile downstream of the confluence of the Rocky River with the Pee Dee River. The line would extend westward to Pinkston River Road where it would then travel southward along Pinkston River Road to Dunlap Road. The line would travel westward along Dunlap Road to US-52 and would then travel southward along US- 52 towards Ansonville. The alignment would turn west along Fries Boulevard and briefly travels overland before reconnecting with Fries Boulevard. At the intersection with Plank Road, the alignment turns northward and travels along Plank Road to the intersection of Randall Road. At this intersection, the line would travel northwestward along Randall Road which eventually becomes Rocky Mount Church Road. The line would turn westward and travel along Burnsville Church Road to NC-742 and would then travel northward along NC-742 to Pine Logging Road, where it would turn westward. The alignment would follow Pine Logging Road and then cross overland to Fish Road and travel westward along Fish Road. Just north of the intersection of NC-205 and NC-218 in New Salem, the alignment would cross overland to NC-205 and Old Kennedy Ford Road to the proposed Site A for the North Union County Water Treatment Plant.

Alternative 5: Raw water supply from the Rocky River within Union County with a new water treatment plant in Union County

Alternative 5 would extend approximately 3 miles beginning at the proposed raw water intake and pump station on the Rocky River at the Union-Stanly County line at NC-205. The raw water transmission line would then follow NC-205 south to the proposed Site A for the North Union County Water Treatment Plant, located just north of New Salem, near Old Kennedy Fork Road.

Alternative 6: Expansion of the Catawba River Water Supply Project (modification to existing grandfathered IBT amount for a larger inter-basin IBT from the Catawba River Basin to the Rocky River Sub-Basin of the Yadkin River Basin)

The existing route for finished water transmission from the Catawba River Water Treatment Plant (CRWTP) to Union County begins at the CRWTP in Lancaster County, SC near the town of Van Wyck. There are two mains which carry water from the CRWTP to two finished water storage tanks owned by Union County near Sims Road. The 42-inch ductile iron main travels northeastward along Steel Hill Road through the Town of Van Wyck, across US Highway 521, following Niven Road to the intersection of Rehobeth Road (Alternative 6). At this point both mains travel in parallel eastward along Rehobeth Road and continue to follow this road to the north and intersect with Sims Road.

From the storage tanks at Sims Road, the 24-inch transmission main continues northward along Rehobeth Road into the western portion of the County's Catawba River Basin water service area including the municipalities of Waxhaw, Marvin, and Weddington. The 42-inch transmission main continues from the Sims Road storage tanks eastward along Sims Road and then eastward along Old Waxhaw-Monroe Road. The main continues to follow Old-Waxhaw-Monroe Road northeastward, crossing over Waxhaw Road (NC-75), where the road then becomes Rocky River Road. The 42-inch main briefly continues along Rocky River Road to a pump station located at the intersections of Rocky River Road with Watkins Road and Price Shortcut Road, at which point the transmission mains are reduced in size and branched in multiple directions. The two main lines leaving the pump station are a 24-inch service line to the north along Price Shortcut Road and a 16-inch service line traveling north along Rocky River Road. The 16-inch line continues along Rocky River Road to US Highway 74 (W. Roosevelt Blvd.), where it then travels westward along US-74. The 42-inch main and its associated branches serve eastern portion of the County's Catawba River Basin service area and western portion of the Yadkin River Basin service area including the municipalities of Mineral Springs, Wesley Chapel, Indian Trail, Stallings, Lake Park and Hemby Bridge.

Alternative 7: Interconnection with CMUD (inter-basin IBT from Catawba River Basin to the Rocky River Sub-basin of the Yadkin River Basin).

CMUD has several 16-inch finished water transmission mains which approach the Mecklenburg-Union County line. Of these mains, the northernmost main is the most logical tie-in point for Union County to supply water to their Rocky River Sub-Basin service area. CMUD's main extends along NC 218 (Fairview Road). The proposed tie-in location for Union County would be just southeast of the intersection of Whitmire Lane with Fairview Road, near Mint Hill, on the east side of I-485. The proposed extension of a proposed finished water main into Union County would extend through the Goose Creek Watershed and the Town of Fairview along NC 218.

Alternative 8: Raw Water Supply through Groundwater Withdrawal within Union County

The raw water supply alternative (Alternative 8) includes approximately 28,300 acres of area designated as a groundwater well field development area south of Monroe. Specific well locations and pipe corridor routes have not been developed at this time. Should this alternative be selected as the preferred, additional information will be provided. Numerous Study List and Surveyed Only structures were noted within this well field area as well as the nearby Center United Methodist Church which was Determined Eligible at the northern boundary of the well field.

The transmission corridor proposed with this alternative begins at the intersection of Snyders Store Road and Faulks Church Road. The alignment follows Faulks Church Road to the northeast to Old Pageland Marshville Road. The alignment then follows Old Pageland Marshville Road to the north to West Main Street for a short distance before turning onto Hasty Road. The alignment then follows Hasty Road to the east to the proposed East Union County Water Treatment Plant (Site D).

Alternative 11: Wastewater Returns to the Yadkin-Pee Dee River Basin

The proposed transmission alignment for Alternative 11 would begin at the Monroe WWTP. From the Monroe WWTP, the transmission alignment would follow Monroe-Ansonville Road (SR1751) east to Ansonville Road (SR1002). The alignment would follow Ansonville Road to the northeast to NC 205 at which point it would travel northward along NC 205 towards New Salem. Where the alignment reaches the proposed Alternative 1 alignment, the wastewater conveyance alignment would follow an identical alignment as the raw water transmission alignment for Alternative 1 northeastward to Norwood. Once reaching US 52 in Norwood, the wastewater conveyance alignment would diverge from the raw water conveyance alignment and travel northward toward the headwaters of Lake Tillery. The proposed alignment for Alternative 11 would cross over US 52 in Norwood and follow Pee Dee Avenue northward. Pee Dee Avenue eventually becomes Indian Mound Road, and the proposed alignment would continue northward along Indian Mound Road to the intersection with Troy Road (NC 24/27/73), southeast of

Albemarle. At this location, the alignment would travel eastward along Troy Road approximately 1 mile to the upstream reach of Lake Tillery, where it would discharge into the river.

Water Treatment Plant Sites B and C (Associated with Alternatives 1, 2, 3A, 4, and 5)

Three proposed Water Treatment Plant Sites are being included for study in the EIS which include Site A as described in the above alternatives as well as two additional study locations, Sites B and C. Alternative alignments 1, 2, 3A, 4, and 5 are all described above to a common location ending at Site A. The following description details the additional transmission routes that would be necessary to get to proposed Sites B and C from Site A.

The Site B alignment would continue an additional 8 miles southward along NC-205 to NC-218 at New Salem. The alignment would turn southwest on NC-218 and travel to Haigler Gin Road, where it would turn onto this road. The alignment would follow Haigler Gin Road to the southwest and travel to Morgan Mill Road (NC-200), where it would turn and continue south on Morgan Mill Road. The line would then turn west off of Morgan Mill Road onto Henry Baucom Road to the proposed Site B for the Yadkin River Water Treatment Plant.

The Site C alignment would continue an additional 7 miles southward along NC-205 to the southwest onto New Salem Road. The alignment would continue to follow New Salem Road to the southwest to the proposed Site Area C for the Yadkin River Water Treatment Plant, in the proximity of Mullis Newsome Road, Baucom Tarleton Road, and Lawyers Road.

Water Treatment Plant Site D (Associated with Alternatives 3B and 8)

This site is being included in the EIS and is associated with Alternative 3B and Alternative 8 described earlier. This plant is being referred to as the East Union County Water Treatment Plant and is just southeast of Marshville. Both of these alternative end at a location just south of US 74 in the proximity of Hasty Road near the intersection with Landsford Road.

Nearby Historic Resources

The following table includes a list of historic resources/properties identified in or near the proposed project corridors described above and from the information available in the HPOWEB Database. The attached mapping also illustrates the locations of these resources. Properties that were “Surveyed Only” (SO) and those noted as “Gone” or “Replaced” (a bridge designation) in the database are not included on the attached mapping for clarity. Resources within 1 mile of the project corridors are labeled on the mapping.

Alternatives	Name of Resource	County	National Register Listing Status	Site ID	See Figure:
1A, 1B, 11	Norwood Commercial District	Stanly	Study List	ST0531	3a
1A, 1B, 11	Norwood Railroad Complex	Stanly	Blockface	ST0538	3a
1A, 1B, 11	Efrid-Skidmore House	Stanly	Study List	ST0512	3a
1A, 11	Cottonville Crossroads	Stanly	Surveyed Area	ST0323	3j
2A	Carter House (The Farmhouse)	Stanly	Study List	ST0199	3b
2B	C.V. Ritchie House	Stanly	Study List	ST0254	3c
2B	Culp Bungalow	Stanly	Study List	ST0209	3c
3B	Wadesboro Downtown Historic District	Anson	Listed	AN0554	3d
3B	Polkton Historic District	Anson	Determined Eligible	AN0575	3k
4	Bridge	Anson	Determined Eligible	AN----	3e
6	Broom Cotton Gin	Union	Study List	UN0066	3f

Alternatives	Name of Resource	County	National Register Listing Status	Site ID	See Figure:
7	Long House	Union	Determined Eligible	UN0217	3g
7	Uriah Tilden Belk House	Union	Study List	UN0038	3h
1, 2, 3a, 4, 5, & Site B	Marshall Baucom House and Stores	Union	Study List	UN0025	3i
8	Faulks Baptist Church and Cemetery	Union	Study List	UN0117	3n
8	James Bivens House	Union	Study List	UN0052	3m
8	James Austin House	Union	Study List	UN0012	3l
11	James B. Garrison Bridge	Stanly	Determined Eligible	ST0688	3o

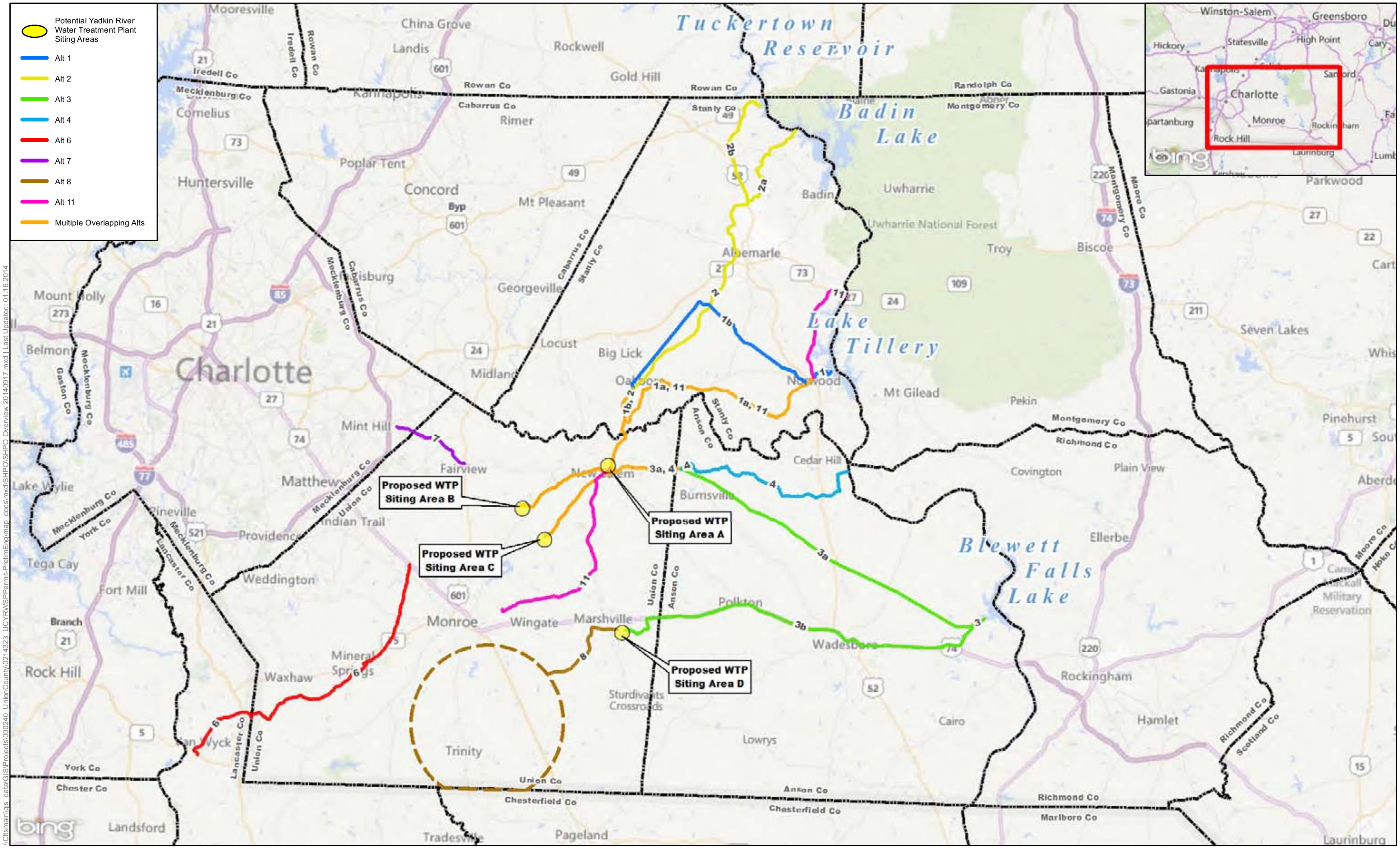
Only one nearby resource, the Wadesboro Downtown Historic District, is currently listed on the National Register of Historic Places. The historic district appears to be very close to the proposed alignment for Alternative 3B in Wadesboro. Additional guidance related to this district as well as other historic/cultural resources determined to be nearby is requested. We look forward to your comments and appreciate your participation in this project. Should you need additional information or more detailed mapping, please contact me at 919.232.6637 or vickie.miller@hdrinc.com.

Sincerely,

HDR Engineering, Inc. of the Carolinas

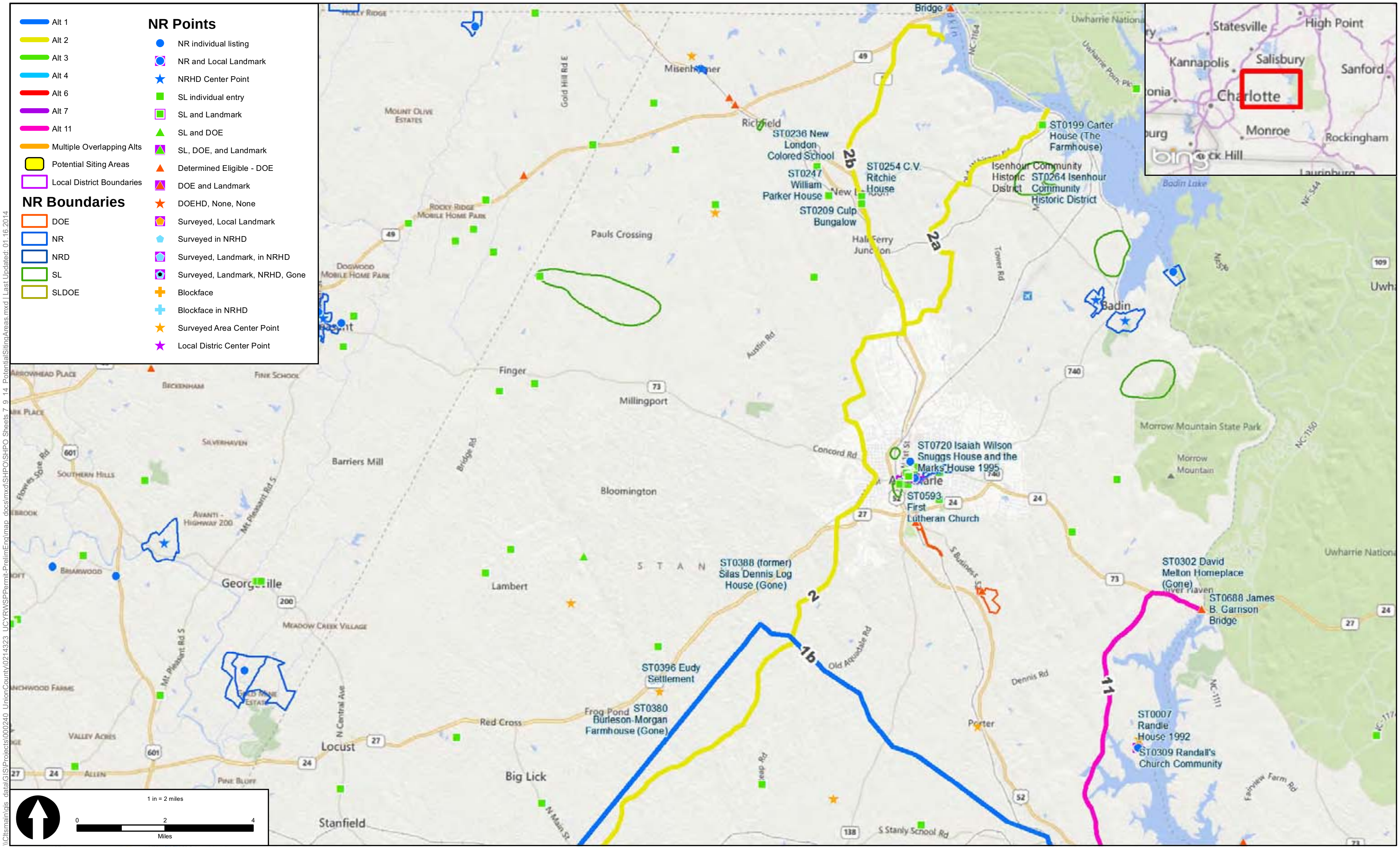
Vickie Miller, AICP, PWS
Senior Environmental Scientist

Figure 1: Union County IBT Alternatives Overview
Figure 2: Union County IBT Alternative Corridors Overview (6 Sheets)
Figure 3: Union County IBT Alternatives and SHPO Resources (15 Sheets)



Yadkin River Water Supply Project - Alternatives Overview

Figure 1

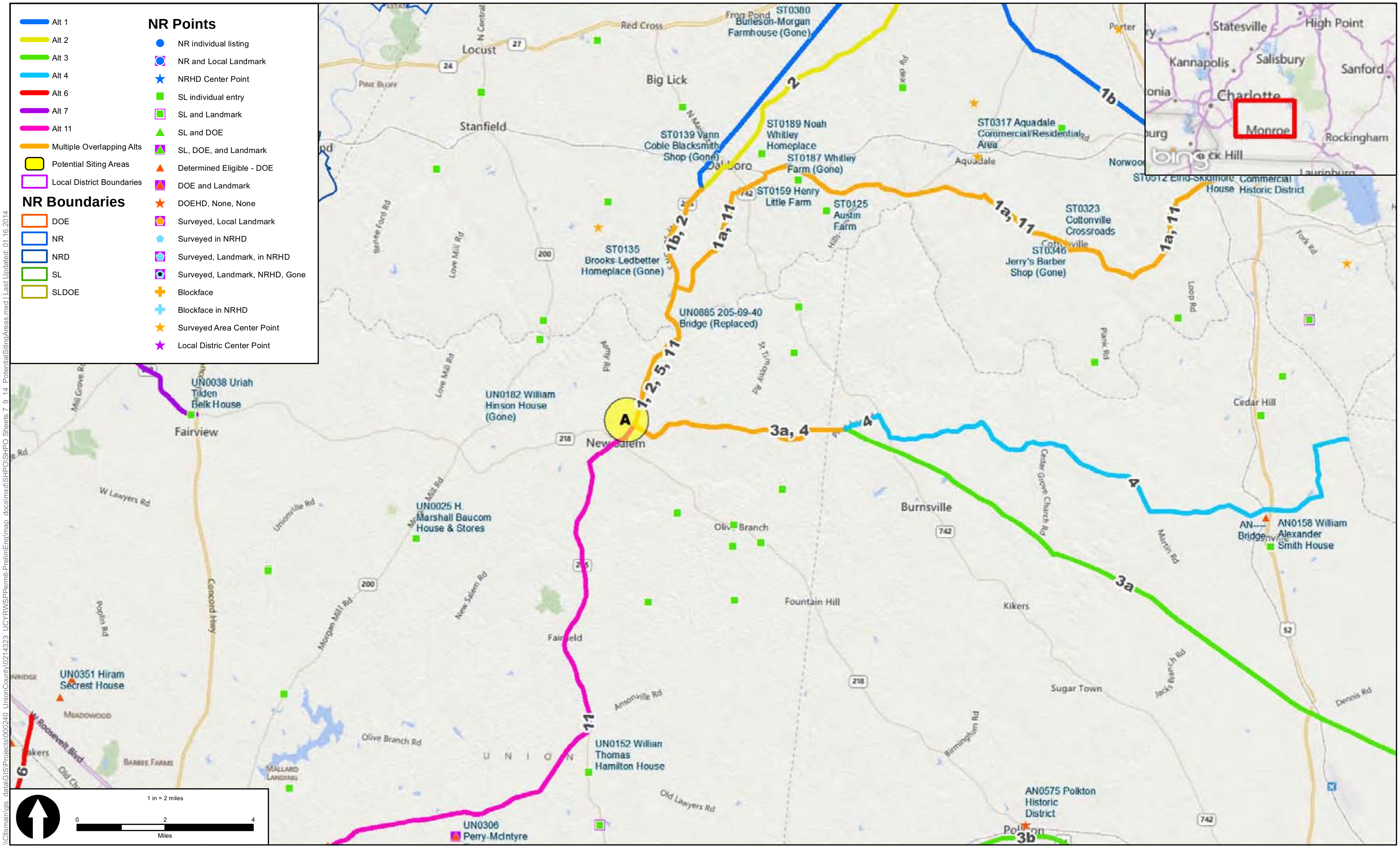


Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas A, B, C

Figure 2a

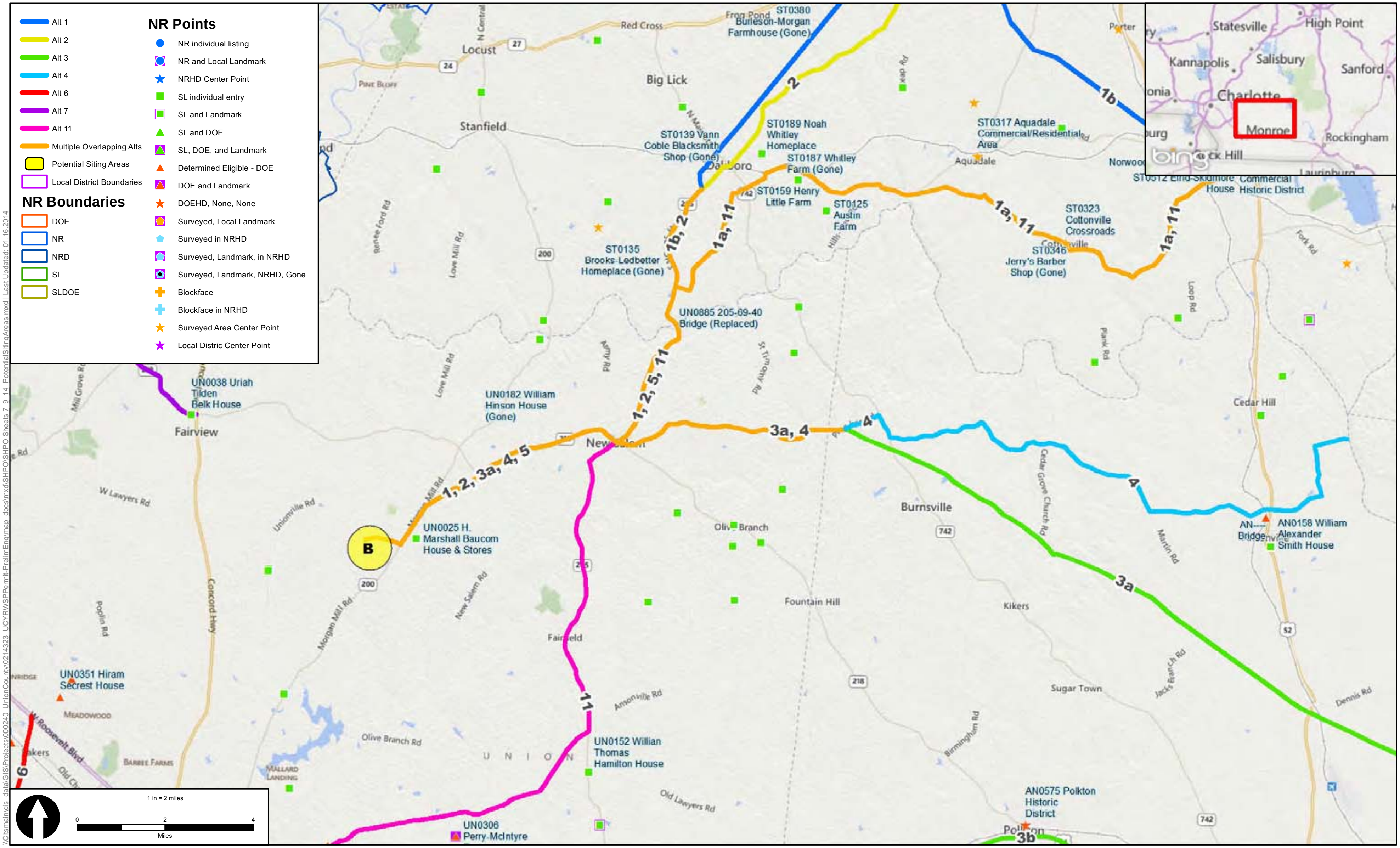
Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

\\Cltsmain\gis_data\GIS\Projects\000240_UnionCounty\0214323_UCYRWSPPermit-PrelimEng\map_docs\mxd\SHPO\SHPO Sheets 7_9_14_PotentialSitingAreas.mxd | Last Updated: 01.16.2014



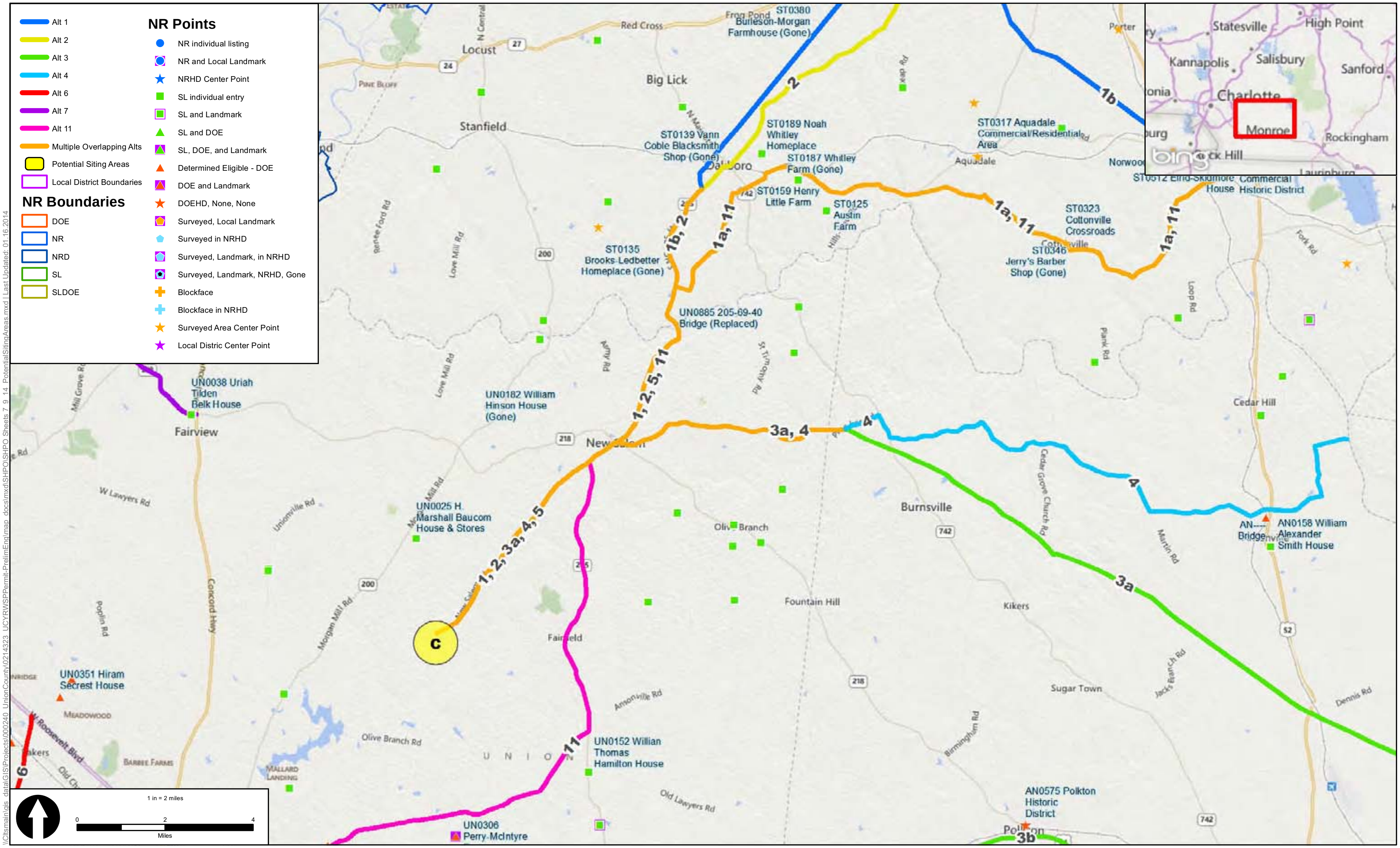
Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas A

Figure 2b



Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas B

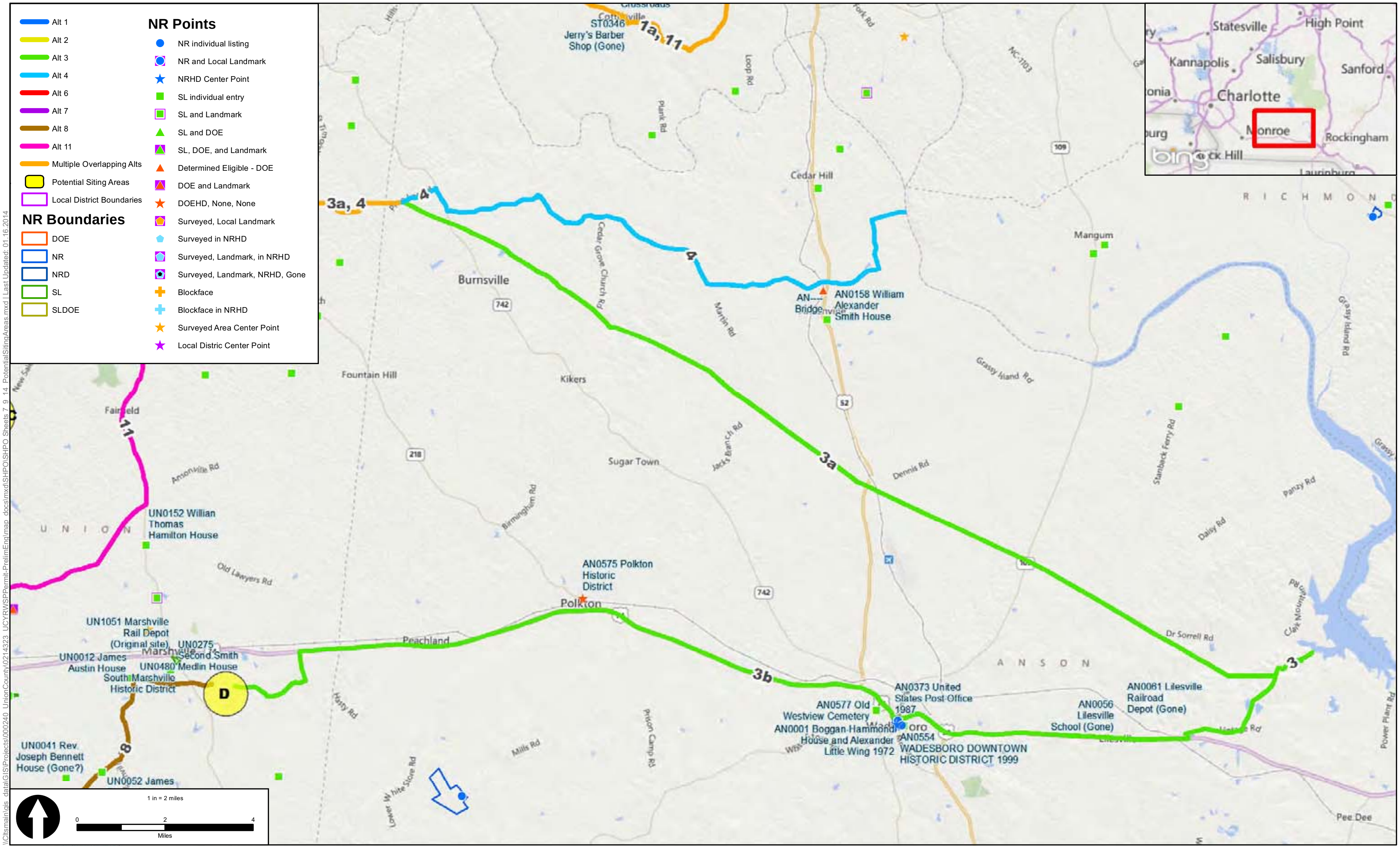
Figure 2b



Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas C

Figure 2b

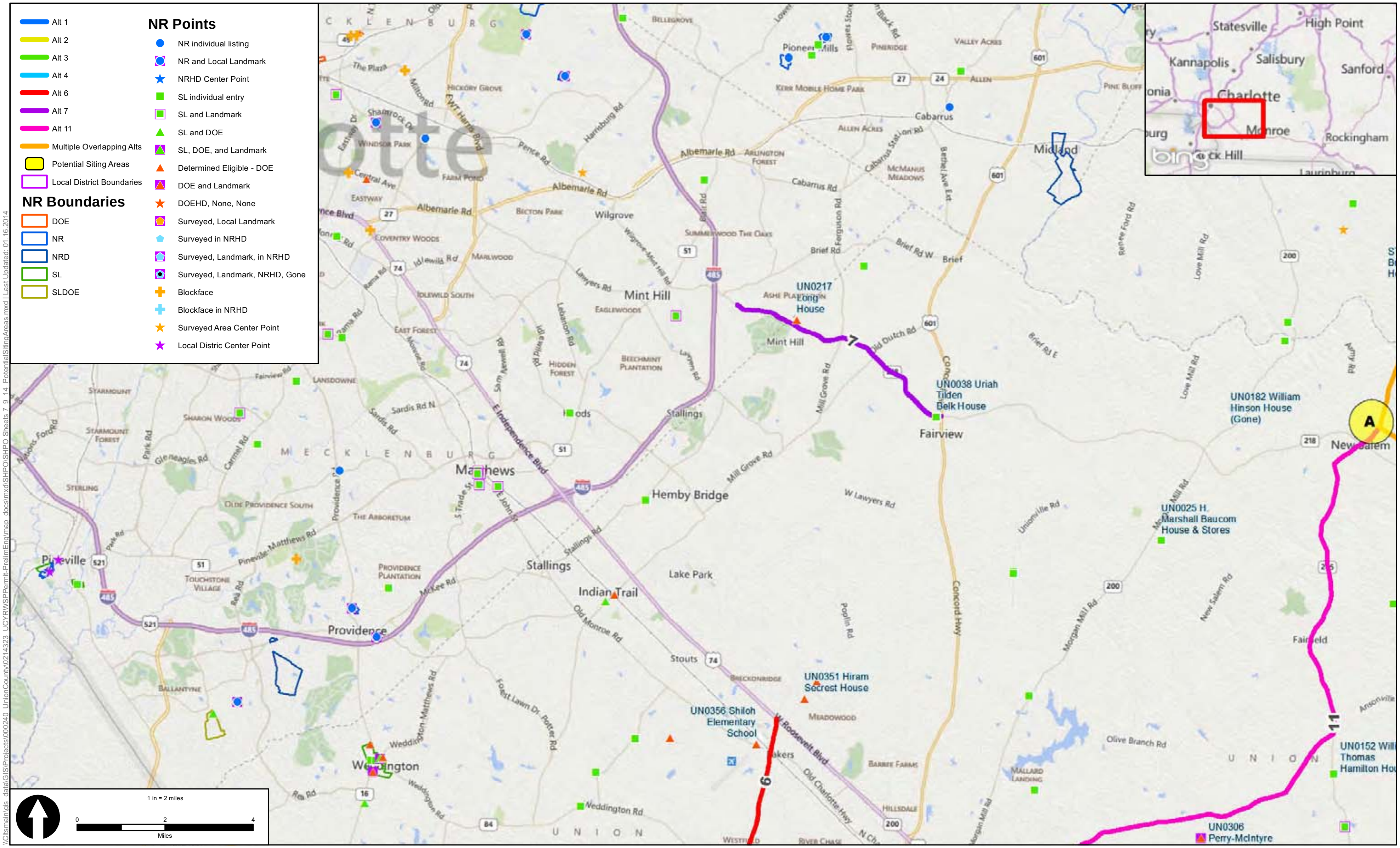
Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas A, B, C, D

Figure 2c

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



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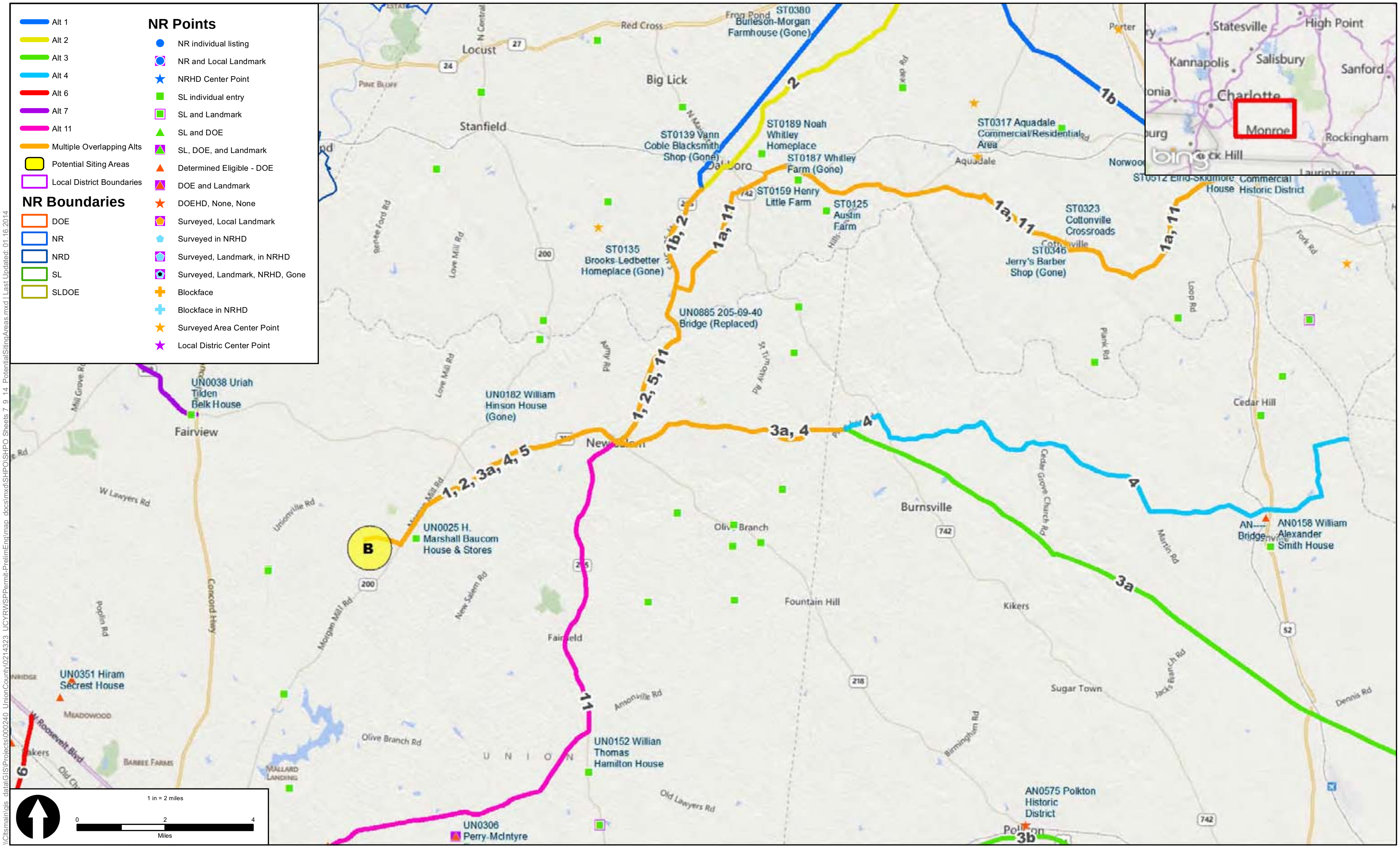
Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas A

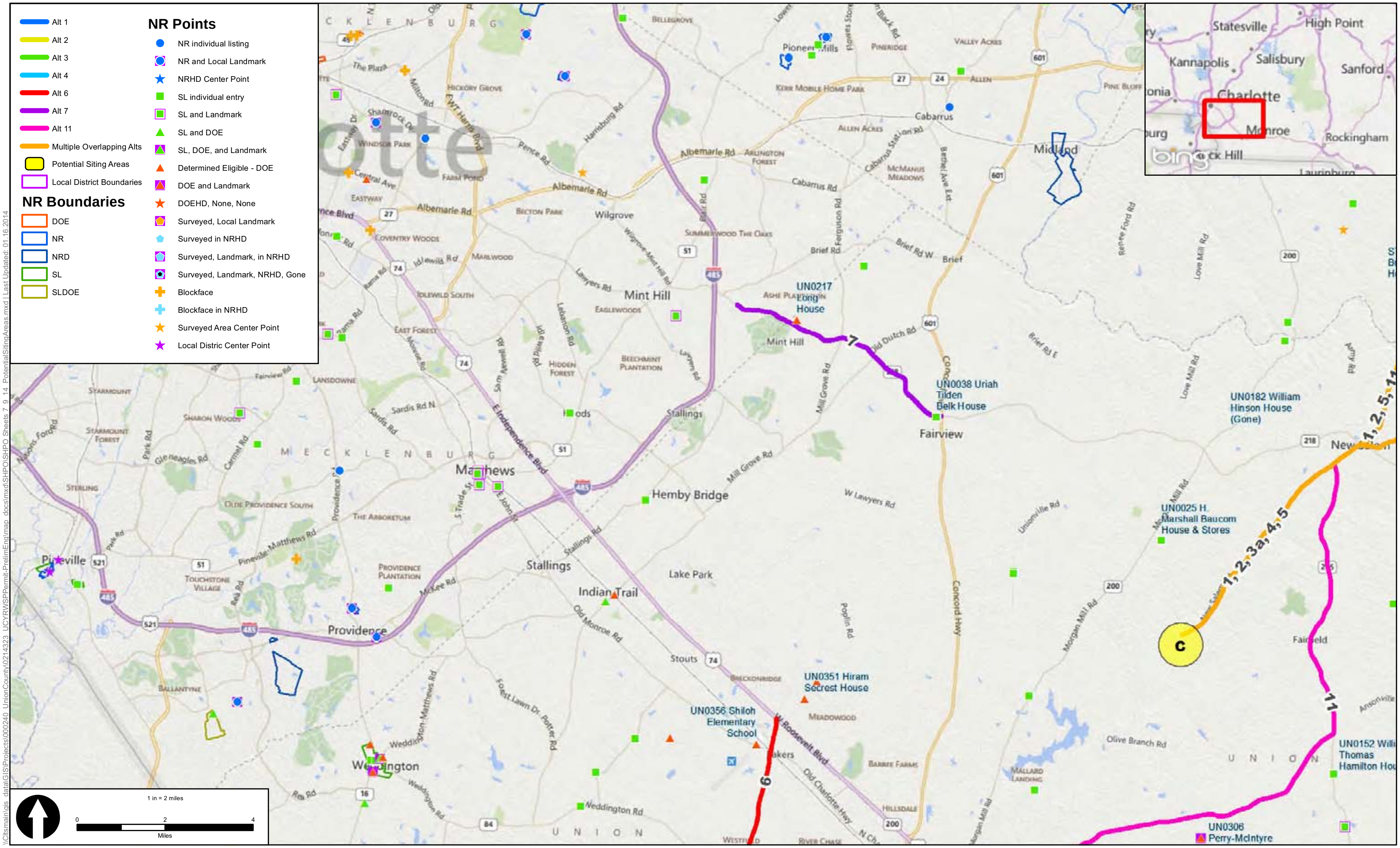
Figure 2d

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas B

Figure 2d



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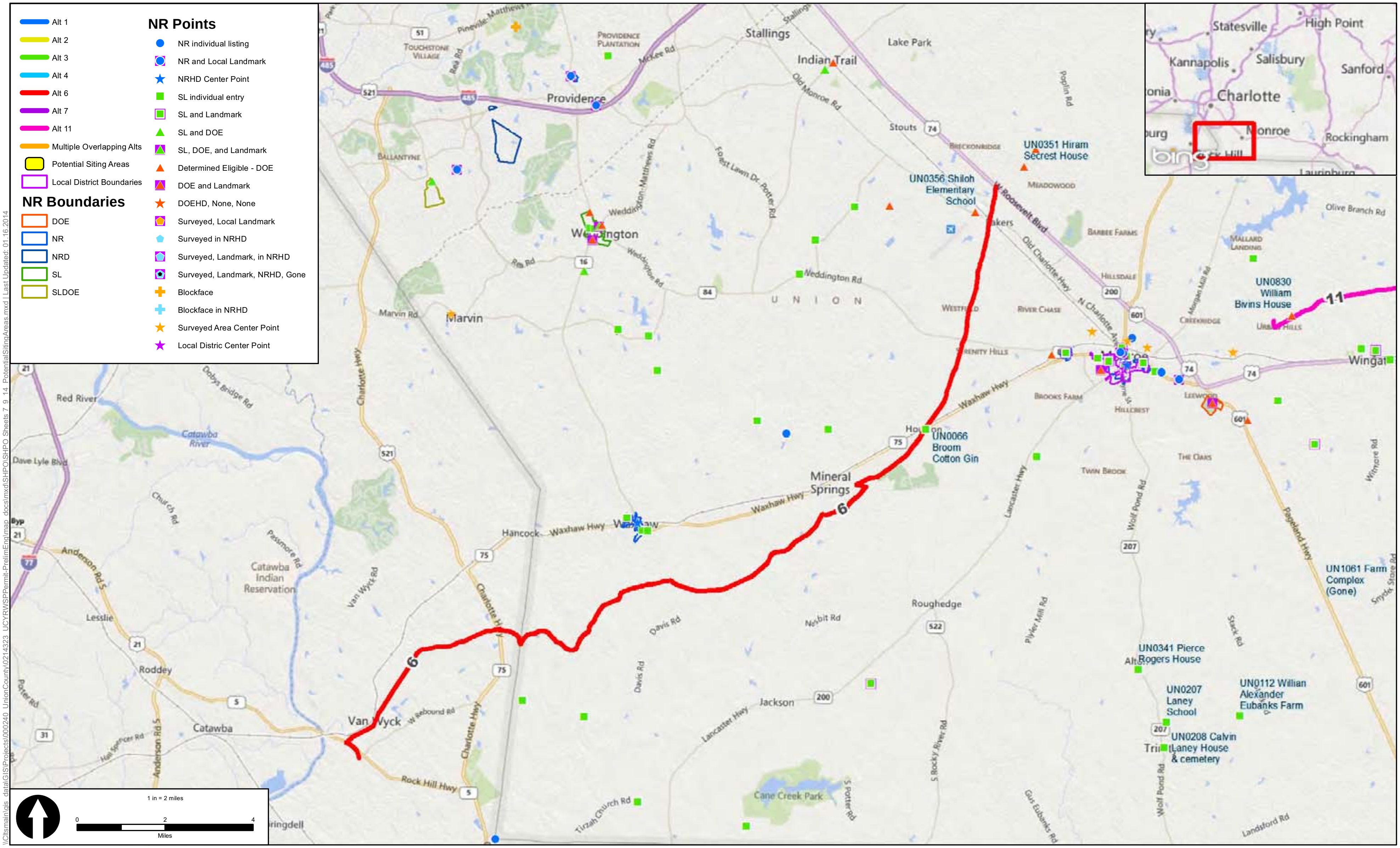
Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas C

Figure 2d

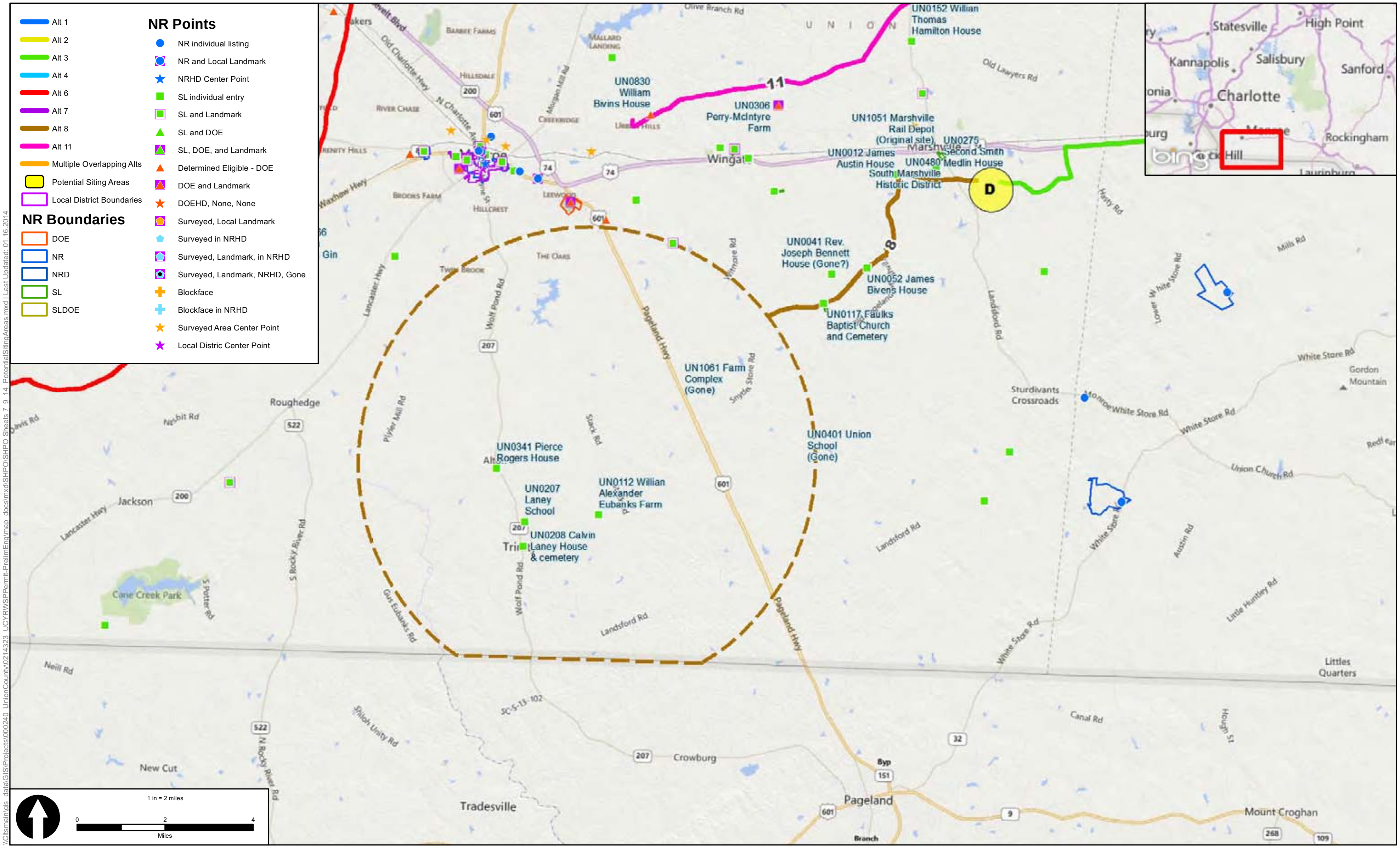
Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas A, B, C

Figure 2e

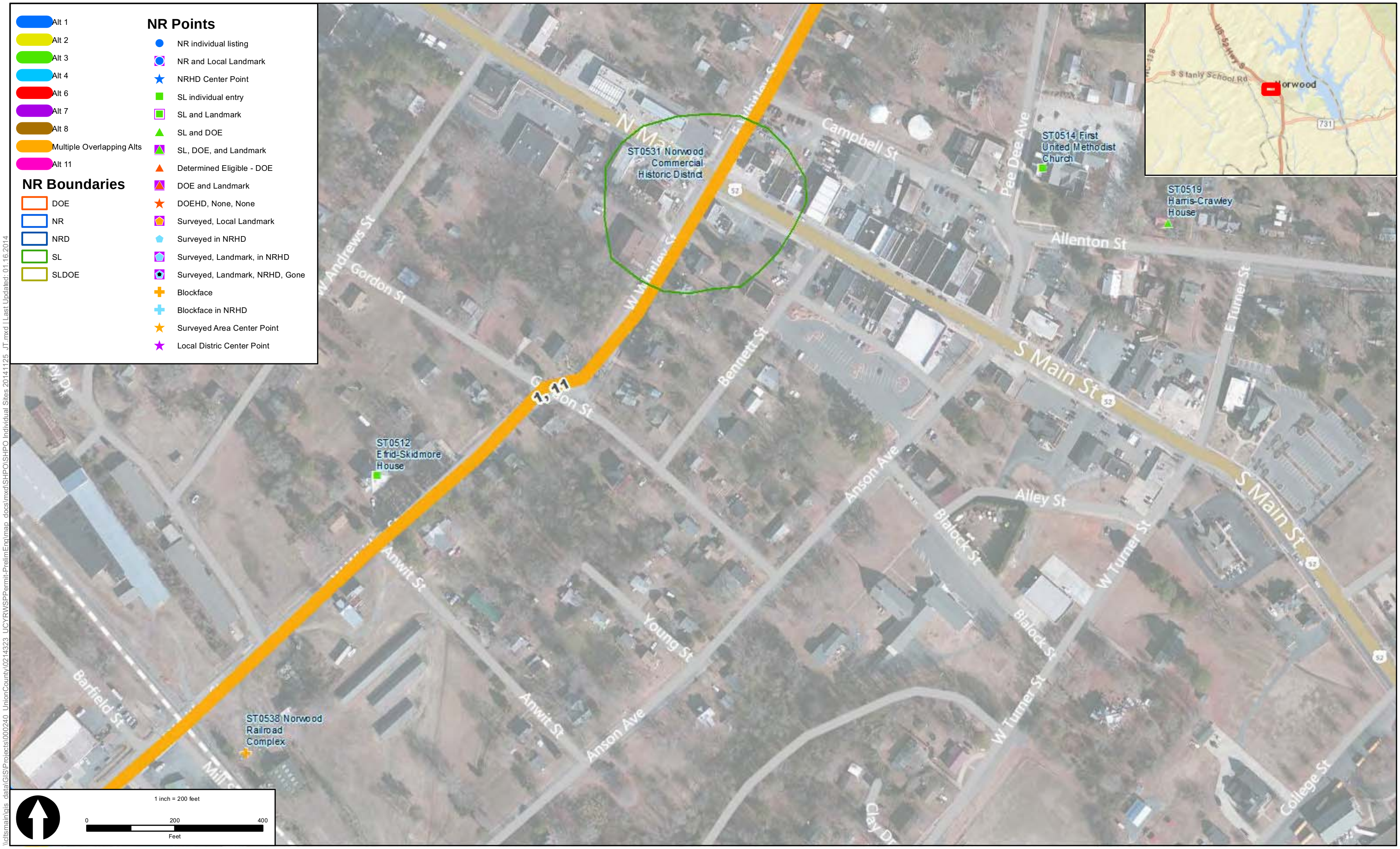
Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



Yadkin River Water Supply Project - Alternatives Overview - Potential Siting Areas A, B, C, D

Figure 2f

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



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Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3a

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

HDR

Yadkin River Water Supply Project - Alternatives and SHPO Resources

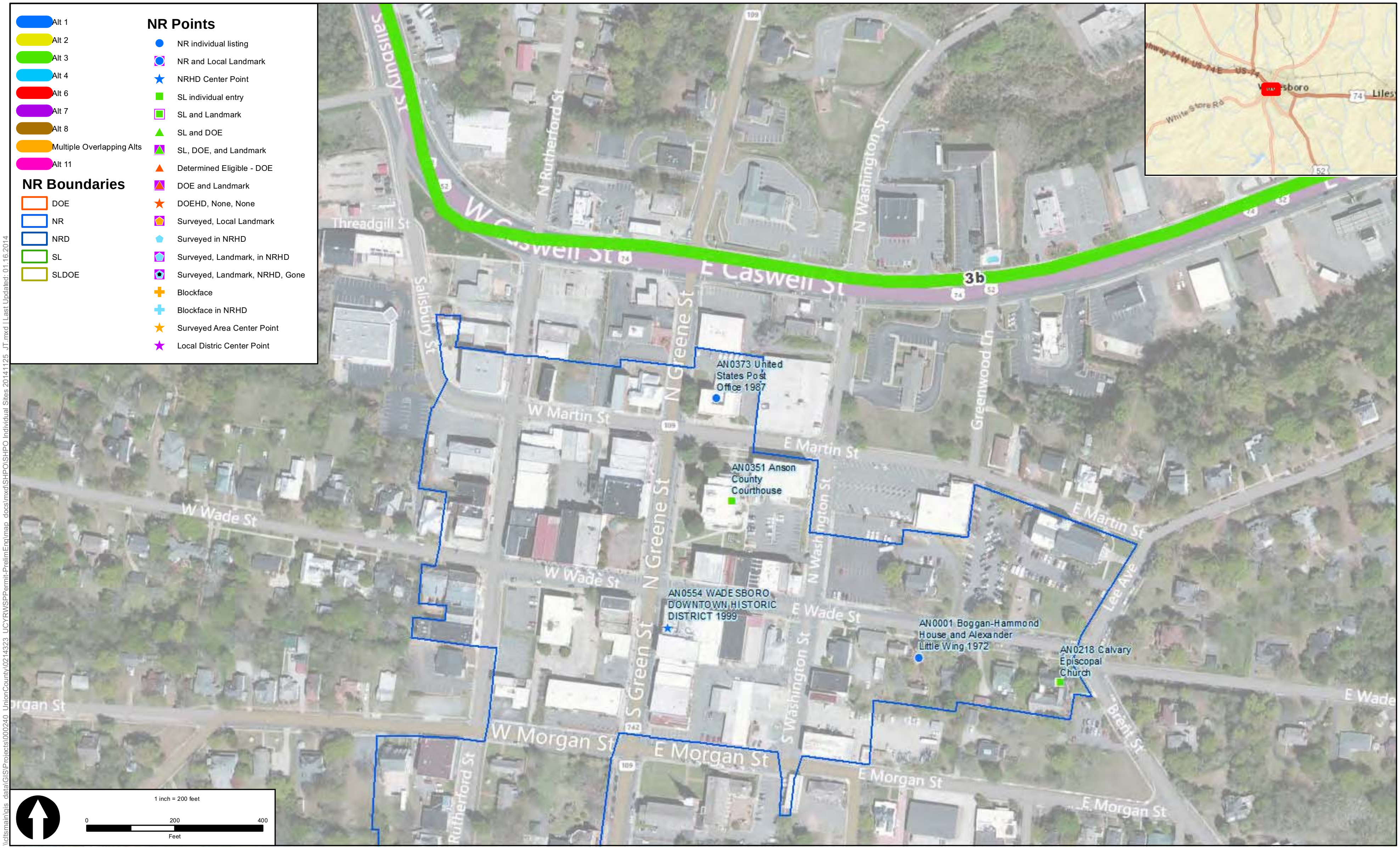
Figure 3b

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3c

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



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Yadkin River Water Supply Project - Alternatives and SHPO Resources

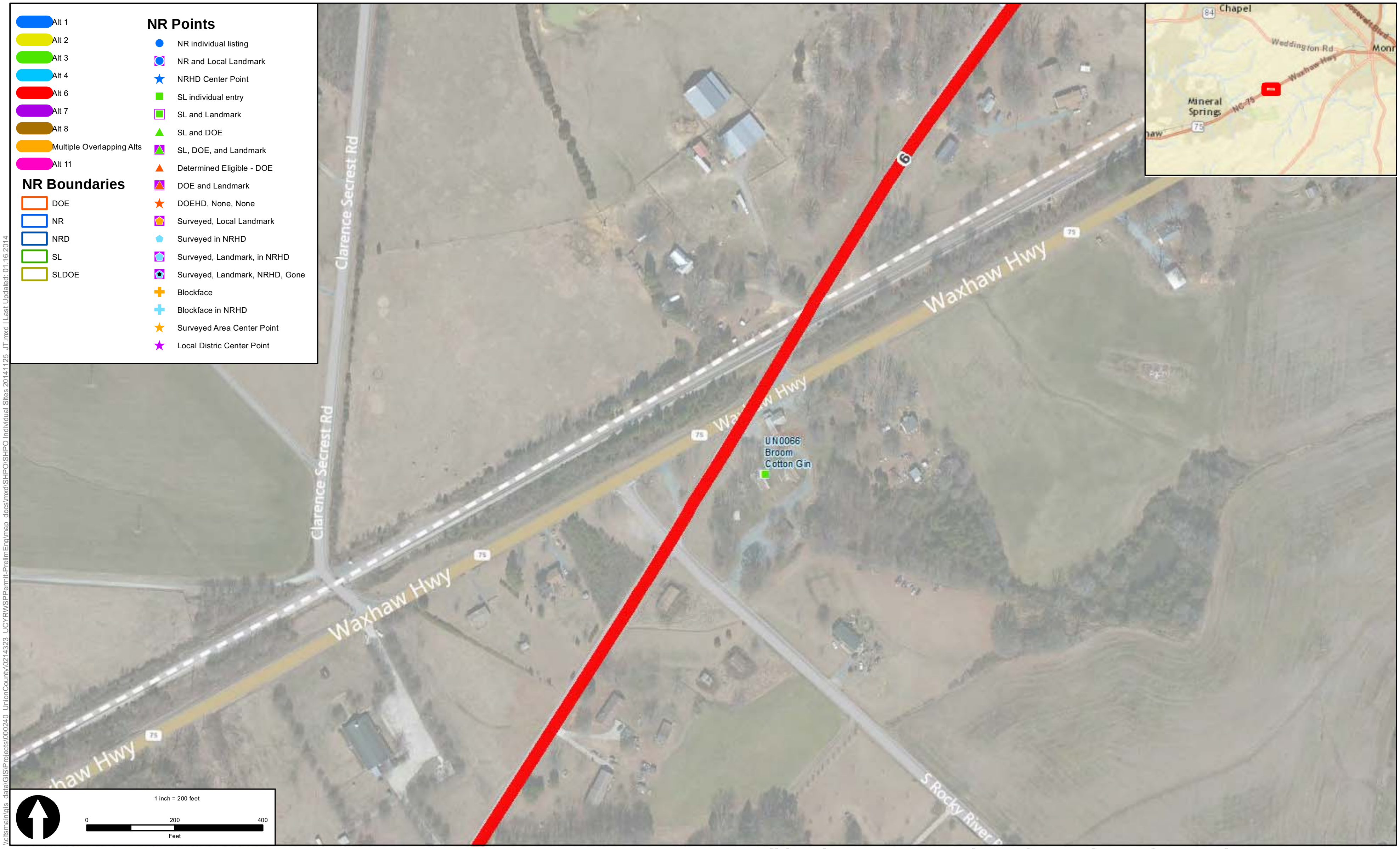
Figure 3d

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3e

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



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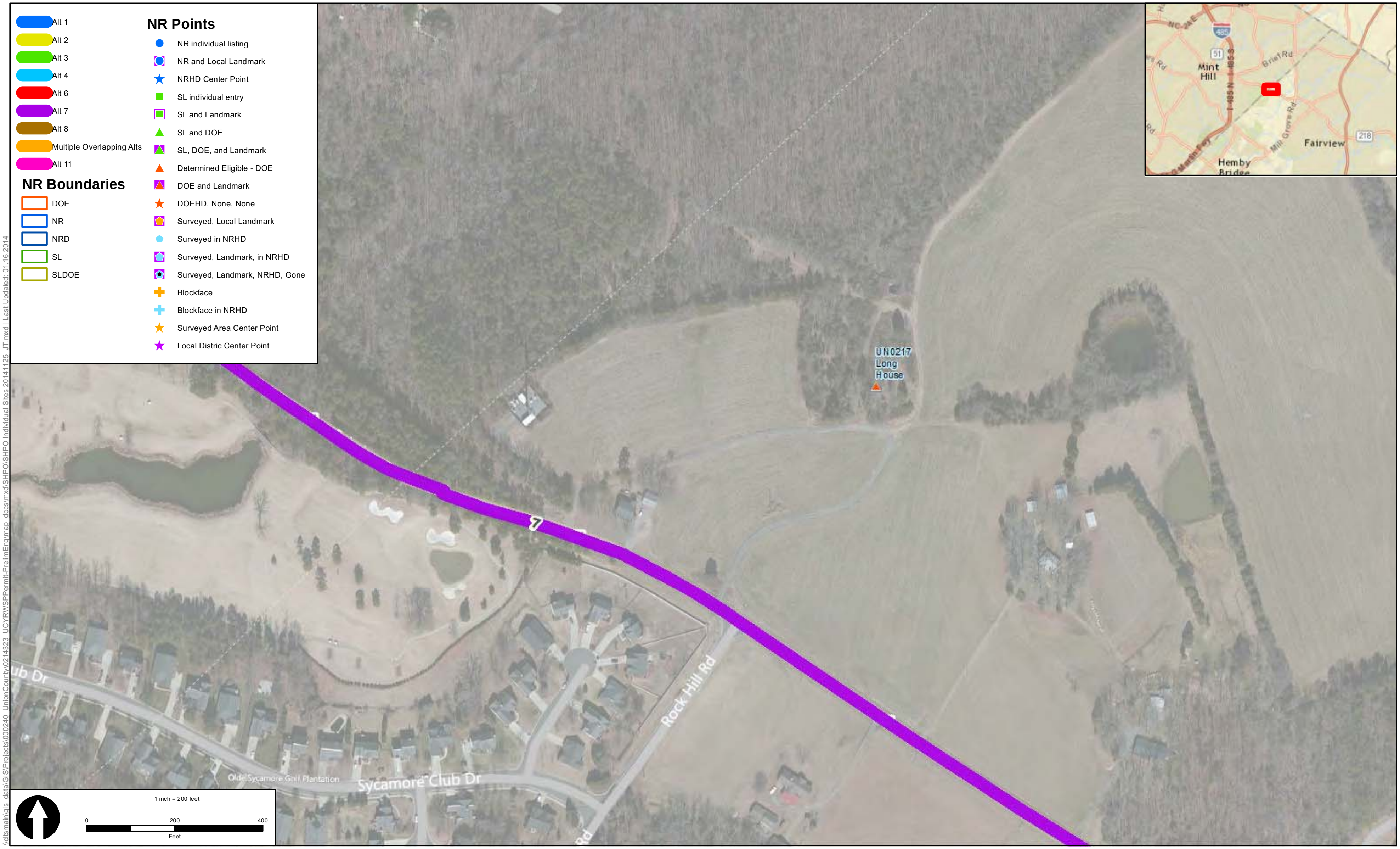
Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3f

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



HDR

Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3g

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3h

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

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HDR

Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3i

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3j

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

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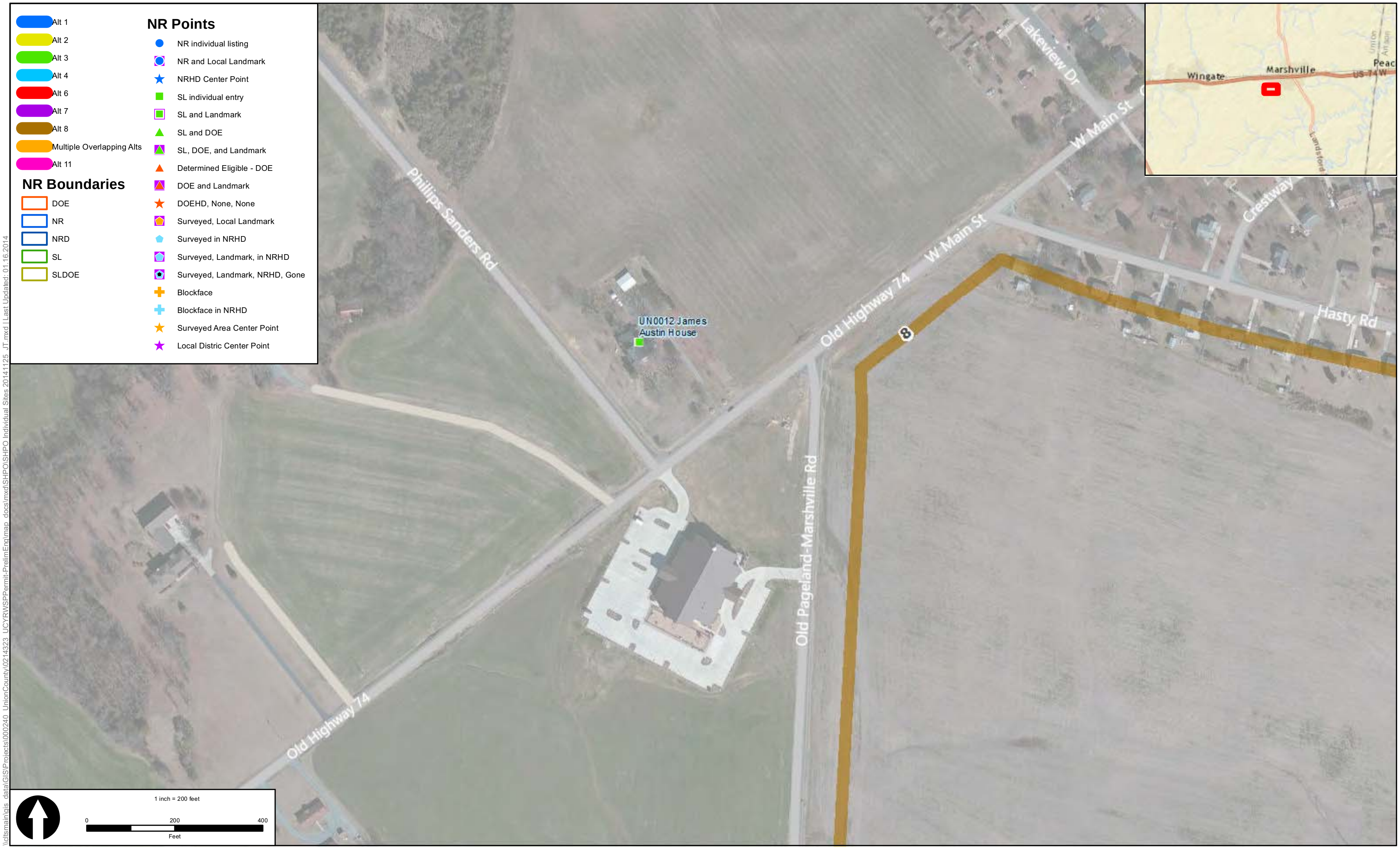
HDR

Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3k

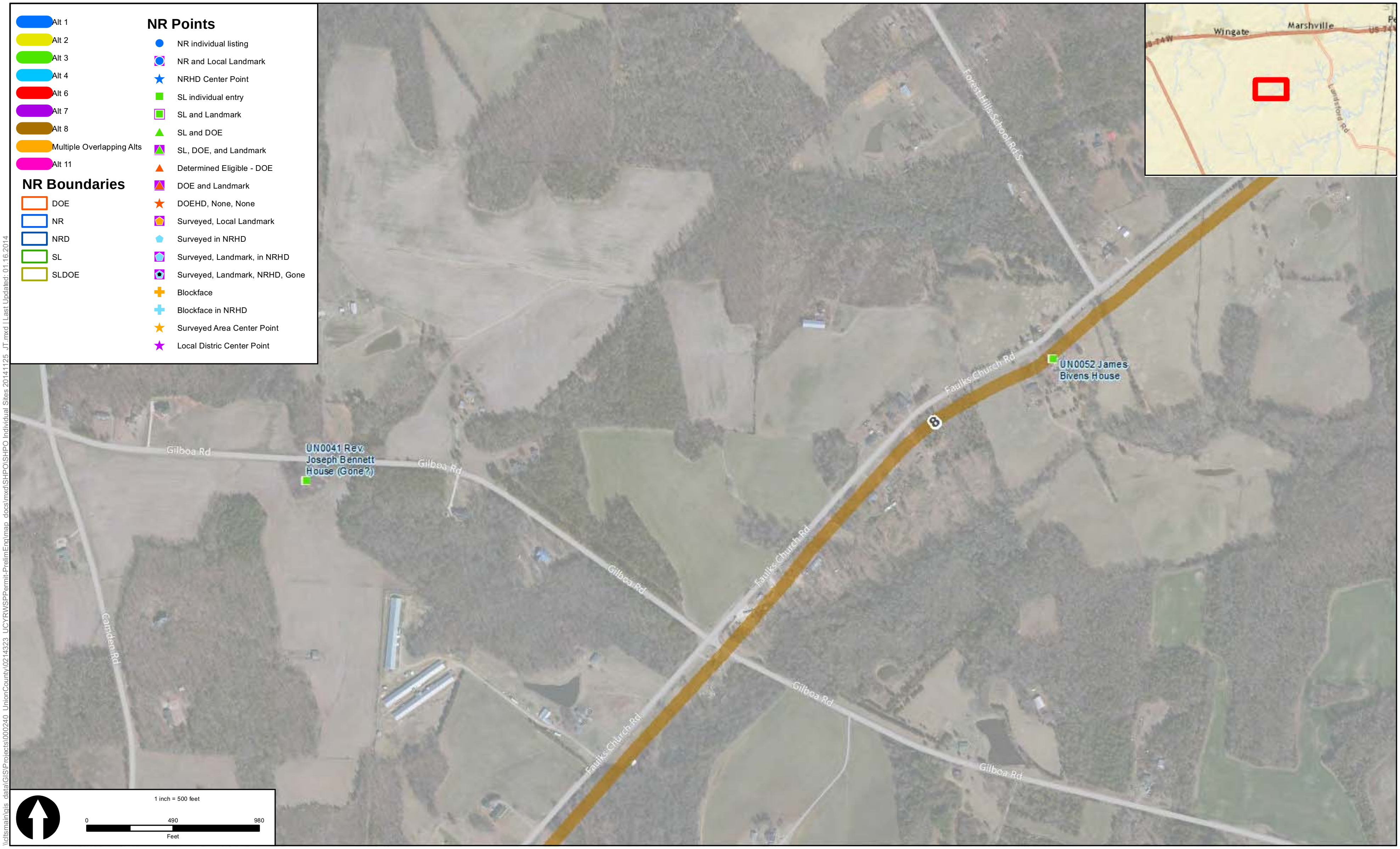
Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3I

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



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HDR

Yadkin River Water Supply Project - Alternatives and SHPO Resources

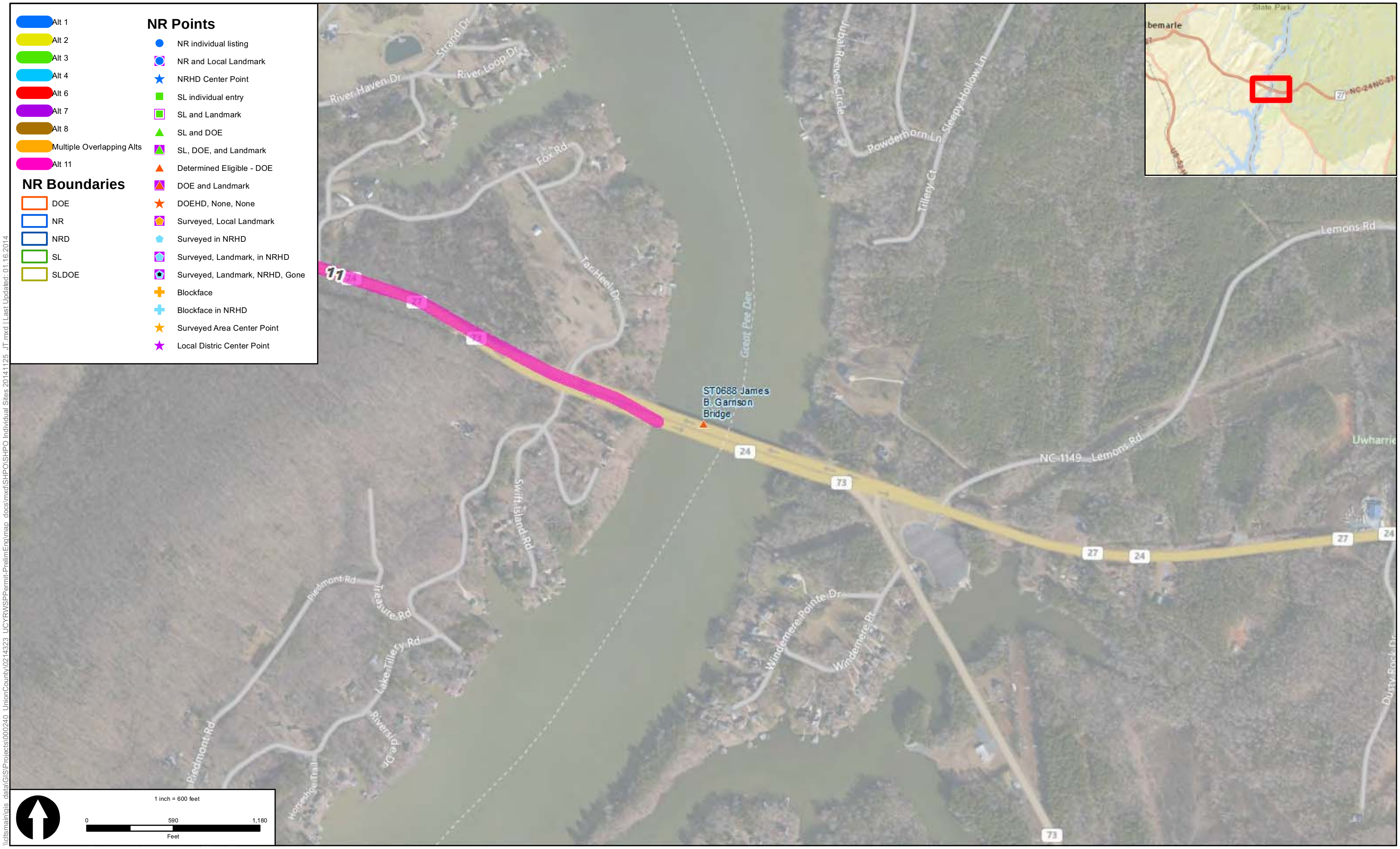
Figure 3m

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3n

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering



Yadkin River Water Supply Project - Alternatives and SHPO Resources

Figure 3o

Union County Public Works | Yadkin River Water Supply Project Planning & Preliminary Engineering

From:	Miller, Vickie M
To:	renee.gledhill-earley@ncdcr.gov
Subject:	Yadkin River Water Supply Project, Interbasin Transfer, Union County, ER 13-2841
Date:	Tuesday, November 25, 2014 4:04:15 PM
Attachments:	Supplemental Scoping_Yadkin River IBT_Union_ER 13-2814_reduced.pdf

Hello Renee,

I have been working on the Yadkin River Water Supply project and several alternatives and water treatment plant options have been developed. We have created mapping with the HPOWEB Database information on it and a detailed description of the alternatives/alignments in the attached letter. I know there are a lot of options detailed but any direction on these would be greatly appreciated. The letter outlines the transmission line corridors being assessed as well as 4 treatment plant sites. Hopefully the mapping and table helps narrow down the resources around the transmission lines and proposed treatment plant options. If you have any questions or comments, please feel free to call or email me.

Thanks,
Vickie

Vickie M. Miller, AICP, PWS
Senior Environmental Scientist / Planner

HDR
3733 National Drive, Suite 207
Raleigh, NC 27612-4845
D 919.232.6637 **M** 919.559.2632
vickie.miller@hdrinc.com

hdrinc.com/follow-us

From: Miller, Vickie M
To: "Gledhill-earley, Renee"
Subject: RE: Yadkin River Water Supply Project, Interbasin Transfer, Union County, ER 13-2841
Date: Wednesday, December 03, 2014 1:58:00 PM

Hi Renee,

That isn't a problem. I just sent it to you based on the previous response letter which had your email on it. I will send it to the environmental review address today.

Thanks,
Vickie

Vickie Miller, AICP, PWS
D 919.232.6637 M 919.559.2632

hdrinc.com/follow-us

From: Gledhill-earley, Renee [mailto:renee.gledhill-earley@ncdcr.gov]
Sent: Monday, December 01, 2014 4:08 PM
To: Miller, Vickie M
Subject: RE: Yadkin River Water Supply Project, Interbasin Transfer, Union County, ER 13-2841

Vickie:
I hate to ask, but will you please send your email to our environmental review emailbox at: environmental.review@ncdcr.gov

You will get an autoreply to let you know we got it. By following the advice in the note below my signature, you can help us expedite your project.

Thanks,
R

--
Renee Gledhill-Earley
Environmental Review Coordinator
NC State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617
Phone: 919-807-6579 Fax: 919-807-6599
http://www.hpo.dcr.state.nc.us
Please Note: Requests for project review or responses to our review comments should be sent to our Environmental Review emailbox at environmental.review@ncdcr.gov not to this personal mailbox. Otherwise, I will have to return your request and ask that you send it to the proper mailbox. This will cause delays in your project. Information on email project submittal is at: http://www.hpo.ncdcr.gov/er/er_email_submittal.html

From: Miller, Vickie M [mailto:Vickie.Miller@hdrinc.com]
Sent: Tuesday, November 25, 2014 4:04 PM

To: Gledhill-earley, Renee
Subject: Yadkin River Water Supply Project, Interbasin Transfer, Union County, ER 13-2841

Hello Renee,

I have been working on the Yadkin River Water Supply project and several alternatives and water treatment plant options have been developed. We have created mapping with the HPOWEB Database information on it and a detailed description of the alternatives/alignments in the attached letter. I know there are a lot of options detailed but any direction on these would be greatly appreciated. The letter outlines the transmission line corridors being assessed as well as 4 treatment plant sites. Hopefully the mapping and table helps narrow down the resources around the transmission lines and proposed treatment plant options. If you have any questions or comments, please feel free to call or email me.

Thanks,
Vickie

Vickie M. Miller, AICP, PWS
Senior Environmental Scientist / Planner

HDR
3733 National Drive, Suite 207
Raleigh, NC 27612-4845
D 919.232.6637 **M** 919.559.2632
vickie.miller@hdrinc.com

hdrinc.com/follow-us

From: DCR - Environmental_Review
To: Miller, Vickie M
Subject: DCR Environmental Review
Date: Wednesday, December 03, 2014 2:03:39 PM

Thank you for your email submission. We will log it into our tracking system for review.

From:	DCR - Environmental Review
To:	Miller, Vickie M
Subject:	Automatic reply: Yadkin River Water Supply Project, Interbasin Transfer, Union County, ER 13-2841
Date:	Wednesday, December 03, 2014 2:04:10 PM

Thank you for your email submission. We will log it into our tracking system for review.

We prefer receiving attachments. All attachments should be in .pdf, .doc (or .docx), or .jpeg formats.

Please do not send .zip, .tif files, downloads, or links to websites as we are not able to process these types of items. The message size, including all attachments, should be NO larger than 10 megabytes.

Please allow 30 days for a response.

D.4

Public Involvement – General Scoping Comments from the Public

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Williams, Jonathan

From: Union County YRWSP
Sent: Thursday, September 19, 2013 9:33 AM
To: Michael S. Acquesta
Cc: Union County YRWSP
Subject: RE: Union County IBT
Attachments: UC-YRWSP_NOI Exhibit 1.pdf; UC-YRWSP_NOI Exhibit 2.pdf

Mr. Acquesta,

Thank you for interest in this project. Per your request, two figures are attached, which were previously submitted with the Notice of Intent to the North Carolina Environmental Management Commission. Exhibit 1 reflects the current water supply sources for Union County, denoted in blue, and the proposed future Yadkin River water supply to serve its Yadkin River Basin service area (Rocky River Sub-basin) denoted in purple. Exhibit 2 reflects the Catawba River Basin and Yadkin River Basin service areas for Union County's water system. As part of these public meetings Union County is in the process of scoping alternatives to evaluate as part of the Environmental Impact Study.

Regards,

Union County Yadkin River Water Supply Project

From: Michael S. Acquesta [mailto:macquesta@mesco.com]
Sent: Tuesday, September 10, 2013 3:33 PM
To: Union County YRWSP
Subject: Union County IBT

Can you provide me with a map showing where the water withdrawal will take place? I would like to have this map prior to any of the public hearings. Thanks.

Michael S. Acquesta, PE, PhD
Municipal Engineering Services Co., PA
671 West King Street
PO Box 349
Boone, NC. 28607
(828)262-1767 (O)
(919)971-5859 (C)
macquesta@mesco.com

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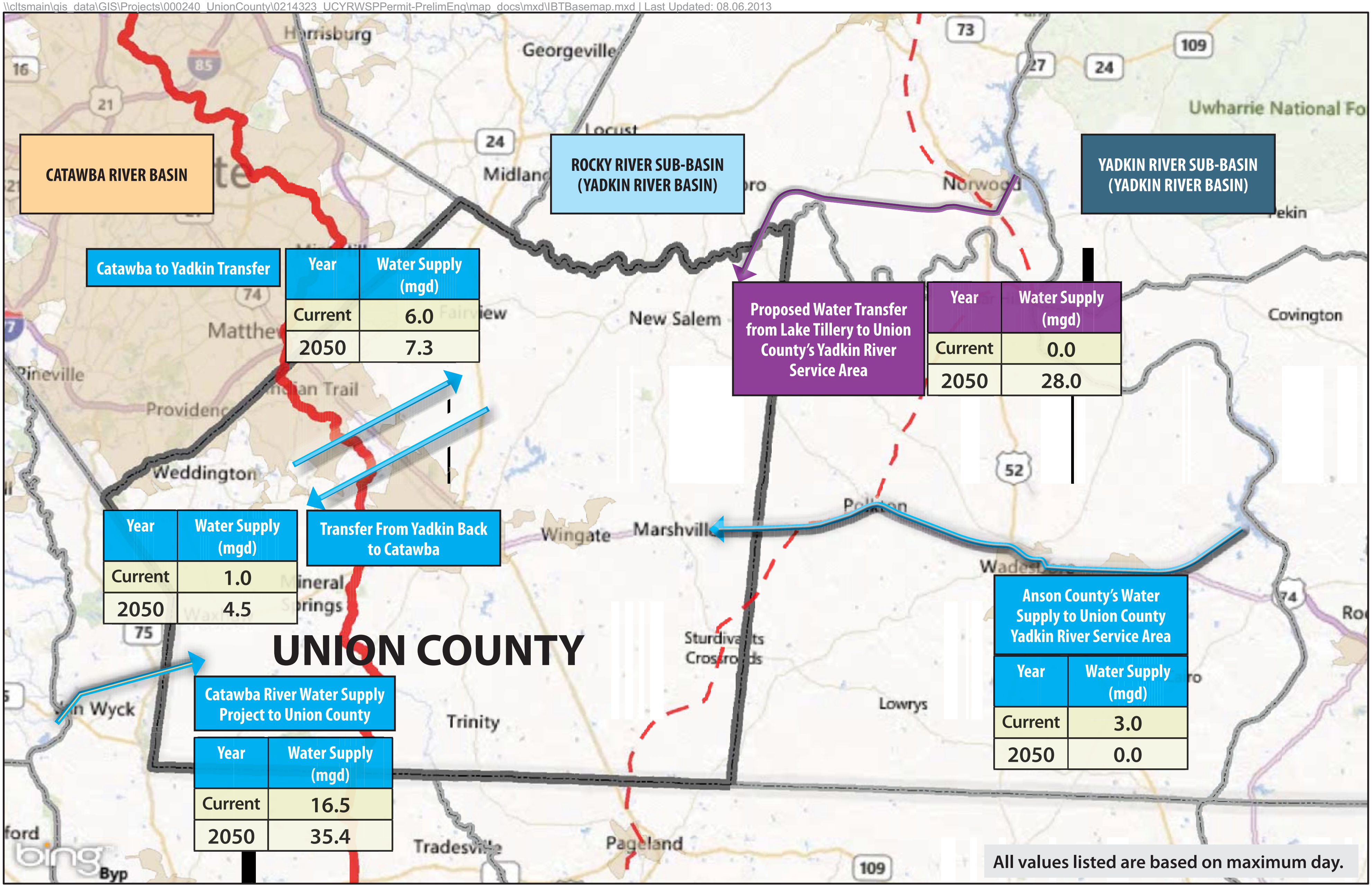


Catawba to Yadkin Transfer

Year	Water Supply (mgd)
Current	6.0
2050	7.3

Proposed Water Transfer from Lake Tillery to Union County's Yadkin River Service Area

Year	Water Supply (mgd)
Current	0.0
2050	28.0

Transfer From Yadkin Back to Catawba

Year	Water Supply (mgd)
Current	1.0
2050	4.5

Anson County's Water Supply to Union County Yadkin River Service Area

Year	Water Supply (mgd)
Current	3.0
2050	0.0

Catawba River Water Supply Project to Union County

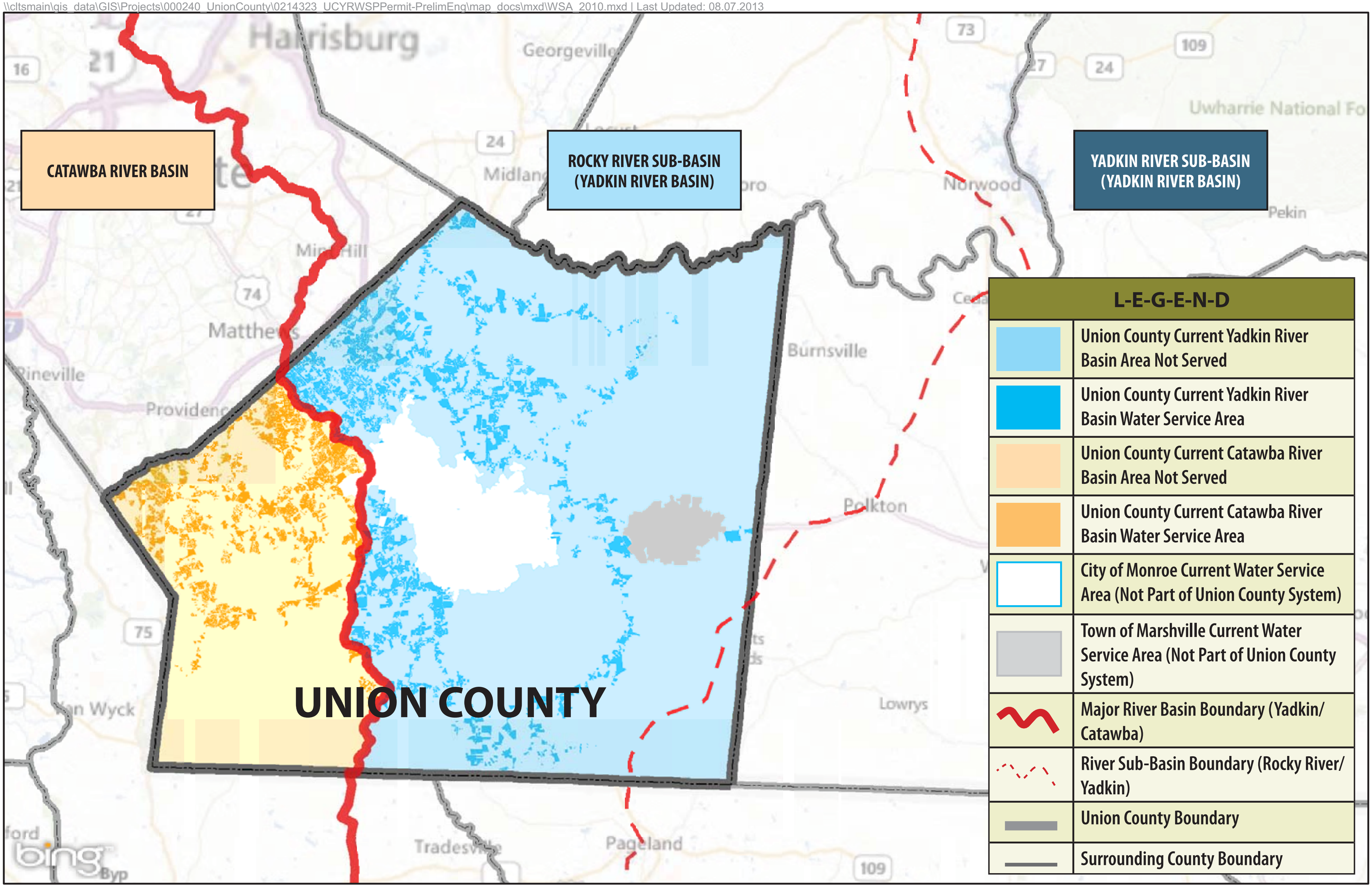
Year	Water Supply (mgd)
Current	16.5
2050	35.4

HDR ONE COMPANY | *Many Solutions*

Exhibit 1

UNION COUNTY, NC – WATER SUPPLY OVERVIEW

\\cltsmain\gis_data\GIS\Projects\000240_UnionCounty\0214323_UCYRWSPPermit-PrelimEng\map_docs\mxd\WSA_2010.mxd | Last Updated: 08.07.2013



HDR ONE COMPANY | Many Solutions

Exhibit 2

UNION COUNTY, NC – WATER SUPPLY SERVICE AREAS

This page intentionally left blank.

Williams, Jonathan

From: Angela Williams <angelaw@lcwasd.org>
Sent: Thursday, November 14, 2013 2:42 PM
To: Union County YRWSP; Edward. Goscicki
Cc: Steven White; Mike Bailes (mbailes@crwtp.org); Brad Bucy
Subject: Union County Yadkin River Water Supply Project Public Comments
Attachments: DOC.PDF

Please read the attached letter from Stephen White at Lancaster County Water and Sewer District.

Thanks,
Angela Williams
Administrative Assistant
Lancaster County Water & Sewer

LCWSD
Lancaster County
Water & Sewer District

"Serving Lancaster County For Over 50 Years"

November 14, 2013

Union County – YRWSP – IBT Comments
HDR Engineering Inc. of the Carolinas
Attn: Mr. Kevin Mosteller, P.E.
440 South Church Street
Charlotte, NC 28202

Re: Union County Yadkin River Water Supply Project
Public Comments

Dear Mr. Mosteller, P.E.:

We are familiar with the purpose and need of Union County's Yadkin River Water Supply Project. As a public utility with customers in both the Catawba River Basin and the Yadkin – Pee Dee River Basin of South Carolina, we support the proposed project as a solution to meet Union County's future water demand projections in the County's Yadkin River Basin service area.

Please let us know if you need our cooperation on this project.

Sincerely,

Stephen White
Manager
Lancaster County Water & Sewer District

Cc: Ed Goscicki, Director, Union County Public Works

P.O. Box 1009 - Lancaster, South Carolina 29721
Phone 803-285-6919 - Fax 803-285-9574

GRAND STRAND
WATER & SEWER
AUTHORITY

P.O. Box 2368 • Conway, SC 29528-2368
www.gswsa.com

September 9, 2013

Union County – YRWSP – IBT Comments
HDR Engineering Inc. of the Carolinas
Attn: Mr. Kevin Mosteller, PE
440 South Church Street
Charlotte, NC 28202

Re: **Union County – Proposed Interbasin Transfer**
Public Comments

Dear Mr. Mosteller:

Grand Strand Water & Sewer Authority (GSWSA) has reviewed the Notice of Public Meetings for the Union County request for an interbasin transfer (IBT) certificate. It is our understanding that they are requesting an IBT certificate for a maximum daily flow of 28 MGD from the source river basin of the Yadkin River Sub-Basin to the receiving river basin of the Rocky River Sub-Basin. It is our further understanding that both sub-basins are a part of the Yadkin River Basin.

GSWSA is a public water provider for Horry County, as well as, portions of Dillon County, Marion County, and Georgetown County in SC. The in-take structure for our major Surface Water Treatment Plant, the Bull Creek SWTP, is located on the Bull Creek which is a part of the Pee Dee River Basin and downstream the Yadkin River Basin. We want to ensure that the referenced IBT certificate does not negatively impact the flow entering the Pee Dee River Basin.

We request any additional information or comments available to the public regarding this matter. If you have any questions, please feel free to contact me at 843.443.8293 or by email at ceverett@gswsa.com.

Sincerely,

Christy S. Everett, P.E.
Chief Operations Officer

cc: Fred Richardson, Chief Executive Officer – GSWSA
Irv Wooley, Chief of Utility Operations – GSWSA
Tim Brown, Chief of Plant Operations – GSWSA

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D.5

NCDENR Draft EIS Interim Review Comments

July, 2015

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NCDENR

North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

MEMORANDUM

TO: Harold Brady
Division of Water Resources

FROM: Lyn Hardison
Division of Environmental Assistance and Customer Service
Permit Assistance & Project Review Coordinator

RE: Draft Environmental Impact Statement
Yadkin River Water Supply Project – Proposed Interbasin Transfer to Rocky River
Union Count
DENR Internal # 1637

Date: July 27, 2015

The NC Department of Public Safety Emergency Management requested to participate in NC Department Environment and Natural Resources internal review process and it was granted essentially to help expedite the environmental document for the applicant.

Both departments have completed their review of the proposal referenced project. Based on the information provided, the agencies identified permits that may be required and offered specific guidance that will assist the applicant in preparing the necessary environmental document. The comments are attached for the applicant's consideration.

The Department agencies will continue to be available to assist the applicant through the environmental review and permitting processes.

Thank you for the opportunity to respond.

Attachments

1639 Mail Service Center, Raleigh, North Carolina 27699-1639
Customer Service Toll Free 1-877-623-6748 \ Internet: www.ncdenr.gov

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

MEMORANDUM

TO: Lyn Hardison, Environmental Assistance and SEPA Coordinator
NCDENR Division of Environmental Assistance and Customer Services

FROM: Shari L. Bryant, Western Piedmont Coordinator
Division of Habitat Conservation

DATE: 15 July 2015

SUBJECT: Draft Environmental Impact Statement for Union County Yadkin River Water Supply Project – Proposed Interbasin Transfer to the Rocky River, Union County. DENR Project No. 1637.

Biologists with the North Carolina Wildlife Resources Commission (NCWRC) have reviewed the subject document and we are familiar with the habitat values of the area. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e), North Carolina Environmental Policy Act (G.S. 113A-1 through 113A-10; 1 NCAC 25) and North Carolina General Statutes (G.S. 113-131 et seq.).

Union County (County) is requesting an Interbasin Transfer (IBT) certificate for a maximum month average daily amount of 23 mgd (maximum day amount of 28 mgd) from the Yadkin River basin to the Rocky River basin. The County serves customers in the Catawba River basin and the Rocky River basin of the Yadkin River basin. The County has a 5 mgd IBT from the Catawba River basin to the Rocky River basin, and a 4 mgd water purchase agreement with Anson County. The requested IBT certificate would meet the 2050 water supply needs of the County.

Twelve alternatives were evaluated and Alternative 1 (raw water supply from Lake Tillery) is the preferred alternative. Lake Tillery and Rocky River and its tributaries in the Yadkin-Pee Dee River basin flow through the Alternative 1 project area. There are records for the federal species of concern and state endangered Carolina creekshell (*Villosa vaughaniana*) and yellow lampmussel (*Lampsilis cariosa*), and the federal species of concern and state significantly rare Septima's clubtail (*Gomphus septima*) within the Alternative 1 project area. Listed terrestrial species include the state significantly rare coachwhip (*Masticophis flagellum*) and the state special concern mole salamander (*Ambystoma talpoideum*). In addition, there are records for several federal and state listed species including the federal and state endangered Carolina heelsplitter (*Lasmigona decorata*) within the project's service area. The U.S. Fish and Wildlife Service recently listed the Northern long-eared bat (*Myotis septentrionalis*) as threatened under the Endangered Species Act. We suggest contacting the U.S. Fish and Wildlife Service at (828) 258-3939 to ensure that any issues related to this species and other federally listed species are addressed.

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

Direct Impacts

The preferred alternative is Alternative 1; however, it is unclear which Alternative 1 – A or B, or which water treatment plant (WTP) site (A, B, or C) will be part of the preferred alternative. We have no objection to the selection of Alternative 1. However, we support the selection of Alternative 1A and WTP A site. When compared to Alternative 1B and WTP B and C, Alternative 1A and WTP A site have less impact to forested lands, the 100-year floodplain, wetlands, perennial streams, and riparian buffers, and only slightly more impact to Natural Heritage Natural Areas and intermittent streams.

Streams and Wetlands

Although USGS topographic maps and National Wetland Inventory (NWI) maps provide a general overview of stream and wetland resources, these should not be used to determine whether the project will impact streams or wetlands. We recommend wetlands and streams within the project boundaries are identified through on-site surveys prior to any land disturbing activities. If wetlands and/or streams will be impacted by construction activities, then the project should be coordinated with the U.S. Army Corps of Engineers and the N.C. Division of Water Resources.

Water Intake Structure

The conceptual design for the facility includes a 48-inch diameter intake line with a 66-inch diameter screen and up to seven raw water pumps. Impingement and entrainment of aquatic life are anticipated. We offer the following recommendations regarding construction and operation of the water intake structure to minimize impacts to aquatic life:

- The water intake structure should use passive screens with openings not to exceed 1 centimeter and with a maximum intake velocity of 0.5 fps (feet per second).
- Dredging and lake drawdown (if needed) should not take place from March 15 to June 1 to prevent impacts to spawning fish.
- Excavated materials should not be stockpiled where sediment will erode to surface waters.
- Intake structures should be marked to reduce hazards to navigation during and after construction.
- Wet concrete is toxic to aquatic life. Construction procedures that prevent wet concrete from contacting surface waters should be used.
- Construction and operation of the water intake structure should adhere to any applicable provisions in the Lake Tillery Shoreline Management Plan.

Water Transmission Line

For Alternative 1A, the raw water transmission alignment from Lake Tillery to the new WTP would primarily follow road rights-of-way. Alternative 1B would primarily follow power utility easements. The raw water transmission line would be approximately 24 miles to WTP A and would extend an additional 7 to 8 miles for WTP B and WTP C. Open cut would be used to install the water line at stream crossings. We offer the following recommendations to minimize impacts to aquatic and terrestrial wildlife resources:

- We prefer the installation of water lines along road rights-of-way, where feasible. For water lines not installed within road rights-of-way, avoid the removal of large trees at the edges of construction corridors. Re-seed disturbed areas with seed mixtures that are beneficial to wildlife. Avoid fescue based mixtures because fescue is invasive and provides little benefit to wildlife. Minimize corridor maintenance and prohibit mowing between April 1 and October 1 to minimize impacts to nesting wildlife.

- If any water lines will be installed parallel to stream channels, then a minimum 100 foot setback for perennial streams and a 50-foot setback for intermittent streams and wetlands should be maintained.
- Stream crossings should be kept to a minimum. The directional bore (installation beneath the riverbed avoiding impacts to the stream and buffer) stream crossing method should be used wherever practicable, and the open cut stream crossing method should be used only when water level is low and stream flow is minimal. Stream crossings should be near perpendicular (75° to 105°) to stream flow.

Secondary and Cumulative Impacts

Additional impervious surface associated with new development results in an increase in stormwater runoff that can exert significant impacts on stream morphology. This will cause further degradation of aquatic habitats through accelerated stream bank erosion, channel and bedload changes, altered substrates, and scouring of the stream channel. In addition, pollutants (e.g., sediment, heavy metals, pesticides, and fertilizers) washed from roads and urban landscapes can adversely affect and extirpate species downstream of developed areas.

The County and local governments within the service area have measures to protect riparian buffers and manage stormwater and impervious surfaces mainly through NPDES Phase II Post Construction requirements and/or Water Supply Watershed Rules. However, most allow development within the 100-year floodplain. In addition, the *Site Specific Water Quality Management Plan for the Goose Creek Watershed* applies to portions of the service area. While some of these measures provide protection for aquatic and terrestrial wildlife resources, we are concerned that many of the measures may not be adequate to protect aquatic and terrestrial wildlife resources from impacts associated with additional new development facilitated by the project.

We recommend the County and local governments in the service area consider integrating additional measures to address the issues of development and its impact on water quality and aquatic and terrestrial wildlife habitat before degradation of area streams occurs. Adopting ordinances that protect wide forested riparian corridors and the 100-year floodplain and that adequately treat stormwater in development areas are essential to protect water quality and aquatic habitat in developing landscapes. NCWRC's *Guidance Memorandum to Address and Mitigate Secondary and Cumulative Impacts to Aquatic and Terrestrial Wildlife Resources and Water Quality* (August 2002; http://www.ncwildlife.org/Portals/0/Conserving/documents/2002_GuidanceMemorandumforSecondaryandCumulativeImpacts.pdf) details measures to minimize secondary and cumulative impacts to aquatic and terrestrial wildlife resources. The "Specific Mitigation Measures for Waters Containing Federally Listed Species" applies to those watersheds that support the Carolina heelsplitter. Also, the Green Growth Toolbox (http://www.ncwildlife.org/Conserving/Programs/GreenGrowthToolbox.aspx) provides information on nature-friendly planning.

Thank you for the opportunity to comment on this project. If we can be of further assistance, please contact our office at (336) 449-7625 or shari.bryant@ncwildlife.org.

ec: Chris Goudreau, NCWRC
Vann Stancil, NCWRC
Allen Ratzlaff, USFWS

NCDENR

North Carolina Department of Environment and Natural Resources

Office of Land and Water Stewardship

Pat McCrory Governor	Bryan Gossage Director	Donald R. van der Vaart Secretary

July 23, 2015

TO: Lyn Hardison, NCDENR State Clearinghouse Coordinator

FROM: Allison (Schwarz) Weakley, North Carolina Natural Heritage Program Allison Weakley

SUBJECT: Draft Environmental Impact Statement (EIS) – Proposed Interbasin Transfer (IBT) of up to 23 mgd of Raw Water from Yadkin River IBT Basin (Basin Code 18-1) to Rocky River IBT Basin (Basin Code 18-4) within Yadkin River Basin to serve Union County – Anson, Mecklenburg, Stanly, and Union Counties, North Carolina

REFERENCE: DENR Project No. 1637

Thank you for the opportunity to provide information from the North Carolina Natural Heritage Program (NCNHP) database for the proposed project referenced above. The NCNHP database shows numerous records for rare species, important natural communities, natural areas, and conservation/managed areas within or nearby the proposed project areas shown in EIS Figure 2-3.

We recommend that NCNHP data be used to identify known occurrences of natural heritage element occurrences (rare species and natural communities), natural areas, and conservation/managed areas that have been documented within and nearby the proposed project areas. For example, the NCNHP would be happy to provide site-specific project information for the rare species documented in Table 4-17 of the EIS.

Some site-specific natural heritage data may be viewed and accessed on the Natural Heritage Data Explorer (NHDE) available on the NCNHP website (www.ncnhp.org) under Data Services>Data Explorer Map. Alternatively, if provided with site-specific maps or Geographic Information System (GIS) data, we would be happy to provide more detailed information on natural heritage resources documented within and nearby the proposed project areas. In addition, the NCNHP Database Search webpage (http://ncnhp.org/web/nhp/database-search) may be used to access summary lists of rare species and natural communities that have been documented by county or topographic quadrangle.

Please note that the use of Natural Heritage Program data should not be substituted for actual field surveys if needed, particularly if the project areas contains suitable habitat for rare species. If rare species are found during field surveys, the NCNHP would appreciate receiving this information so that we may update our database.

Please feel free to contact me at Allison.Weakley@ncdenr.gov or 919-707-8629 if there are questions or additional information is needed.

NCDENR
North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

Date: July 2, 2015

To: Linda Culpepper, Director
Division of Waste Management

From: Pete Doorn, Special Remediation Branch Head

Subject: DENR Project #1637, Union County Yadkin River Supply Project, Union County, North Carolina

The Superfund Section has reviewed the Draft Environmental Impact Statement (EIS) for the Union County Yadkin River Supply Project. This project proposes an inter basin transfer between the Yadkin River Basin and the Rocky River Basin to support projected water demands in Union County through 2050. Twelve alternatives are evaluated and the preferred alternative is to utilize water from Lake Tillery by means of a new a pump station, transmission line and treatment plant.

CERCLIS and other contaminated sites under the jurisdiction of the Superfund Section are located within the project study area which covers portions of Anson, Stanley and Union Counties (see attached Fig. 2-3). It is unlikely that the increased withdrawal from Lake Tillery for use by customers in other watersheds would impact any known sites in the study area or vice versa. However, when final locations of the pump station, transmission lines, and water treatment plant are selected, it is recommended that Superfund Section maps and records be reviewed to understand where potentially contaminated soil or water may be encountered. The Superfund Section's website: http://portal.ncdenr.org/web/wm/sf, is a resource that includes location information for contaminated sites and access to online records.

If Union County wishes to reconsider non-preferred alternatives that rely on groundwater as a supplemental water supply, it is also recommended that the locations of known sources of contamination be re-evaluated.

Please contact me at 919.707.8369 if you have any questions.

Cc: Jim Bateson

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-707-8200 \ Internet: http://portal.ncdenr.org/web/wm

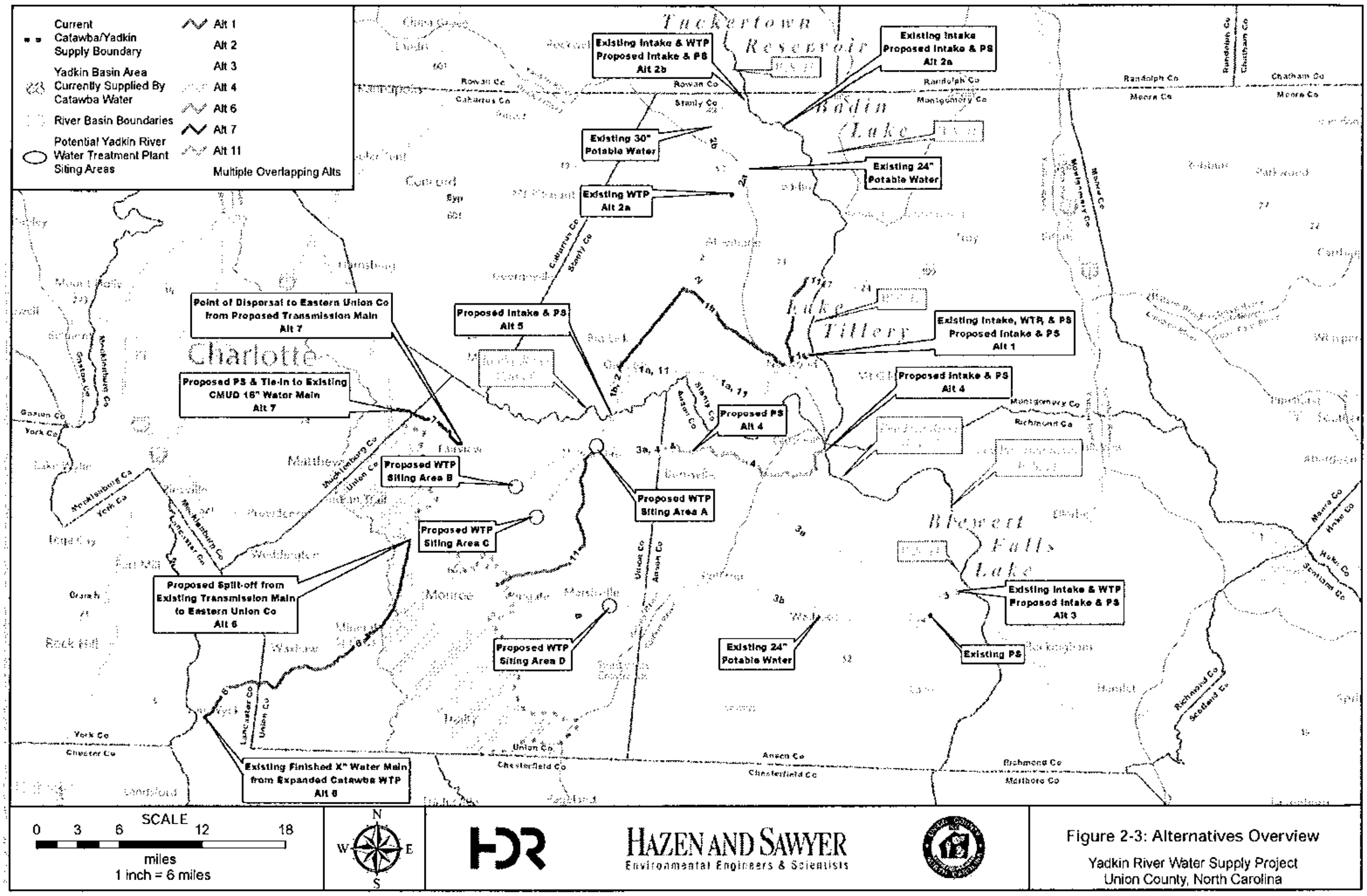

Figure 2-3: Alternatives Overview

Yadkin River Water Supply Project
Union County, North Carolina

NCDENR
North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

MEMORANDUM

DATE: July 15, 2015

TO: Linda Culpepper, Division Director through Sharon Brinkley

FROM: Deb Aja, Western District Supervisor - Solid Waste Section

Digitally signed by Deborah Aja
DN: cn=Deborah Aja, o=Solid Waste Section, ou, email=deborah.aja@ncdenr.gov, c=US
Date: 2015.07.15 09:23:00 -04'00'

RE: DENR Review - Project Number 1637, Union and Anson Counties
Union County IBT Certificate

The Solid Waste Section has reviewed the Draft Environmental Impact Statement for Union County to pursue an IBT certificate to transfer raw water from the Yadkin River IBT Basin to the Rocky River IBT of the Yadkin River Basin to meet the water supply needs of its current and future residents, and on behalf of the wholesale communities served by the County. A portion of the project is proposed to be located in Anson County. The review has been completed and has seen no adverse impact on the surrounding community and likewise knows of no situations in the community which would affect this project from a solid waste perspective.

During construction, Union County should make every feasible effort to minimize the generation of waste, to recycle materials for which viable markets exist, and to use recycled products and materials in the development of this project where suitable. Any waste generated by this project that cannot be beneficially reused or recycled must be disposed of at a solid waste management facility approved to manage the respective waste type. The Section strongly recommends that the County require its contractors to provide proof of proper disposal for all waste generated as part of the project. Permitted solid waste facilities available in the multi-county proposed project area are listed on the Solid Waste Section portal site at: http://portal.ncdenr.org/web/wm/sw/facilitylist.

Questions regarding solid waste management should be directed to Teresa Bradford, Environmental Senior Specialist, Solid Waste Section, at (704)-235-2160 or by email at teresa.bradford@ncdenr.gov.

Cc: Jason Watkins, Field Operations Branch Head
Dennis Shackelford, Eastern District Supervisor
Teresa Bradford, Environmental Senior Specialist
Sarah Rice, Compliance Officer

2090 US Highway 70, Swannanoa, North Carolina 28778
Phone: 828-296-4500 \ FAX: 828-299-7043 \ Internet: http://portal.ncdenr.org/web/wm

Department of Environment and Natural Resources
Project Review Form

Project Number	County	Date Received	Date Response Due
DENR # 1637	Union	6-24-2015	7-15-2015

Draft Environmental Impact Statement -Union County is pursuing an IBT certificate to transfer up to 23 mgd of raw water from the Yadkin River IBT Basin (Basin code 18-1) to the Rocky River IBT Basin (Basin code 18-4) of the Yadkin River Basin to meet the water supply needs of its current and future residents, and on behalf of the wholesale communities served by the County.

This project is being reviewed as indicated below:

Regional Office	Sections	In-House Review
☐ Asheville	☒ Air	☐ Marine Fisheries ☐ Coastal Management
☐ Fayetteville	☐ DWR – All Water Programs	☒ Waste Mgmt (Haz, solid, Inactive, Superfund & UST)
☒ Mooresville	☒ Land Quality & Stormwater Programs	☒ Air Quality ☒ CC & PS Div. of Emergency Mgmt.
☐ Raleigh	☒ UST	☐ Water Resources Management (Public Water, Planning & Water Quality Program)
☐ Washington	☒ Public Water	☐ Shellfish Sanitation
☐ Wilmington		☒ Parks & Recreation
☐ Winston-Salem		☐ DWR – Transportation Unit _____
		☒ Wildlife Shari Bryant
		☐ Wildlife (DOT) _____

Regional Coordinator Sign-off:	Date:	In-House Reviewer/Agency:
_____	June 29, 2015	John D. Brubaker, PE, CFM, NFIP Engineer, Risk Mgt, Dept of Public Safety

Response (check all applicable)

☒ No objection to project as proposed ☐ No comment

☐ Insufficient information to complete review ☐ Other (specify or attach comments)

The Draft Environmental Impact Statement appears to include all of the appropriate information regarding floodplain development and permitting requirements. The applicant should maintain contact with the local floodplain administrators during the permitting process to make sure all appropriate local floodplain permits are issued for the construction. For all work in the floodway or non-encroachment area, a No-Rise Certification or Conditional Letter of Map Revision should be approved by the local municipality prior to permitting and construction.

RETURN TO:
Lyn Hardison – Lyn.Hardison@ncdenr.gov, 252-948-3842

State of North Carolina
Department of Environment and Natural Resources
INTERGOVERNMENTAL REVIEW - PROJECT COMMENTS

Reviewing Office: MRO

Project Number __-1637 Due Date: 7/15/2015

County Union

After review of this project it has been determined that the ENR permit(s) and/or approvals indicated may need to be obtained in order for this project to comply with North Carolina Law. Questions regarding these permits should be addressed to the Regional Office indicated on the reverse of the form. All applications, information and guidelines relative to these plans and permits are available from the same Regional Office.

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☒	Permit to construct & operate wastewater treatment facilities, sewer system extensions & sewer systems not discharging into state surface waters.	Application 90 days before begin construction or award of construction contracts. On-site inspection. Post-application technical conference usual.	30 days (90 days)
☒	NPDES - permit to discharge into surface water and/or permit to operate and construct wastewater facilities discharging into state surface waters.	Application 180 days before begin activity. On-site inspection. Pre-application conference usual. Additionally, obtain permit to construct wastewater treatment facility-granted after NPDES. Reply time, 30 days after receipt of plans or issue of NPDES permit-whichever is later.	90-120 days (N/A)
☐	Water Use Permit	Pre-application technical conference usually necessary	30 days (N/A)
☐	Well Construction Permit	Complete application must be received and permit issued prior to the installation of a well.	7 days (15 days)
☐	Dredge and Fill Permit	Application copy must be served on each adjacent riparian property owner. On-site inspection. Pre-application conference usual. Filling may require Easement to Fill from N.C. Department of Administration and Federal Dredge and Fill Permit.	55 days (90 days)
☐	Permit to construct & operate Air Pollution Abatement facilities and/or Emission Sources as per 15 A NCAC (2Q.O100 thru 2Q.0300)	Application must be submitted and permit received prior to construction and operation of the source. If a permit is required in an area without local zoning, then there are additional requirements and timelines (2Q.0113).	90 days
☐	Permit to construct & operate Transportation Facility as per 15A NCAC (2D.0800, 2Q.0601	Application must be submitted at least 90 days prior to construction or modification of the source.	90 days
☐	Any open burning associated with subject proposal must be in compliance with 15 A NCAC 2D.1900	N/A	60 days (90 days)
☐	Demolition or renovations of structures containing asbestos material must be in compliance with 15 A NCAC 20.1110 (a) (1) which requires notification and removal prior to demolition. Contact Asbestos Control Group 919-707-5950.		
☐	Complex Source Permit required under 15 A NCAC 2D.0800		
☒	The Sedimentation Pollution Control Act of 1973 must be properly addressed for any land disturbing activity. An erosion & sedimentation control plan will be required if one or more acres to be disturbed. Plan filed with proper Regional Office (Land Quality Section) At least 30 days before beginning activity. A fee of **$65** for the first acre or any part of an acre. An express review option is available with additional fees.		20 days (30 days)
☐	Sedimentation and erosion control must be addressed in accordance with NCDOT's approved program. Particular attention should be given to design and installation of appropriate perimeter sediment trapping devices as well as stable stormwater conveyances and outlets.		(30 days)
☐	Mining Permit	On-site inspection usual. Surety bond filed with ENR Bond amount varies with type mine and number of acres of affected land. Any are mined greater than one acre must be permitted. The appropriate bond must be received before the permit can be issued.	30 days (60 days)
☐	North Carolina Burning permit	On-site inspection by N.C. Division Forest Resources if permit exceeds 4 days	1 day (N/A)
☐	Special Ground Clearance Burning Permit - 22 counties in coastal N.C. with organic soils	On-site inspection by N.C. Division Forest Resources required "if more than five acres of ground clearing activities are involved. Inspections should be requested at least ten days before actual burn is planned."	1 day (N/A)
☐	Oil Refining Facilities	N/A	90-120 days (N/A)
☐	Dam Safety Permit	If permit required, application 60 days before begin construction. Applicant must hire N.C. qualified engineer to: prepare plans, inspect construction, certify construction is according to ENR approved plans. May also require permit under mosquito control program. And a 404 permit from Corps of Engineers. An inspection of site is necessary to verify Hazard Classification. A minimum fee of $200.00 must accompany the application. An additional processing fee based on a percentage or the total project cost will be required upon completion.	30 days (60 days)

County Union	Project Number: __-1637 Due Date: 7/15/2015	
PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐ Permit to drill exploratory oil or gas well	File surety bond of $5,000 with ENR running to State of NC conditional that any well opened by drill operator shall, upon abandonment, be plugged according to ENR rules and regulations.	10 days N/A
☐ Geophysical Exploration Permit	Application filed with ENR at least 10 days prior to issue of permit. Application by letter. No standard application form.	10 days N/A
☐ State Lakes Construction Permit	Application fee based on structure size is charged. Must include descriptions & drawings of structure & proof of ownership of riparian property.	15-20 days N/A
☒ 401 Water Quality Certification	N/A	60 days (130 days)
☐ CAMA Permit for MAJOR development	$250.00 fee must accompany application	55 days (150 days)
☐ CAMA Permit for MINOR development	$50.00 fee must accompany application	22 days (25 days)
☐ Several geodetic monuments are located in or near the project area. If any monument needs to be moved or destroyed, please notify: N.C. Geodetic Survey, Box 27687 Raleigh, NC 27611		
☒ Abandonment of any wells, if required must be in accordance with Title 15A. Subchapter 2C.0100.		
☒ Notification of the proper regional office is requested if "orphan" underground storage tanks (USTS) are discovered during any excavation operation.		
☐ Compliance with 15A NCAC 2H 1000 (Coastal Stormwater Rules) is required.		45 days (N/A)
☐ Catawba, Jordan Lake, Randalman, Tar Pamlico or Neuse Riparian Buffer Rules required.		
☒ Plans and specifications for the construction, expansion, or alteration of a public water system must be approved by the Division of Water Resources/Public Water Supply Section prior to the award of a contract or the initiation of construction as per 15A NCAC 18C .0300 et. seq. Plans and specifications should be submitted to 1634 Mail Service Center, Raleigh, North Carolina 27699-1634. All public water supply systems must comply with state and federal drinking water monitoring requirements. For more information, contact the Public Water Supply Section, (919) 707-9100.		30 days
☒ If existing water lines will be relocated during the construction, plans for the water line relocation must be submitted to the Division of Water Resources/Public Water Supply Section at 1634 Mail Service Center, Raleigh, North Carolina 27699-1634. For more information, contact the Public Water Supply Section, (919) 707-9100.		30 days

Other comments (attach additional pages as necessary, being certain to cite comment authority)

Division	Initials	No comment	Comments	Date Review
DAQ		☐		/ /
DWR-WQROS (Aquifer & Surface)	JB	☐ ☐		7/13/15 / /
DWR-PWS	JHW	☐	All proposed transmission mains and proposed treatment plants must be reviewed and approved by the PWSS.	6/24/15
DEMLR (LQ & SW)	ZSK	☐	Erosion and sediment control permit is required and Stormwater permit may be required.	6/30/15
DWM - UST	RHT	☐	RE: Project Review: 1637 The following comments are pertinent to my review: 1. The Mooresville Regional Office (MRO) UST Section recommends removal of any abandoned or out-of-use petroleum USTs or petroleum above ground storage tanks (ASTs) within the project area. The UST Section should be contacted regarding use of any proposed or on-site petroleum USTs or ASTs. We may be reached at 704-663-1699. 2. Any petroleum spills must be contained and the area of impact must be properly restored. Petroleum spills of significant quantity must be reported to the North Carolina Department of Environment & Natural Resources – Division of Waste Management Underground Storage Tank Section in the Mooresville Regional Office at 704-663-1699. 3. Any soils excavated during demolition or construction that show evidence of petroleum contamination, such as stained soil, odors, or free product must be reported immediately to the local Fire Marshall to	6/29/15

			determine whether explosion or inhalation hazards exist. Also, notify the UST Section of the Mooresville Regional Office at 704-663-1699. Petroleum contaminated soils must be handled in accordance with all applicable regulations. If you have any questions or need additional information, please contact me at Ron.Taraban@ncdenr.gov or by phone at 704-235-2167.	

REGIONAL OFFICES

Questions regarding these permits should be addressed to the Regional Office marked below.

☐ **Asheville Regional Office**
2090 US Highway 70
Swannanoa, NC 28778
(828) 296-4500

☒ **Mooresville Regional Office**
610 East Center Avenue, Suite 301
Mooresville, NC 28115
(704) 663-1699

☐ **Wilmington Regional Office**
127 Cardinal Drive Extension
Wilmington, NC 28405
(910) 796-7215

☐ **Fayetteville Regional Office**
225 North Green Street, Suite 714
Fayetteville, NC 28301-5043
(910) 433-3300

☐ **Raleigh Regional Office**
3800 Barrett Drive, Suite 101
Raleigh, NC 27609
(919) 791-4200

☐ **Winston-Salem Regional Office**
450 West Hanes Mill Road, Suite 300
Winston-Salem, NC 27105
(336) 771-9800

☐ **Washington Regional Office**
943 Washington Square Mall
Washington, NC 27889
(252) 946-6481

Department of Environment and Natural Resources
Project Review Form

Project Number DENR # 1537	County Union	Date Received 6-24-2015	Date Response Due 7-15-2015
Draft Environmental Impact Statement -Union County is pursuing an IBT certificate to transfer up to 23 mgd of raw water from the Yadkin River IBT Basin (Basin code 18-1) to the Rocky River IBT Basin (Basin code 18-4) of the Yadkin River Basin to meet the water supply needs of its current and future residents, and on behalf of the wholesale communities served by the County.			

This project is being reviewed as indicated below:

Regional Office	Sections	In-House Review
☐ Asheville ☐ Fayetteville ☒ Mooresville ☐ Raleigh ☐ Washington ☐ Wilmington ☐ Winston-Salem	☒ Air ☒ DWR – All Water Quality Programs ☒ Land Quality & Stormwater Programs ☒ UST ☒ Public Water	☐ Marine Fisheries ☐ Coastal Management ☒ Waste Mgmt (Haz, Solid, Inactive, Superfund & UST) ☒ Air Quality ☒ CC&PS Div. of Emergency Management ☐ Water Resources Management (Public Water, Planning & Water Quality Programs) ☐ Shellfish Sanitation ☒ Parks & Recreation ☐ DWR – Transportation Unit_____ ☒ Wildlife Shari Bryant ☐ Wildlife (DOT) _____

Regional Coordinator Sign-off:	Date:	In-House Reviewer/Agency:
_____	7/13/15	[signature] / Hazardous Waste Section

Response (check all applicable)

☐ No objection to project as proposed ☑ No comment

☐ Insufficient information to complete review ☐ Other (specify or attach comments)

RETURN TO:
Lyn Hardison SEPA@ncdenr.gov , 252-948-3842
943 Washington Square Mall
Washington N C 27889
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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Asheville Field Office 160
Zillicoa Street
Asheville, North Carolina
28801

July 17, 2015

Mr. Harold M. Brady
NCDENR, Division of Water
Resources
1601 Mail Service Center
Raleigh, NC 27699-1601

Dear Mr. Brady:

Subject: Draft Union County Interbasin Transfer Environmental Impact Statement

We received your letter dated June 23, 2015 (received June 25, 2015), transmitting and requesting our comments on the subject project. We have reviewed the information presented and we are providing the following comments in accordance with the provisions of the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661-667e); the National Environmental Policy Act (42 U.S.C.§ 4321 et seq.); and section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543) (Act).

Union County (County) is requesting an Interbasin Transfer (IBT) certificate for a maximum month average daily amount of 23 million gallons per day (mgd) (maximum day amount of 28 mgd) from the Yadkin River basin to the Rocky River basin. The County serves customers in the Catawba River basin and the Rocky River basin of the Yadkin River basin. The County has a 5 mgd IBT from the Catawba River basin to the Rocky River basin, and a 4 mgd water purchase agreement with Anson County. The requested IBT certificate would meet the 2050 water supply needs of the County.

Twelve alternatives were evaluated and Alternative 1 (raw water supply from Lake Tillery) is the preferred alternative. Lake Tillery and Rocky River and its tributaries in the Yadkin-Pee Dee River basin flow through the Alternative 1 project area. However, it is unclear which Alternative 1 – A or B, or which water treatment plant (WTP) site (A, B, or C) will be part of the preferred alternative. We have no objection to the selection of Alternative 1. However, we support the selection of Alternative 1A and WTP A site. When compared to Alternative 1B and WTP B and C, Alternative 1A and WTP A site have less impact to forested lands, the 100-year floodplain, wetlands, perennial streams, and riparian buffers.

We are concerned with the stream-crossing technique (open-cut trenching) that is being proposed for this project. From our past experiences with similar projects, we believe this technique increases the likelihood of future lateral movement of the stream (which could undercut or erode around the utility line), and the correction of these problems could result in additional future maintenance and impacts to the stream. Therefore, we recommend the use of directional boring under the stream in order to prevent stream impacts. All utility crossings should be kept to a minimum, and all utility infrastructures should be kept out of riparian buffer areas. Directional boring under streams significantly minimizes impacts to aquatic resources and riparian buffers. If this method cannot be used and trenching is determined to be the only viable method, the crossing should be made perpendicular to the stream flow, and we recommend the development of a stream-bank monitoring and maintenance program that would allow for the prompt stabilization of stream banks near the utility crossing (should any stream-bank erosion or destabilization occur) throughout the life of this project. If any water lines will be installed parallel to stream channels, then a minimum 100 foot setback for perennial streams and a 50-foot setback for intermittent streams and wetlands should be maintained.

The draft EIS mistakenly refers to "Federal Species of Concern" as "federally listed species." Federal Species of Concern (FSC) are not only not federally listed species but they are not legally protected under the Endangered Species Act and are not subject to any of its provisions, including section 7. Including FSCs in the comparison of alternatives as listed species does not provide an accurate representation of potential impacts on species listed under the Endangered Species Act.

All of the alternatives have the potential to impact one or more federally listed species (Michaux's sumac, Carolina heelsplitter, Schweinitz's sunflower, smooth coneflower, red-cockaded woodpecker, or northern long-eared bat) and any selected alternative will thus, as noted in the EIS, require a survey of suitable habitat within the selected route. Of particular concern is the possible direct effects of Alternative 7 on the federally endangered Carolina heelsplitter. This alternative would cross both Goose and Duck Creeks – two of the last three streams known to harbor this extremely rare species in North Carolina (Waxhaw Creek in Union County is the third location). Alternative 7 would likely require formal consultation with our agency.

Of as much concern as the potential adverse impacts of the direct impacts of this project are the secondary impacts, particularly the increase in impervious surfaces. Additional impervious surface associated with new development results in an increase in stormwater runoff that can exert significant impacts on stream morphology. This will cause further degradation of aquatic habitats through accelerated stream bank erosion, channel and bedload changes, altered substrates, and scouring of the stream channel. In addition, pollutants (e.g., sediment, heavy metals, pesticides, and fertilizers) washed from roads and urban landscapes can adversely affect and extirpate species downstream of developed areas.

We acknowledge that the County and local governments within the service area have some measures to protect riparian buffers and manage stormwater and impervious surfaces, mainly through NPDES Phase II Post Construction requirements and/or Water Supply Watershed Rules.

However, most allow development within the 100-year floodplain. In addition, the *Site Specific Water Quality Management Plan for the Goose Creek Watershed* applies to portions of the service area. While some of these measures provide protection for aquatic and terrestrial wildlife resources, we are concerned that many of the measures may not be adequate to protect aquatic and terrestrial wildlife resources from impacts associated with additional new development facilitated by the project.

We recommend the County and local governments in the service area consider integrating additional measures to address the issues of development and its impact on water quality and aquatic and terrestrial wildlife habitat before degradation of area streams occurs, particularly in the Goose, Duck, and Waxhaw Creek watersheds. Adopting ordinances that protect wide forested riparian corridors and the 100-year floodplain and that adequately treat stormwater in development areas are essential to protect water quality and aquatic habitat in developing landscapes. The North Carolina Wildlife Resource Commission's (NCWRC) *Guidance Memorandum to Address and Mitigate Secondary and Cumulative Impacts to Aquatic and Terrestrial Wildlife Resources and Water Quality* (August 2002; http://www.ncwildlife.org/Portals/0/Conserving/documents/2002_GuidanceMemorandumforSecondaryandCumulativeImpacts.pdf) details measures to minimize secondary and cumulative impacts to aquatic and terrestrial wildlife resources. The "Specific Mitigation Measures for Waters Containing Federally Listed Species" applies to those watersheds that support the Carolina heelsplitter. Also, the Green Growth Toolbox (http://www.ncwildlife.org/Conserving/Programs/GreenGrowthToolbox.aspx) provides information on nature-friendly planning.

Thank you for allowing us to comment on this project. If you have any questions, please contact Mr. Allen Ratzlaff of our staff at 828/258-3939, Ext. 229. In any future correspondence concerning this project, please reference our Log Number 4-2-15-425.

cc:

Ms. Shari L. Bryant, Eastern Piedmont Region Permit Reviewer, North Carolina Wildlife Resources Commission, P.O. Box 129, Sedalia, NC 27342-0129

D.6

Draft EIS Summary of Comments and Responses

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Draft Environmental Impact Statement Comments and Response to Comments (From Public Comment Period 8/31/2015 to 11/16/2015)

A. Commenter(s): Duke Energy (Date 10/14/2015)

Comment #	Request or Comment	Response to Comment
A.1	**Executive Summary and Numerous Places in the Document:** There are incorrect references to the Yadkin River in the Draft EIS which should correctly refer to the Pee Dee River. The Yadkin River becomes the Pee Dee River at the confluence of the Uwharrie River and the Yadkin River in the headwaters of Lake Tillery. The intake location for the preferred alternative is in Lake Tillery, downstream of the Uwharrie River, and therefore in the Pee Dee section of the river. We understand the entire source basin is called the Yadkin River in the State regulation governing IBTs, thus the references to the Yadkin IBT River Basin; however, many other references should be changed to either the Yadkin-Pee Dee River or the Pee Dee River.	References to the "Yadkin River" and "Pee Dee River" have been updated throughout the document to more accurately reflect the appropriate river name, based on location, in response to the reviewer's comment.
A.2	**Executive Summary, page ES-1:** Water needs in the County's Yadkin IBT River Basin Service Area are projected to increase from a current (2013) maximum month average daily demand of 7.7 million gallons per day (mgd) to 28.9 mgd by 2050 (equivalent to a current maximum daily demand of 9 mgd to 35.3 mgd by 2050). This equates to an Annual Growth Rate (AGR) of 3.5% per year. This number is higher than the projections for some comparable neighboring Catawba-Wateree River Basin water suppliers (e.g., Town of Mooresville, 1.47% annual growth rate, etc.). This larger growth rate should be explained in greater detail (e.g., service area expansion, etc.).	Water demand growth rates are based on both Union County population growth projections and projected service area expansion of Union County's water system within its Yadkin River Basin Service Area. These projections, assumptions and growth rates are presented in Section 2.3. Additionally, Tables 2-1 and 2-2 reflect the service area growth projections for Union County's water system. The Executive Summary has been updated to include a brief reference to the water demand increase being a result of projected county population growth and Union County water system service area growth, while also referencing Section 2.3 for additional details on the basis for the projections. It is important to note that comparison of the Union County water system to the Town of Mooresville is not a "best fit" comparison. Several distinct differences between these two water systems exist which affect the potential for future system demand growth. The Town of Mooresville is a municipal (city) system, with its customer base essentially limited to the jurisdiction of the city limits. Thus, there is

Comment #	Request or Comment	Response to Comment
		limited ability for system expansion and new customer growth will be limited to either infill development or annexation. Union County, however, is a county-wide system, which currently serves a limited portion of the county in its Yadkin River Basin Service Area (Rocky River IBT Basin). Over the last 15 years, Union County has been one of the fastest growing counties in North Carolina and, at times, one of the fastest growing counties in the nation. With the extent of growth having previously occurred in the County's Catawba River Basin Service Area, growth is now being experienced within the County's Yadkin River Basin Service Area. Such growth in this area is projected to intensify and also presents the need for system expansion within this area to serve both current and future residents. Such considerations have been made in the development of Union County's water demand projections within the EIS and are indicative of sustained growth Union County has experienced in the past and is expected to experience in the future.
A.3	**For Illustration ES-1 and other similar images**, the 2050 12-mile Water Reclamation Facility (WRF) return to the Catawba River Basin combined with the 2050 IBT from the Catawba Basin is confusing and seems to imply a net increase to the Catawba River Basin.	While Illustrations ES-1 and 2-3 may seem to indicate a net increase to the Catawba River Basin, it should be considered that the illustrations are simply intended to reflect representative water supply and wastewater discharge rates for current and future (2050) years. Based on water and wastewater demand projections established for this EIS, there is not necessarily a proposed net increase to the Catawba River Basin as part of this project. The projected water transfer from the Catawba to Yadkin River Basins under Union County's existing grandfathered IBT is projected to remain between 0 and 5 mgd over the course of the planning period for the Yadkin River Water Supply project. The values shown within these two illustrations are not necessarily intended to represent net transfer amounts due the following considerations: 1) The illustrations present <u>maximum month</u> average day water supply volumes and <u>average annual daily</u> wastewater return values. A true water transfer amount is calculated based on actual water supplied form a source basin on a given day minus the amount returned on a given day. Therefore, the full

Comment #	Request or Comment	Response to Comment
		impact of a water transfer amount is estimated by maximum month average day water supply (typically a hot, dry month when water use is highest) minus minimum month sewer flow (corresponding hot, dry month when sewer flow is lowest due to reduced inflow and infiltration). 2) Wastewater return values depicted in the illustrations are based on Union County assumptions for future scalping of wastewater flow from the Crooked Creek WRF and pumping of wastewater from the Poplin Road Pump Station to the 12 Mile WRF. Actual future transfer amounts will be based on decisions of Union County Public Works made in the future related to infrastructure expansion, with due consideration given to transfer limits.
A.4	**Alternative 3A** relies on running a water transmission line along Duke Energy electric transmission rights-of-way for a portion of the route. Duke Energy's transmission line crossing guidelines do not allow water transmission lines to run along electric transmission line rights-of-way at angles greater than 30 degrees from the perpendicular line to the electric transmission right-of-way.	Based on this comment, it appears Alternative 3A will not be possible based on Duke Energy transmission line crossing guidelines. A brief discussion outlining these requirements, as indicated in the comment, has been added to the EIS document for discussion of Alternative 3A.
A.5	**In Section 2.3**, there is a conservative assumption that the "per-capita" demand rate will remain at 120 gallons per capita per day (gpcd). This rate is higher than the Catawba-Wateree Water Management Group (CWWMG) Water Supply Master Plan current residential use (85 gpcd) and reduction target (70 gpcd) for the next fifty years. A brief discussion should be included comparing the assumptions for the two different numbers (e.g., residential versus total water use, etc.).	As indicated in Section 2.3, the 120 gallons per capita per day (gpcd) water demand rate used for Union County's projections in the EIS are based upon the total water demand (inclusive of all categorical uses (residential, industrial, institutional, etc.), process uses (water treatment backwash, line flushing, etc.) and unaccounted system losses. The 85 gpcd and reduction target of 70 gpcd referenced in the CWWMG Water Supply Master Plan are residential category water demand rates, and therefore, comparison between the 120 gpcd used for the Union County total water demand and the CWWMG Water Supply Master Plan residential water demand are not applicable. However, Section 2.3 has been updated to include a brief comparison of how the Union County residential water demand projection compares to the CWWMG Water Supply Master Plan residential water use values, as requested by the commenter.

Comment #	Request or Comment	Response to Comment
A.6	**Section 2.6.3 - Low Inflow Protocol (LIP) for the Yadkin & Yadkin-Pee Dee River Hydroelectric Projects:** Clarification is needed as to who would be required to abide by the Yadkin-Pee Dee LIP (i.e., the intake owner and/or some other entity).	The text within the Draft EIS, Section 2.6.3, currently includes a statement of the following, "If granted an IBT certificate to transfer water from one of the reservoirs of the Yadkin-Pee Dee River Basin governed by the LIP, Union County would also be required to abide by such LIP requirements." While this statement clearly indicates Union County would be required to abide by this LIP, for the purposes of this LIP, a "Public Water System" is any publicly or privately owned water system that supplies potable water to the public having an instantaneous withdrawal capacity of one million gallons per day or more, and withdraws from storage in the projects' reservoirs. Further, the LIP defines membership of Public Water Systems to the Yadkin-Pee Dee River Basin Drought Management Advisory Group (YPD-DMAG) as "all owners of a Public Water System intake or a Non-Public Water User's intake that withdraw from storage in one of the projects' reservoirs." Members of the YPD-DMAG agree to comply with this LIP. Under the provisions of the 2013 Interlocal Intake and Transmission Agreement between Union County and the Town of Norwood, both parties would jointly own the expanded raw water intake in Lake Tillery and the above ground structure (pump station) housing each of Union County's and Norwood's raw water pumps. Based on this joint ownership of the raw water intake, both Union County and Norwood would be members of the YPD-DMAG and required to comply with the Low Inflow Protocol for the Yadkin & Yadkin-Pee Dee River Hydroelectric Projects. These additional clarifications have been added to Section 2.6.3, as recommended by the commenter.
A.7	**Section 4.12 – Water Resources (Surface Water and Groundwater):** Reservoir levels and hydropower production should appropriately be listed as "affected environments".	A new subsection (4.12.4) has been included in Section 4.12 to address Existing Surface Water Quantity including reservoir levels and hydropower production as affected environments.

Comment #	Request or Comment	Response to Comment
A.8	**Section 5.8 - Air Quality:** The effects of less hydropower production on air quality should be discussed briefly (e.g., relatively minor impact, etc.)	Section 5.8.1 has been updated to indicate the negligible to minor impacts to hydropower generation and thus the minimal impacts to air quality in this regard.
A.9	**Section 5.12.2.6 - Direct Impacts – Yadkin River Basin Water Quantity:** **a. In Table 5-11 Period of Record (1955 to 2013) Lake Aesthetics (Elevation) Impacts,** Based on % of Time End of Day Elevations within Particular Range of Rule/Guide Curve or Full Pond Elevation, (along with Tables 5-12 and 5-13), the actual range analyzed should be added to each table. Also, this section characterizes impacts on lake level in tabular form, assigning designations of impact such as 'negligible' or 'minor', etc. Lake level duration curves should be provided for each of the alternatives showing differences between scenarios in impacts on lake levels. Additionally, simulated lake levels for Blewett Falls Lake and Lake Tillery should be shown graphically for all IBT scenarios during the drought of record and assuming future demands. b. In the Reservoir Discharge discussion for Lake Tillery (page 262), the statement “Even withdrawals from the Rocky River would have a minor impact to Lake Tillery releases…” is an unclear conclusion given the Rocky River discharge is downstream of Lake Tillery. This should be removed or explained in more detail. c. Tables 5.26 – 5.28 (page 268) discuss hydropower generation impacts due to the IBT withdrawals. The lost hydropower would result in a slight increase in fossil generation that should be mentioned as a minor impact.	a. Graphical output for CHEOPS modeling results is included in Appendix E, CD-2 for Yadkin River Basin modeling results and in Appendix E, CD-3 for Catawba River Basin modeling results. These appendices contain the quantitative results of the modeling in Performance Measure Sheets (PMS) as referenced in the body of the EIS document, as well as Reservoir Operational Detail Histograms, Hydropower Generation Detail Histograms, Elevation Exceedance Curves, Storage Exceedance Curves, Elevation and Storage Comparison Charts, Outflow Exceedance Curves, and Hydropower Generation Comparison Charts for each reservoir and all modeling scenarios. We believe these appendices sufficiently address the commenter’s request. b. This conclusion is accurate, as withdrawals from the Rocky River would reduce inflow to Blewett Falls Lake. Per operational rules of the Yadkin-Pee Dee Hydroelectric Project, the reduced inflow of the Rocky River into the Pee Dee River upstream of Blewett Falls Lake would subsequently result in impacts to the Lake Tillery releases, according to the CHEOPS model results. The following additional explanation has been added to this section to more clearly explain this conclusion: “In the CHEOPS model and in actual operation, any required operating parameter for Blewett Falls will be supported by Tillery since they are the same licensee. An example is when the total Blewett Falls outflows (continuous flow requirement, withdrawals and losses due to evaporation and leakage) cannot be met on any given day from the sum of Blewett Falls usable storage and inflows, Tillery will be scheduled to release sufficient flow to allow Blewett Falls to make the required release without having to violate its minimum elevation rule. Thus, when inflows to Blewett Falls are reduced due to

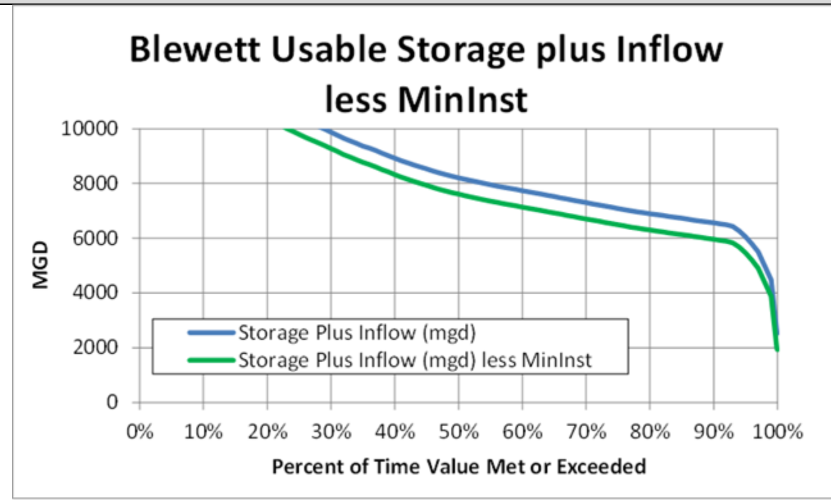
Comment #	Request or Comment	Response to Comment
		withdrawals from Rocky River, Tillery may need to release additional flows during low flow periods to ensure Blewett Falls' outflows are met." c. The following text (see underlined) has been added to the discussion before Tables 5.26 – 5.28 to address the comment: "Increases in system water withdrawals can reduce the available water storage by which APGI and Duke Energy Progress are able to access from the reservoirs they operate, in order to produce hydropower. Such reductions to hydropower production would result in slight increases in fossil-based power generation to continue meeting energy demands. As such, this is an important metric to evaluate in the comparison of IBT alternatives for Union County.
A.10	**Section 5.12.3.6. Direct Impacts – Catawba River Basin Water Quantity - In Table 5-34, Lake Aesthetics (Elevation) Impacts, Alternative 6** (presumed increased withdrawal from the lower Catawba River Basin) shows a small impact in the upper Catawba River Basin, but Alternative 7 does not. The result may be modeling "noise", but does seem unusual.	The model output files show that Alternative 6 (UC-Alt6_UC2050_2012) and Alternative 7 (UC-Alt7_UC2050_2012) both spend 3 months in LIP stage 2, the most severe stage of LIP during these scenario runs. The next most severe LIP stage with different flow requirements than LIP "normal" (-1) is LIP stage 1, and Alternative 7 spends three additional months in this LIP stage than Alternative 6. This causes the withdrawals, required reservoir outflows, bypass flows and other requirements to be reduced when compared to their default (LIP "normal" and LIP "monitor" (LIP stage = -1 or 0)) conditions. Due to less required outflows in Alternative 7, the reservoirs are able to retain more water in storage, staying closer to the reservoir target elevation. This is represented as no end of day elevation differences between Alternative 7 when compared to Base Case. Since Alternative 6 has higher outflow requirements, its end of day elevations differ slightly when compared to Base Case.

B. Commenter(s): Anson County (Date 10/19/2015)

Comment #	Request or Comment	Response to Comment
B.1	On behalf of Anson County, I am writing to express our concerns regarding Union County's request for a 23.0 million gallons per day (MGD) Interbasin Transfer (IBT) from the Yadkin River basin to the Rocky River basin.	Comment is noted.
B.2	Anson County draws all of its water from Blewett Falls Lake on the Yadkin-Pee Dee River. We understand that Union County's proposed point of transfer is Lake Tillery above Anson County's water intake. We have reviewed the draft Environmental Impact Statement (EIS) for the project and understand that the document concludes that under normal conditions the proposed project is not likely to adversely impact our ability to withdraw needed water at our raw water intake. However, during drought conditions and prolonged low flow period we are greatly concerned about the potential impact on our ability to serve citizens of Anson County and neighboring Richmond County.	The results of the CHEOPS water quantity modeling evaluations for the Yadkin-Pee Dee River Basin for this EIS, as summarized within Section 5.12 of the EIS, and as presented, in detail, in Appendix E, CD-2, identify the impacts of the proposed Union County IBT under both normal and low flow periods. In fact, model evaluations and impacts were assessed for three distinct hydrologic periods: 1) Period of Record (1955 to 2013), Drought 1 (significant low flow period in the basin from 1999 to 2003) and Drought 2 (significant low flow period in the basin from 2006 to 2009). In regards to the commenter's concern for its water interests in Blewett Falls Lake, the results for lake elevations and water withdrawal ability for existing intakes, as presented in Section 5.12.2.6, indicate no adverse impact to Anson County's ability to withdraw water from Blewett Falls lake under normal or low flow conditions, both now and in the future, even as basin-wide water demands grow. Quantitative modeling results to substantiate this conclusion is contained in the approximately 900-plus pages of model output (Performance Measure Sheets and model output charts) contained in Appendix E, CD-2 of this EIS.
B.3	Anson County has recently assumed the role of sole water supplier for the Town of Wadesboro in addition to other communities that rely solely on Anson County for their potable water supply. We are also seeing signs of increased agribusiness development within our county. So, just like Union County, we want to be sure we have adequate water resources to meet the needs of our citizens and businesses now and into the future.	Comment is noted. To account for this projected population, economic and water demand growth throughout the Yadkin-Pee Dee River Basin, the CHEOPS water quantity modeling for the proposed Union County IBT evaluated two conditions for water use through the basin: 1) Basin-wide water demands under current (Year 2013) water use) and 2) Basin-wide water demands under future (Year 2050) water use. In doing this, the EIS is able to evaluate the potential impacts of the Union County IBT both now and in the future, while accounting for projected future increases in water needs by other entities which may currently withdraw water from Yadkin-Pee Dee River and its impounded reservoirs or others who may have needs for water in the future. Under both scenarios, the modeling indicates Anson County's

Comment #	Request or Comment	Response to Comment
		ability to obtain its needed water from Blewett Falls Lake will not be adversely impacted. The basis for the water demand projections is summarized in Sections 5.12.2.2 and 5.12.2.3 and described in detail in Appendix E, CD-4.
B.4	The draft EIS includes summary data from CHEOPS modeling performed for various IBT scenarios. The conclusion of the report is that there would only be a "negligible" (as defined in the draft) impact to the downstream water intakes within Blewett Falls Lake and "minor" impacts to lake elevations and lake discharges, even under drought conditions. While the Yadkin Basin has not recently been in a period of severe drought, a September 18, 2015 release from ALCOA states that "Water inflow into the Yadkin Basin is down nearly 50 percent from historical average" and "APGI requested and received a temporary variance from the Federal Energy Regulatory Commission (FERC) to conserve water by reducing required minimum flows out of the Yadkin Project". Statements like these raise doubts in our minds as to what will happen in the future during periods of drought. ALCOA and Duke Energy work in conjunction to manage water levels and flows in the Yadkin River Basin. When low flow characteristics become more severe and prolonged droughts returns, will adequate water still be available for release from Lake Tillery to maintain Blewett Falls Lake levels and releases below the dam? With competing demands for the water in the Yadkin system from its many users, long term future water demands have to be considered.	The system operating rules defined in the Federal Energy Regulatory Commission (FERC) relicensing applications and Settlement Agreements for the two Yadkin-Pee Dee River Basin hydropower projects, including the Alcoa (APGI) operated Yadkin Hydroelectric Project and Duke Energy Progress operated Yadkin-Pee Dee Hydroelectric Project, are incorporated into the CHEOPS model used as part of the extensive water quantity modeling completed for this EIS. These operating rules define the required operational parameters for reservoirs between High Rock Lake and Blewett Falls Lake, with consideration given to minimum lake levels, required downstream releases and operations during periods of normal, high and low inflow. For operation of the reservoirs during low inflow periods (drought), the modeling specifically incorporates the approved basin-wide drought plan, the Low Inflow Protocol (LIP). The modeling for this EIS evaluated each Union County water supply alternative from the Yadkin River Basin under these defined reservoir operating rules, for the full period of hydrology from 1955 to 2013, with consideration given to two very significant drought periods (1999 to 2003 (Drought of Record) and 2006 to 2009). Furthermore, the effect of potentially more severe future droughts was also evaluated as part of the water quantity modeling effort through the incorporation of future climate change impacts to water by modeling increased reservoir evaporation due to future increasing temperatures. Modeling results incorporating these factors indicates that, under the proposed Union County withdrawal, there currently is and will continue to be sufficient available water for release from Lake Tillery to maintain Blewett Falls Lake levels and releases below the dam. With respect to competing demands for water in the Yadkin system, long term future water demands have been considered as part of the modeling effort for this EIS. In fact, a special effort was made to

Comment #	Request or Comment	Response to Comment
		develop basin-wide water demand projections (withdrawals and projections) through the year 2060 were made for all current and potential future water uses throughout the basin, and not solely for Union County. The effects of these future water uses have been modeled as part of this EIS. Detailed information on the basin-wide water demand projections for this EIS may be found as part of Appendix E, CD-4, Section 4.2.
B.5	In Figure A (*reference Anson County letter dated 10/19/2015*), the USGS stream gauge 02129000 near Rockingham shows stream flows varying from a normal high of approximately 8,000 CFS (5,169 MGD) to a low of less than 200 CFS (129 MGD). 23 MGD is an insignificant percentage of 5,169 MGD but it's over 10 percent of the 129 MGD low flow. This again gives us concern about the impact of the proposed IBT request. Anson County undertook a significant project in the past to create a new, emergency intake at a lower elevation in Blewett Falls Lake due to drought conditions, but it might not be possible to accomplish this type of project again should the lake levels be even lower than experienced in the past.	The use of the gaged river flows at USGS 02129000 for estimating likely future availability of water in Blewett Falls reservoir does not take into account future operating conditions under which Duke and Alcoa operate, including the Low Inflow Protocol and other components of the Comprehensive Settlement Agreement (CSA). Per the CSA, Tillery will receive no less than 1000 cfs daily average flow from Falls during normal conditions (June through December), and will receive no less than 770 cfs during LIP stage 4 (June through December). Since Duke Energy operates Tillery and Blewett Falls powerhouses, Duke is required to ensure that any flow requirement from Blewett Falls, whether minimum streamflows, storage support for withdrawals, or elevation requirements, are supported through coordinating operations with Tillery. The modeled inflow into Blewett Falls reservoir in scenario Alternative 1 with 2050 consumptive withdrawal rate, including Tillery discharge and incremental accretions, plus the usable storage from Blewett Falls reservoir, shows sufficient water to support approximately 2,530 MGD on a single day, not including usable water in Tillery that could be released to provide additional support. This is shown as the blue series in the below graph. During periods of LIP stage 4, where the minimum instantaneous flow requirement at Blewett Falls drops to 925 cfs (598 MGD), there is enough water in Blewett Falls to support 1,932 MGD for a single day, not including storage in Tillery. This is shown as the green series in the graph below.

Comment #	Request or Comment	Response to Comment
		 From this usable storage less minimum instantaneous river flow time series, the requirements of water withdrawals and losses to evaporation would be met. Any inflow in excess of withdrawal requirements, evaporative losses, or retention in storage would be released as additional river flow, either through turbines or the spillways.
B.6	As referenced previously, we understand that the draft EIS concludes that under normal circumstances, the proposed IBT should not have an adverse impact on Anson County's water consumers. While we view this as a reasonably supported conclusion, we want to be assured that as both Union and Anson County populations grow and business activity in the region increases in the future; that both jurisdictions are able to meet future water supply demands.	Comment noted. Through the incorporation of future basin-wide water demand projections for current and potential future water withdrawers and returners to the Yadkin River Basin, this EIS effectively evaluates the impact of Union County's proposed IBT, with due consideration given to other projected future water uses throughout the basin to conclude that all jurisdictions are able to meet current and future water supply needs from the Yadkin-Pee Dee River and its associated reservoirs through the period of study for this document.

C. Commenter(s): North Carolina Department of Public Safety – Emergency Management (Date 9/9/2015)

Comment #	Request or Comment	Response to Comment
C.1	The Draft Environmental Impact Statement (DEIS) clearly and thoroughly outlines the impacts within the Special Flood Hazard Areas due to the proposed project. As noted in the DEIS, a floodplain development permit issued by the local jurisdiction will be required for all work within the SFHA. Please note that although mitigation or hydraulic analysis may not be required, permitting is still required for all work within the SFHA.	Comment noted.
C.2	A hydraulic analysis will be required for new grading, construction, or the storage of equipment or materials within a floodway or non-encroachment area. A No-Rise Certification is required if the proposed element of the project does not increase flood levels during the base flood discharge. A Conditional Letter of Map Revision (CLOMR) will be required if the project results in an increase in flood levels during the base flood discharge. No structures may be impacted by an increase in flood levels.	Comment noted.
C.3	Critical facilities should be protected to the 0.2% (500-year) flood level or the Regulatory Flood Protection Elevation, whichever is higher.	Comment noted.
C.4	Please coordinate with this office if the project results in any changes to the hydrology of the Yadkin River or adjoining basins.	Comment noted.

D. Commenter(s): North Carolina Department of Cultural Resources – State Historic Preservation Office (Date 9/25/2015)

Comment #	Request or Comment	Response to Comment
D.1	The preferred alternative chosen for the proposed undertaking is Alternative 1A. As stated in our previous letter, this alternative has the potential to adversely affect the Norwood Commercial Historic District (ST0531), which is considered eligible for listing in the National Register of Historic Places. However, if the undertaking is conditioned to occur wholly within existing DOT or utility rights-of-way, it is unlikely the work will adversely affect the historic district or archaeological resources. However, if earth moving activities associated with the project impinges on previously undisturbed areas then an archaeological investigation may be warranted.	Comment noted. It is anticipated that the project would occur, to the extend feasible, in existing rights-of-way; however, final design will address constructability. Union County commits to additional coordination with SHPO if the final project footprint impacts previously undisturbed areas.

E. Commenter(s): North Carolina Department of Environmental Quality – Division of Water Resources (Date 10/28/2015)

Comment #	Request or Comment	Response to Comment
E.1	**Section 5.12:** Please identify the source of the performance measures criteria for the hydrologic modeling and document the background information on the source. As well, please provide the source for the interpretation criteria of the results from the hydrologic modeling. In particular the source for the ranges selected for the minor, moderate, and major categories used needs to be documented. Additional explanation for each table related to the hydrologic modeling needs to be included to avoid misinterpretations of the data presented. This should be done in the text prior to or following each table. This information will provide the reader as well as the lead agency with confidence in the presentation of the results from the hydrologic modeling activities and allow for greater understanding of any hydrologic impacts.	Per 10/29/2015 follow-up phone conversation with the commenter (Harold Brady at NCDWR), the basis of this comment was the result of the reviewer not having received access (from other NCDWR staff) to Appendix E CD-2, CD-3, and CD-4 which contain all the performance measure sheets, modeling results and model logic information. These were included in the deliverables provided to the State. These appendices contain all the quantitative data to support the conclusions and summary of impacts as presented in the body of the EIS document and are the basis from which the impact summary tables were developed. Additional text has been added in the body of the EIS to clearly indicate how the Performance Measures were developed (i.e. through a rigorous stakeholder process during Federal Energy Regulatory Commission relicensing of the respective hydroelectric projects, whereby stakeholders provided input into the development of these mutually agreed upon performance measures). It is important to note these measures are not arbitrarily developed measures by the EIS authors. The additional text added to Section 5.12 seeks to more clearly reflect the historical background behind the development of the Performance Measures and appropriately reference their location within the EIS appendices. The following text has been added to Section 5.12: The original concept of the Performance Measures Sheet (PMS) was developed during the relicensing process for the Duke Energy Catawba-Wateree Hydroelectric Project. Since the 11 reservoirs and numerous diverse stakeholders to the system all had different metrics of interest and differing opinions on how to rate differences between operating regimes (as computed and measured as output to model scenarios), the PMS concept was developed. In this concept, each reservoir basin is evaluated with general criteria such as reservoir elevations, outflows, powerhouse generation, and time spent in Low Inflow Protocol (LIP) stages. Since recreational boaters and parties who

Comment #	Request or Comment	Response to Comment
		withdraw water for consumptive uses have different criteria, general categories were developed. These different categories allow for the setting of the elevation or flow of interest, and the variance around that value which is considered acceptable, moderately acceptable, or not acceptable. Each stakeholder in the CW relicensing process had an opportunity to participate in the identification of categories and setting of the metric values to best represent their interests. Additional experience in the PMS development process was gained during the Keowee-Toxaway relicensing for Duke Energy's Jocassee, and Keowee developments. During this relicensing process, stakeholder inputs were sought and utilized in measuring the impacts from one operating regime to another. During the Union County IBT model development process, HDR worked with Union County, Duke Energy and NCDWR representatives to identify likely metrics and conditions which may be of concern to other stakeholders. The metrics of this PMS contain the licensed flow requirements, likely areas of concern such as the amount of time spent at or near the maximum pool elevation(s), target elevation(s), and minimum elevation(s). The determination of what was considered a "minor" versus a "moderate" category were based on experience from the previously noted regional hydroelectric relicensing efforts, taking into consideration the possible concerns of stakeholders throughout the Yadkin-Pee Dee River Basin.
E.2	**Section 5.12.1.4**, second paragraph, last sentence: Please change "UFWS" to "USFWS".	The acronym "UFWS" has been changed to "USFWS" as requested.
E.3	**Appendices:** Please include water balance tables for current year (or year used for baseline within document) and each ten-year increment for 30-years, at a minimum.	Water balance tables have been added to Appendix B, as requested.

F. Commenter(s): Tom Okel, Executive Director, Catawba Lands Conservancy (Date 11/16/2015)

Comment #	Request or Comment	Response to Comment
F.1	I am the Executive Director for the Catawba Lands Conservancy. As it relates to the proposed inter-basin transfer agreement between Lake Tillery and Union County, CLC would be pleased to work with Union County, the Town of Norwood and others to increase protection of Lake Tillery and the Yadkin/Pee Dee River Basin to ensure that the environmental impact is minimized and that the quantity and quality of basin is protected through land conservation. Please feel free to contact me if you would like to discuss.	Comment noted and will be taken under advisement as this proposed project moves forward.

G. Commenter(s): Bill Holman, North Carolina Director, The Conservation Fund (Date 11/16/2015)

Comment #	Request or Comment	Response to Comment
G.1	The Fund commends Union County for planning for its water supply needs for 2050 and beyond and for collaborating with the Town of Norwood on a solution with mutual benefits.	Comment noted.
G.2	The Fund will be respectfully urging Union County and the Town of Norwood to build upon their regional water supply planning collaboration to work with land conservation organizations and other local governments: 1) to develop a plan to increase protection and restoration of Lake Tillery and other important reservoirs in the Yadkin/Pee Dee River Basin, and 2) to begin to reserve and invest funds in land conservation and restoration in the Lake Tillery watershed. Their investments in land conservation and restoration will increase source water protection and would leverage other public and private funds.	Comment noted and will be taken under advisement as this proposed project moves forward.
G.3	The Fund respectfully asks the Division of Water Resources and the Environmental Management Commission to also urge Union County and Norwood to work with land conservation organizations, such as The Fund, the Land Trust for Central North Carolina, and the Catawba Lands Conservancy to develop a plan to increase protection of Lake Tillery and to invest in protecting Lake Tillery.	Comment noted and will be taken under advisement as this proposed project moves forward.
G.4	The Fund also recommends that Union County, Norwood, other water utilities, Duke Energy and Alcoa consider creating an organization similar to the Catawba-Wateree Water Management Group (CWWMG) to facilitate long term planning and collaboration on water supply and water quality problems. CWWMG updated its 50-year Water Supply Master Plan in June, 2015. It's a great model for river basin wide planning and collaboration by water utilities, electric utilities and key stakeholders.	Comment noted. It is our understanding that a group of water users within the Yadkin River Basin are in the initial planning phase of establishing a group within this basin similar to Catawba-Wateree Water Management Group (CWWMG). Further, Union County has participated in the initial discussions being held by these water users and regulatory agencies. Union County recognizes the benefits this type of organization could bring to the Yadkin River Basin, as it actively participates in the CWWMG.
G.5	The Fund notes that CWWMG plans to study and model the benefits of land conservation in reducing	Comment noted.

Comment #	Request or Comment	Response to Comment
	sedimentation/preserving reservoir capacity and in maintaining stream flows in 2016 as it begins to implement the options identified in its Water Supply Master Plan. The Fund recommends that Union County, Norwood and other utilities consider a similar study and model in the Yadkin/Pee Dee River Basin.	
G.6	The Fund has reviewed the DEIS prepared by HDR in August, 2015 and agrees with many of its conclusions. The Fund believes that the environmental assessment and review process conducted under the State Environmental Policy Act (SEPA) worked well. The environmental and economic costs and benefits of many alternatives were carefully considered.	Comment noted.
G.7	The preferred alternative takes advantage of Lake Tillery, an existing reservoir, and avoids building a new reservoir and the environmental damage associated with building new impoundments. The preferred alternative also avoids increasing water withdrawals and interbasin transfers from the stressed Catawba-Wateree River Basin. The preferred alternative requires collaboration between Union County and The Town of Norwood and will provide benefits to both local governments.	Comment noted.
G.8	Under the preferred alternative Union County will make substantial investments in a new intake on Lake Tillery and in a new water distribution and treatment system. The DEIS does not adequately address policies and measures to protect the source water, Lake Tillery, or other reservoirs in the Yadkin/Pee Dee River Basin.	Comment noted and will be taken under advisement as this proposed project moves forward. However, the service area for Union County's proposed IBT is not located within the source watershed and therefore permanent impacts within the source watershed due to this project are not expected. Temporary impacts due to construction within the source watershed will be mitigated in accordance with the Lake Tillery Shoreline Management Plan (see Appendix E, CD-1) and applicable state and federal permits which will be required for the project (see Section 8.0).
G.9	The DEIS also does not adequately address policies and measures to reduce and mitigate the secondary environmental impacts that will be the result of the new growth in Union County enabled by new water capacity and infrastructure.	Comment respectfully received. However, mitigation measures to address both direct and indirect (secondary and cumulative) environmental impacts are adequately addressed in Section 6.0 of the Draft EIS document. Furthermore, the new water capacity and infrastructure proposed Yadkin River Water Supply project is intended as a proactive County response to expected growth in the Yadkin

Comment #	Request or Comment	Response to Comment
	Union County is one of the fastest growing counties in North Carolina. The NC Office of State Budget & Management projects that Union County's population will increase to 243,620 from 201,307 or by 21.0% between 2010 – 2020 and will increase to 289,766 from 243,620 or by 18.9% between 2020 – 2030.	River Basin Service Area, and not a mechanism by which to create growth.
G.10	A variety of preventable disasters threatened drinking water supplies across the United States in 2014. In response to these threats Representative Rick Catlin from New Hanover County and others sponsored HB 894, An Act to Improve Source Water Protection Planning, in the 2014 General Assembly. The General Assembly enacted and Governor McCrory signed SL 2014-41. GS 130A-320 strengthens the State's existing source water protection program and requires public water suppliers to develop source water protection plans. Investments in land conservation and restoration will help Union County, Norwood and other local governments comply with GS 130A-320.	Comment noted and will be taken under advisement as this proposed project moves forward.
G.11	North Carolina's Source Water Assessment Program in the Division of Water Resources considers Lake Tillery to have a moderate inherent vulnerability rating, a moderate contaminant rating and a moderate susceptibility rating. Land conservation will reduce the risk of potential contamination.	Comment noted and will be taken under advisement as this proposed project moves forward.
G.12	The Environmental Management Commission has classified Lake Tillery as WS-IV, which provides minimal protection from stormwater pollution and land use change. Local initiatives and investments will be required to enhance source water protection in Lake Tillery.	Comment noted and will be taken under advisement as this proposed project moves forward.
G.13	The EMC may require applicants for IBT certificates to mitigate impacts of the IBT pursuant to GS 143-215.22L (m). For example in its July, 2001 decision to approve a temporary increase in IBT from Jordan Lake in the Haw River Basin to the Neuse River Basin, the EMC set out a number of conditions to mitigate the impacts of the IBT.	Comment noted and will be taken under advisement as this proposed project moves forward. It is important to note that the referenced example for required mitigation related to the water transfer from Jordan Lake in the Haw River Basin to the Neuse River Basin differs from the proposed Union

Comment #	Request or Comment	Response to Comment
	The EMC also gave the applicants credits for their policies and programs that exceeded state minimum standards.	County IBT. In the case of the Jordan Lake example, a sizable portion of that applicant's water service area was actually within the source watershed. As such, the applicant had a more significant opportunity to implement mitigation initiatives within the source watershed in which they had direct control and influence with local regulations. In the case of Union County, their water service area and jurisdiction for the proposed IBT lies outside of the source watershed, thereby limiting opportunities for mitigation within the source watershed.
G.14	The Fund notes that Union County and Norwood will have to file an amendment with Duke Energy Progress and the Federal Energy Regulatory Commission (FERC) to increase water withdrawals from Lake Tillery. The Fund believes and effective and collaborative watershed protection plan will be positively considered by FERC.	Comment noted and will be taken under advisement as this proposed project moves forward.

H. Commenter(s): Will Scott, Yadkin Riverkeeper (Date 11/16/2015)

Comment #	Request or Comment	Response to Comment
H.1	Yadkin Riverkeeper submits these comments on the proposed Yadkin River Water Supply Project(YRWSP) Interbasin Transfer Draft Environmental Impact Statement. The Yadkin Riverkeeper is a 501c(3) organization whose mission is to protect drinkable, fishable, swimmable water in the Yadkin basin. We are a membership-based organization and have members whose use and enjoyment of the waters of the Yadkin/Pee Dee within the project area are affected by the proposed YRWSP Interbasin Transfer.	Comment noted.
H.2	YRK supports water from a given hydrologic unit staying within its natural watershed. If we are to have sustainable long-term growth in North Carolina, our communities must exist within the carrying capacity of their natural systems. To reach, as the proposed alternative does, outside of the Rocky River basin in which the majority of the projected growth will fall, creates unnecessary costs and environmental impacts. For this reason, we raise a number of concerns about the preferred Alternative 1A favored by the Draft EIS. While we agree that Union County must "secure a reliable water supply" we disagree that Alternative 1A is the most efficient means of doing so, either in cost to ratepayers or in terms of environmental impact.	Comment noted.
H.3	<u>Assumptions</u> a. Projected Growth in Union County The Draft is inconsistent in its descriptions of induced growth related to the proposed project. Specifically, the Draft states that the no action alternative would lead to economic stagnation, but then when estimating the impacts of alternatives, the Draft estimates the impacts of growth from the IBT will be "minor" or "insignificant". If the projected growth cannot occur without one of the action alternatives being chosen, the environmental impacts of that growth must be factored into the	Growth within Union County, specifically within the County's Yadkin River Basin Water Service Area, is likely to occur regardless of the proposed IBT. Union County, in response to increasing water demand, is seeking the IBT as a long term, sustainable water supply for this growth. The impacts of this proposed IBT and its alternatives, including secondary and cumulative impacts, are addressed thoroughly in the Draft EIS. While it is hypothesized the No Action Alternative (NAA) will negatively impact industry and commerce within Union County, since no quantitative economic analysis has been completed to assess the economic impact of the NAA, the statement regarding "potential for

Comment #	Request or Comment	Response to Comment
	"Secondary" and "Cumulative" impact analyses. If alternatives themselves will dictate growth, a consideration of meaningful alternatives must then consider different patterns of induced growth paired with different potential water sources.	economic stagnation," as presented in Tables ES-2 and 7-3, has been removed.
H.4	<u>Assumptions</u> b. Projected Need for Water The EIS takes as a given the 28.9 MGD Maximum Monthly Average Projected Water Demand. However, this is not the only reasonable definition of the project's "Purpose and Need". Nowhere in the EIS is a different growth path considered, and how the various projects might satisfy a different target. Given that growth rates in Union County have fluctuated widely in the last decade, it is only prudent, when considering the largest capital expenditure Union County faces, to evaluate the alternatives in relation to a range of growth scenarios. In particular, the stated Purpose and Need, set at 23 MGD, forecloses the possibility of a water supply within the Rocky River subbasin because a withdrawal of that size would, "necessitate a large portion of the total water within the Rocky River be withdrawn at this location[Just above Highway 205]." Draft EIS, p. 276 Given that Alternative 5 is, by far, the lowest cost option at almost $50 million cheaper than Preferred Alternative 1A($190 to $239 million), an alternatives analysis is not complete without a study of what level of water could be withdrawn from the Rocky while achieving minimal environmental impacts.	Comment respectfully received. However, projected population growth and water demand, as well as Alternative 5 have been sufficiently evaluated as part of the EIS and are adequately documented and justified within the document. While the projected 28.9 MGD maximum month average daily water demand is not a given, the future water demand projections and water supply alternatives for Union County have been developed with thoughtful consideration to extensive County planning efforts (e.g. Comprehensive Water and Wastewater Master Plan and preliminary evaluations for the Yadkin River Water Supply Project) which carefully evaluated future population and service area growth, as well as varying growth patterns, prior to arriving at a reasonable, defensible and practical growth pattern for use in planning of the Yadkin River Water Supply Project. Based on the information presented in Section 3.2.5 for the alternatives analysis of Alternative 5, clear and defensible evidence is provided that the alternative of water withdrawals from the Rocky River is unlikely to meet Union County's purpose and need for water supply, and as the Draft EIS indicates, "As a future water supply from the Rocky River is highly contingent upon factors outside of Union County's direct control (i.e. future wastewater flows from another upstream regional utility), this alternative does not lend itself to providing Union County with a reliable surface water source in which to meet the needs of its current and future customers in the Rocky River IBT Basin of the Yadkin River Basin." Yield estimates of the Rocky River indicate the 7Q10 flow to be approximately 14.8 mgd, as indicated in Section 3.2.5.2. As such, a Union County water withdrawal from the Rocky River, meeting the County's purpose and need (23 mgd) would be in excess of this value.

Comment #	Request or Comment	Response to Comment
		Based on the 7Q10 flows within the Rocky River, any significant water withdrawal from that source would likely require a dam to be constructed, as indicated in the Draft EIS, and poses a heightened risk to the ecological integrity of that particular waterway and the surrounding ecosystem. Further, direct, permanent environmental impacts of dam construction would be more than minimal and considerably larger than direct impacts by other water supply alternatives from established impoundments (e.g. Alternative 1A). As such, Alternative 5 is not a viable water supply option for Union County, when compared to the other alternatives evaluated in the Draft EIS.
H.5	Assumptions c. Finding a watershed carrying capacity Ultimately, the most sustainable long-term supply of water for the area will come from its local ground and surface waters. By reaching outside of this area, Union County puts itself in long-term competition for Yadkin River water with other municipalities and opens itself to the possibility that, as with its current agreement with Anson County, a change in local politics will require additional investment in the future. Indeed, the Draft admits that the Preferred Alternative 1A was selected not because it was the most cost efficient or because it had the least environmental impact but because of the current political environment, “"...Union County held discussions with numerous entities along the Yadkin river regarding partnerships for water supply. Of all those contacted, the Town of Norwood was the only political jurisdiction who expressed a desire to participate in a partnership with mutual benefits for both parties." Draft EIS August 2015, p. 25	Comment respectfully received. However, as presented in the Draft EIS, the sustainability of a long-term water supply from ground water either via municipal supply (Alternative 8) or private supply is not a viable option for Union County, as detailed in Section 3.3.1. Lack of groundwater availability, significant land impacts and concerns with groundwater quality (primarily resulting from naturally occurring sub-surface contaminants) throughout Union County, as discussed in Section 3.3.1, preclude this as a viable water supply source for the County. Furthermore, as outlined in the response to the previous comment, the use of local surface waters (assuming the commenter is referring to the Rocky River) is also not a long-term water supply solution. Reliance on existing surface water impoundments within the primary Yadkin River Basin (of which Union County is a part) is the more practical long-term solution to the Yadkin River Basin’s water needs. These established reservoirs have regulated operating rules, defined drought response protocols, and sufficient water yield volumes to support Union County’s long-term water supply demands, along with the many other current and future water needs within the basin from these reservoirs. A conclusion that the Preferred Alternative was selected not because of cost efficiency or environmental impact, but rather based on the current political environment, is without merit. The Draft EIS includes a brief historical summary of the development of the partnership

Comment #	Request or Comment	Response to Comment
		between the Town of Norwood and Union County to indicate Union County has spent many years evaluating the various alternatives of a water supply to serve its Yadkin River Basin Water Service Area customers.
H.6	Local Impacts The preferred alternative 1A is not the option with the least environmental impacts either during construction or after. Alternative 1A will impact 551 acres, Alternative 5 will impact only 67. Draft EIS, p. 225. Alternative 5 will impact less than 10% as much land, permanently and during construction compared to 1A. Alternative 5 is the only alternative outside of modifying existing current WTPs that will not impact any current agricultural land. In terms of Significant Natural Heritage Areas Alternative 5 impacts 5.5 acres while Alternative 1A will impact 7.2 acres of significant Natural Heritage Area. Alternative 5 does not impact any perennial streams, only 1,343 feet of intermittent stream on 3 crossing vs. 11,014 feet of intermittent stream via 20 crossings and 2,848 ft of perennial streams via 11 crossings. By the majority of environmental impact indicators, then Alternative 1A is not the least environmentally damaging option. The primary area it differs from Alternative 1A is that it would withdraw water from the Rocky River rather than a reservoir on the Yadkin, like Lake Tillery. The feasibility of re-classification of the Rocky River as a drinking water supply should be more thoroughly investigated in the Draft EIS, in conjunction with looking at whether the Purpose and Need could be met with a conjunction of efficiency measures combined with a smaller Maximum Monthly Average withdrawal. Before attempting to take clean water from a distant reservoir, the County must come to terms with the impact current growth is having on its own Rocky River,	Comment respectfully received. However, multiple previous studies, as well as evaluations completed in conjunction with this project, have shown that the Rocky River does not meet the Purpose and Need for the Yadkin River Water Supply Project and is not a viable water supply solution for Union County. As such, impacts and costs of a solution which do not meet the Purpose and Need (Alternative 5) cannot be accurately correlated through direct comparison to other alternatives which meet the Purpose and Need, including the Preferred Alternative (e.g. Alternative 1A. With respect to re-classification of the Rocky River as a drinking water supply, it is imperative to note that a significant volume of the Rocky River flow, particularly in low flow periods, is comprised of treated wastewater effluent discharge from the Water and Sewer Authority of Cabarrus County (WASACC), upstream of Union County. As a future water supply from the Rocky River is highly contingent upon factors outside of Union County's direct control (i.e. future wastewater flows from another upstream regional utility), this alternative does not lend itself to providing Union County with a long-term, sustainable surface water source in which to meet its water demands.

Comment #	Request or Comment	Response to Comment
	which is impaired for copper, turbidity and biological integrity. Draft EIS, p.281. We would respectfully submit that when local waters are impaired, the long-term solution to them is not to seek water elsewhere but to protect those waters to the point where they are a viable water supply. An assessment of the cost of mitigating the impacts of a low-head dam on the Rocky River are not included in the Draft EIS, nor are any estimate of what stormwater and land conservation measures would be necessary to bring the Rocky into line with state water supply guidelines.	
H.7	Water Efficiency The Draft EIS takes 125 gallons per capita per day as its baseline used to project demand upon the municipal water system. By contrast, the United States Geological Survey estimates per capita per day usage at 80-100 a day for the average American. The Draft itself averaged acknowledges that historical data shows per capita usage in Union County, "between 110 to 120 gpcd, with slightly lower values in the most recent years due to ongoing mandatory water restrictions, increased conservation efforts, and more favorable climate conditions (more annual rainfall and slightly lower annual temperature averages)." Draft EIS, P.15 We would urge that those hard-won lower averages be taken as the new norm and that used to estimate, in conjunction with slowing growth, a variety of projected water demand levels by which the project alternatives can then be meaningfully evaluated.	Comment respectfully received. However, per capita water use rates used to develop the project's Purpose and Need are both reasonable and defensible. Per section, 2.3.4 of the Draft EIS, the total water demand used for projections is 120 gallons per capita per day (gpcd), not 125 gpcd as indicated. While Union County's 2011 Master Plan used a value of 125 gpcd for water demand projections, this EIS document uses the lower 120 gpcd as the "new norm", recognizing the "hard-won lower averages" Union County has recognized over recent years, as suggested. Further, the reference to "the United States Geological Survey estimates per capita per day usage at 80-100 a day for the average American" is based upon residential categorical finished water per capita demand and does not represent total system-wide water supply per capita demand for a utility. Therefore, comparison of the referenced value to the 120 gallons per capita per day (gpcd) used for this EIS is not an accurate comparison. The 120 gpcd rate used to establish the Union County projected water supply demand is based upon total system demand which includes categorical water demands (residential, industrial, commercial, institutional and wholesale) and non-revenue water including water treatment and distribution process needs (filter backwash, line flushing, hydrant testing, etc), all divided by the number of residential customers served. As such, for all water systems, the total system per capita demand is higher than the residential categorical per capita customer demand the commenter

Comment #	Request or Comment	Response to Comment
		references. For comparison sake, text has been added to the EIS document to reflect that “as a portion of this 120 gpcd total system demand, residential water use per capita demand is to be estimated to be 80 gpcd. This is based upon historical Union County residential water use which has averaged 65 to 70 percent of the total treated water supply since 1997. The 80 gpcd residential per capita water demand value compares favorably with the Catawba-Wateree Water Management Group’s 2014 Catawba-Wateree Water Supply Master Plan, which assumed a basin-wide average residential categorical water use rate of 85 gpcd for planning purposes.”
H.8	Conclusion The alternatives proposed do not explore the full extent of options available. Instead of choosing the local, low-cost option of drawing water from the Rocky River in conjunction efforts to reduce per capita usage, the Preferred Alternative is more expensive, more dependent upon politics and more damaging to streams and land across Union County than other available options.	Comment respectfully received. However, please refer to responses to prior comments, above.

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D.7

Draft EIS Public Hearing Transcripts and Comments Received

September 16, 2015

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Interbasin Transfer Certificate for Union County

NOTICE OF PUBLIC HEARING

Wednesday, September 16, 2015, 6:00 PM
Norwood Community Building
247 West Turner Street, Norwood, NC 28128

The North Carolina Environmental Management Commission will hold a public hearing to receive comments on the draft Environmental Impact Statement prepared for Union County's interbasin transfer (IBT) certificate request.

The Union County Public Works Water System (Union County) is a provider of drinking water to citizens of Union County, excluding the City of Monroe, serving customers in both the Catawba River basin and the Rocky River basin. Union County is requesting a 23.0 million gallons per day (mgd) transfer from the Yadkin River IBT basin to the Rocky River IBT basin, calculated on an average day of the maximum month basis, per current statutory regulation. The requested transfer amount is based upon 2050 water demand projections to meet anticipated growth in Union County's Rocky River IBT basin.

Currently, most of the water supplied by Union County is sourced from the Catawba River through the Catawba River Water Treatment Plant in Lancaster County, South Carolina. To support the Rocky River IBT basin service area, Union County transfers a maximum of 5.0 mgd, as allowed by an existing grandfathered authorization, from the Catawba River IBT basin to the Rocky River IBT basin. The proposed request will avoid the need for an increase in the amount transferred from the Catawba River IBT basin. The proposed intake will be on Lake Tillery near the existing location of the intake for the Town of Norwood in the Yadkin River IBT basin.

The public hearing will start at 6:00 p.m. on Wednesday, September 16, 2015, at the Town of Norwood Community Building. The supporting environmental documents will be available for review two weeks prior to the public hearing at: http://www.ncwater.org/?page=420, as well as through the North Carolina Department of Administration State Environmental Review Clearinghouse.

The purpose of this announcement is to encourage interested parties to attend and/or provide relevant written and verbal comments. Division of Water Resources staff requests that parties submit written copies of oral comments. Based on the number of people who wish to speak, the length of oral presentations may be limited.

If you are unable to attend, you may mail written comments to Kim Nimmer, Division of Water Resources, 1611 Mail Service Center, Raleigh, NC 27699-1611. Comments may also be submitted electronically to kim.nimmer@ncdenr.gov. Mailed and emailed comments will be given equal weight. All comments must be postmarked or emailed by October 16, 2015.

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Transcription for Union County Draft EIS - IBT Public Hearing – 9/16/15 (Norwood, NC)

1. Larry McMahon - Norwood Mayor Pro-Term

First of all, this was brought before the town of Norwood, it was a golden opportunity for us first of all that we're able to share the natural resources that we have with Union county. Second of all, when it's said and done Norwood will end up with a new pump station that is substantial monetary value for us in the small town that we need. With that being said and done I would like to relinquish my time to the former administrator Dwight Smith who has been with us from the first day, first meeting with Union county.

2. Dwight Smith – Norwood citizen

Kim kind of stole part of my thunder when she went into all of the different routes that have been looked at and all the hard work that we went into a long time ago. We went over all of our papers 12 or 15 different ways with the Union county people trying to find a better route to send the water because we didn't like everything about it. But, after all was said and done the route that was chosen and the way it was chosen to be done, I believe is the best way that the situation can be handled. Our state has spent a tremendous amount of money and it seems like our county even more so, proving that water belongs to everybody, all the citizens in Stanley County, all the citizens of the United States really, and not to those of us who are lucky enough to live along the banks of the Yadkin River, Catawba River, etc. So actually we/I felt like during this process that they owned just about as much of this water as we did. What I couldn't figure out was, why in the world so many people wanted to live in Union County when they could live over here. (laughter) But it worked the other way and we couldn't change that. There's no denying that we'll be part or a small financial gain from Norwood but actually I think that Cindy and the people from Union County own just as much of this water as we do. There is one thing that I really don't understand about the IBT and I know what that is I've been through it 1000 times, but what I really don't understand is so much emphasis being put on interbasin transfer when it goes in to the rocky and it's going to be taken out at the end of Allington St., it'll come down Rocky River about three miles and then it's right back into the Yadkin Basin. So actually, no water is going to be taken out of the basin, the Yadkin Basin, that won't get back into it. It is a lot better than trying to transfer all that South Carolina water. I think it is a great idea, I think that it will help the great county of Union, and I think it will help the town of Norwood. We understand the flow and the standard of the way that Lake Tillery hydraulics are written. It will not affect the lake level on Lake Tillery, I don't think, even the 28 million gallons a day. One other thing, since I can speak as a citizen of Norwood now and not as an employee. Next time you send somebody to do something, don't send a Yankee to work with us, send somebody local. We heartily endorse this project and believe me it's good for Norwood, even for Stanley County. I'd like to add this, the way this project ended up in Norwood was, first of all they approached Stanley County and Stanley County sent Union County down to Norwood to talk to us about it. I think that is a valid point.

3. Ron Hargrove – City of Winston Salem

I'm the utilities director in Winston Salem. We're here to support the request for the IBT from Union county. Winston Salem has been a beneficiary of the waters of the Yadkin River since 1789 when the town of Salem connected the first connection to what's now called Old Salem. We know the benefits the Yadkin River has and fully support it. Winston-Salem promoted, or was a sponsor of the Kerr Scott Reservoir which is the very head waters of the Yadkin River so we have through some regional collaboration partnerships some ability to call on that water as a reserve source if we were to ever need it. Regional water management is important to us as it is to Union County, we believe that it protects all the public health, all the economic development needs as well as it insures a long term adequate supply for in this case all the Yadkin water users. I understand these gentleman's points, it starts as Yadkin river water and it ends as Yadkin river water even though there are sub basin transfers. We think that the collaboration between the town of Norwood and Union County obviously make sense in this case, we have made partnerships with many of our local partners around Winston-Salem when there have been needs on both sides. We think that's always a good deal for each. We know that Union county did not get here without a great deal of effort, obviously you see how thick the document is a lot of engineering and modeling analysis was put forth in determining all the alternatives and we understand and have been in their shoes before and know what goes into that effort. We also think that through this effort the limit of a true inter basin transfer from the Catawba, even though it's in South Carolina would be limited going out into the future and we think that's actually a good thing for river basins in the end. So with that I'll end my comments.

4. Chris Plate - Union County Executive Director of Economic Development

I appreciate the opportunity to speak tonight and I am in support of this project. Union County has experienced significant growth over the last 20 plus years. In fact in the 2000's Union County was the fastest growing county in North Carolina and actually as high as number 7 nationally of all 3100 counties in the United States. Union County continues to grow specifically industrially and had become a significant job center going to the east of Charlotte. Most of this industrial growth has been in the major Yadkin River Basin portion of Union County and with the construction of the Monroe express way we expect to see that growth continue further east and further into the Yadkin River Basin area. So without the project Union County would have a difficult time to continue to provide job opportunities for our own citizens as well as those in the surrounding counties.

5. Gary Honeycutt – Lake Tillery, homeowner

My name is Gary Honeycutt, I'm a Lake Tillery homeowner and in the interest of full disclosure I also a retired employee of HDR Engineering, one of the companies involved in this environmental impact statement. As a home owner on Lake Tillery the things that interest me is maintaining lake levels, maintaining the quality of the water maintaining, since I use it predominately for recreation keeping the water clean and also to provide water for folks downstream as well as the regional water management. The inter basin transfer as it's been said over and over again is not truly an inter basin transfer but due to the general statues it has to be called that. Most of the water, or a significant portion of the water will come back and be available to folks downstream the Yadkin River on down to South Carolina. I understand that Union County has worked with the town of Norwood to come up with this plan. I know that they have all have put a lot of effort into it and I know that it's a good thing for the citizens of Norwood as well as the folks from Union County. As a retired engineering employee, I understand a lot about what goes into the environmental impact statement and I was involved in the water treatment plant for the city of Albemarle their raw water intake on the Tucker Town reservoir, so I have some idea about what goes into it and the professionalism of the people involved, so I certainly feel good about that. I know that Union County has looked at numerous options which have been discussed here and I think they have come up with the best opportunity to provide water from Union County which they need but also adds infrastructure to the Town of Norwood without additional tax burden on its citizens which is a good thing. So as a resident I am totally in favor of this.

6. Bill Holman – Conservation Fund

I am North Carolina Director for the Conservation Fund we're a national land conservation organization that also supports economic development, so Mayor Johnson and Commissioner Pruitt thank you for the opportunity to speak. Like probably a lot of North Carolinians I have fond memories of being in Stanly, family camping at the state park growing up and I've also done a lot of camping trips in the national forest so you live in a great part of the world. I also want to say we work with a couple of local land conservationist there's the Catawba lands conservancy that serves Union County and then there's the land trust from central North Carolina that serves Stanley and Montgomery and other counties up the Yadkin. Just a few general comments I think the environmental review process is working well. I think I'm in general agreement, I will not claim to have read the entire document but my scanning of the document is the at the preferred alternative has the least environmental impact it's also one of the most cost effective alternatives so I think that's a sign the environmental process is working well. I think the environmental document gives a pretty thoughtful evaluation of the alternatives, and I think in general when you can take advantage of an existing reservoir like Lake Tillery and existing infrastructure, I know a new intake, treatment intakes and distribution system is going to be required but the fact that there is not a proposal for a big new reservoir somewhere and all the environmental issues associated with that, I think that's a real plus. Some of the things I'd like to put into the process for consideration by the environmental management commission and folks in the Yadkin/Pee-Dee Basin is I think there is a good model of long range water supply planning that you can learn from, your neighbors over in the Catawba water region have created the Catawba Water Management Group, that's the water utilities and Duke Energy that are planning on water supply in the future, they've got a 50 year water supply master plan that I think is a really good model for other basins. I live in the research triangle now, I grew up in Greensboro and Winston-Salem but live in the research triangle region now and like has been pointed out there's kind of a ridge, there's a falls way in the Neuse River Basin and there's Jordan Lake and Cape Fear River basin and those cities in those cities in those river basins are working with DWR and are planning together because they're growing as a region and they need to think about water as a region and I think that kind of discussion is right for the folks in the Catawba and Yadkin/Pee-Dee basin because you all are growing together. That's a longer term kind of issue but I would recommend you consider something like that. My organization is in the land conservation business and one of the points I'd like to make is there's a lot of benefits for water quality and quantity in the basin, from parks and forests, frankly there's a lot of private land that's being managed in a conservation way that is delivering clean water to the folks that live in this basin. The benefits of land conservation should be taken into account and we'd be interested in the conservation fund and also the land trust for North Carolina and organizations like Soil and Water Conservation would be interested in working with Union County with Norwood and with all the folks that depend on the Yadkin/Pee-Dee for water supply to think about how we can continue to invest in land conservation and other things that keep delivering clean water and abundant water. I think the preferred alternative, even though it's going to cost millions of dollars is the alternative that is going to be the most effective for Union County and its going to facilitate economic prosperity in the county and so I think it makes sense as we're investing in infrastructure to facilitate growth in the county in Union County we should be investing in protecting not only Lake Tillery but also the storage in this basin comes from High Rock Lake so to be thinking about how we're going to assure 50 years from now that there's going to be adequate supplies of clean water available in the future. Like the other speakers I will provide some written comments. Thanks for the opportunity to speak and I look forward to working with you in the future.

7. Bryan Bowles – Norwood Town Administrator

A few projects that this project will be great for Norwood. We will get a new raw water intake out of it, it will be replacing a 30 year old plus structure which we remodeled in the 80's originally constructed in the 50's. One of the great things about this, working with Jonathan getting a lot of information from him is this structure will have multiple intakes. So if we get a batch of bad water we will be able to change depths, if the lake turns over we will be able to avoid some bad water quality issues. It will also have an updated look, it won't be just a brick building right on the lake, it will be aesthetically pleasing for the neighbors and maybe add a little value there. It will be great for the town in other ways, it'll provide us with a steady revenue stream that hasn't been there in the past. This will give us several options on using these finances whether it be delaying a property tax increase, paying off current or future debt maybe hiring additional personnel or even increasing some of our level of services. In conversations with some of the representatives from Union County and HDR I do feel like this option 1A for this inter basin transfer between Norwood and Union County to be the best fit. It'll reduce the amount of environmental impacts, keep cost down and while being able to meet projected demand for Union County compared to other options listed.

Union County is geographically isolated from any major water supply source so all of our water is brought in from outside of the County. Only 25% of Union County is in the Catawba Basin but 88% of our current available water capacity comes from the Catawba River. Having almost 90% of our available supply come from one source, one water treatment plant, and one major transmission system makes our water system extremely vulnerable. We recently experienced this vulnerability firsthand when a minor fuel spill in the Catawba River forced our water treatment plant to shut down the river intake and draw from our raw water reservoir. With only a 3 or 4 day supply in storage, a larger spill could've forced us to begin water rationing. Serving our Yadkin Basin customers with water from the Yadkin River allows us to have greater resiliency in the face of major emergencies or drought.

The County's current 5 MGD grandfathered IBT is not sufficient to meet both near term and long term future water demands in the Yadkin River Basin Service Area. Union County has been evaluating long-term water supply solutions for over a decade. All of this effort contributed to the development of the proposed alternative included in the Environmental Impact Statement. We have also made efforts to encourage water conservation and extend the County's currently available supply.

While the County's 2011 Comprehensive Water and Wastewater Master Plan identified the Catawba River as offering the lowest cost water supply, Union County recognizes the inherent challenges, legal and political hurdles and potential environmental effects of increasing its grandfathered IBT from the Catawba River to serve its customers in the Yadkin River Basin Service Area. Serving Yadkin Basin customers with water from the Yadkin River is viewed by Union County as a more logical and acceptable solution to meeting the current and future water demands within this area of the County.

Union County IBT
Draft EIS public hearing
9/16/15 - Norwood
Cindy Cotie

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WATER STRATEGY, HYDRO
LICENSING AND LAKE SERVICES

Duke Energy Corporation
526 South Church Street
Charlotte, NC 28202

Mailing Address:
EC12Y/P.O. Box 1006

October 14, 2015

Ms. Kim Nimmer
Division of Water Resources
1611 Mail Service Center
Raleigh, N.C. 27699-1611

Re: Comments on Draft Environmental Impact Statement
Union County Yadkin River Water Supply Project Proposed Interbasin Transfer

Dear Ms. Nimmer:

Duke Energy hereby submits comments on the draft Environmental Impact Statement for the Union County Yadkin River Water Supply Project's proposed Interbasin Transfer from the Yadkin IBT River Basin to the Rocky IBT River Basin.

We appreciate the opportunity to provide the enclosed comments. Please contact Tami Styer at (704) 382-0293 (Tami.Styer@duke-energy.com) if you have questions or required additional information.

Sincerely,

Jeffrey G. Lineberger, P.E.
Director, Water Strategy and Hydro Licensing
Duke Energy

Enclosure: Duke Energy Comments on Draft Environmental Impact Statement

cc: Tami Styer
Phil Fragapane
Ed Bruce
Eric Rouse
Ed Goscicki (Union County)
Bryan Hall (Town of Norwood)
Kevin Mosteller (HDR Engineering)

Duke Energy
Comments on Draft Environmental Impact Statement
Union County Yadkin River Water Supply Project
Proposed Interbasin Transfer from the Yadkin River Basin to the Rocky River Basin

1. Executive Summary and Numerous Places in the Document: There are incorrect references to the Yadkin River in the Draft EIS which should correctly refer to the Pee Dee River. The Yadkin River becomes the Pee Dee River at the confluence of the Uwharrie River and the Yadkin River in the headwaters of Lake Tillery. The intake location for the preferred alternative is in Lake Tillery, downstream of the Uwharrie River, and therefore in the Pee Dee section of the river. We understand the entire source basin is called the Yadkin River in the State regulation governing IBTs, thus the references to the Yadkin IBT River Basin; however, many other references should be changed to either the Yadkin-Pee Dee River or the Pee Dee River.

2. Executive Summary, page ES-1: Water needs in the County's Yadkin IBT River Basin Service Area are projected to increase from a current (2013) maximum month average daily demand of 7.7 million gallons per day (mgd) to 28.9 mgd by 2050 (equivalent to a current maximum daily demand of 9 mgd to 35.3 mgd by 2050). This equates to an Annual Growth Rate (AGR) of 3.5% per year. This number is higher than the projections for some comparable neighboring Catawba-Wateree River Basin water suppliers (e.g., Town of Mooresville, 1.47% annual growth rate, etc.). This larger growth rate should be explained in greater detail (e.g., service area expansion, etc.).

3. For Illustration ES-1 and other similar images, the 2050 12-mile Water Reclamation Facility (WRF) return to the Catawba River Basin combined with the 2050 IBT from the Catawba Basin is confusing and seems to imply a net increase to the Catawba River Basin.

4. Alternative 3A relies on running a water transmission line along Duke Energy electric transmission rights-of-way for a portion of the route. Duke Energy's transmission line crossing guidelines do not allow water transmission lines to run along electric transmission line rights-of-way at angles greater than 30 degrees from the perpendicular line to the electric transmission right-of-way.

5. In Section 2.3, there is a conservative assumption that the "per-capita" demand rate will remain at 120 gallons per capita per day (gpcd). This rate is higher than the Catawba-Wateree Water Management Group (CWWMG) Water Supply Master Plan current residential use (85 gpcd) and reduction target (70 gpcd) for the next fifty years. A brief discussion should be included comparing the assumptions for the two different numbers (e.g., residential versus total water use, etc.).

6. Section 2.6.3 - Low Inflow Protocol (LIP) for the Yadkin & Yadkin-Pee Dee River Hydroelectric Projects: Clarification is needed as to who would be required to abide by the Yadkin-Pee Dee LIP (i.e., the intake owner and/or some other entity).

7. Section 4.12 – Water Resources (Surface Water and Groundwater): Reservoir levels and hydropower production should appropriately be listed as "affected environments".

8. Section 5.8 - Air Quality: The effects of less hydropower production on air quality should be discussed briefly (e.g., relatively minor impact, etc.)

9. Section 5.12.2.6 - Direct Impacts – Yadkin River Basin Water Quantity:
    a. In Table 5-11 Period of Record (1955 to 2013) Lake Aesthetics (Elevation) Impacts, Based on % of Time End of Day Elevations within Particular Range of Rule/Guide Curve or Full Pond Elevation, (along with Tables 5-12 and 5-13), the actual range analyzed should be added to each table. Also, this section characterizes impacts on lake level in tabular form, assigning designations of impact such as 'negligible' or 'minor', etc. Lake level duration curves should be provided for each of the alternatives showing differences between scenarios in impacts on lake levels. Additionally, simulated lake levels for Blewett Falls Lake and Lake Tillery should be shown graphically for all IBT scenarios during the drought of record and assuming future demands.
    b. In the Reservoir Discharge discussion for Lake Tillery (page 262), the statement "Even withdrawals from the Rocky River would have a minor impact to Lake Tillery releases…" is an unclear conclusion given the Rocky River discharge is downstream of Lake Tillery. This should be removed or explained in more detail.
    c. Tables 5.26 – 5.28 (page 268) discuss hydropower generation impacts due to the IBT withdrawals. The lost hydropower would result in a slight increase in fossil generation that should be mentioned as a minor impact.

10. Section 5.12.3.6. Direct Impacts – Catawba River Basin Water Quantity - In Table 5-34, Lake Aesthetics (Elevation) Impacts, Alternative 6 (presumed increased withdrawal from the lower Catawba River Basin) shows a small impact in the upper Catawba River Basin, but Alternative 7 does not. The result may be modeling "noise", but does seem unusual.

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Anson County Board of Commissioners
101 S. Greene St., Suite 205
Wadesboro, NC 28170

October 19, 2015

Ms. Kim Nimmer
Division of Water Resources
1611 Mail Service Center
Raleigh, NC 27699-1611

Re: Union County
Interbasin Transfer Certificate Request

Dear Ms. Nimmer:

On behalf of Anson County I am writing to express our concerns regarding Union County's request for a 23.0 million gallons per day (MGD) Interbasin Transfer (IBT) from the Yadkin River basin to the Rocky River basin.

Anson County draws all of its water from Blewett Falls Lake on the Yadkin-Pee Dee River. We understand that Union County's proposed point of transfer is in Lake Tillery above Anson County's water intake. We have reviewed the draft Environmental Impact Statement (EIS) for the project and understand that the document concludes that under normal conditions the proposed project is not likely to adversely impact our ability to withdraw needed water at our raw water intake. However, during drought conditions and prolonged low flow periods we are greatly concerned about the potential impact on our ability to serve the citizens of Anson County and neighboring Richmond County.

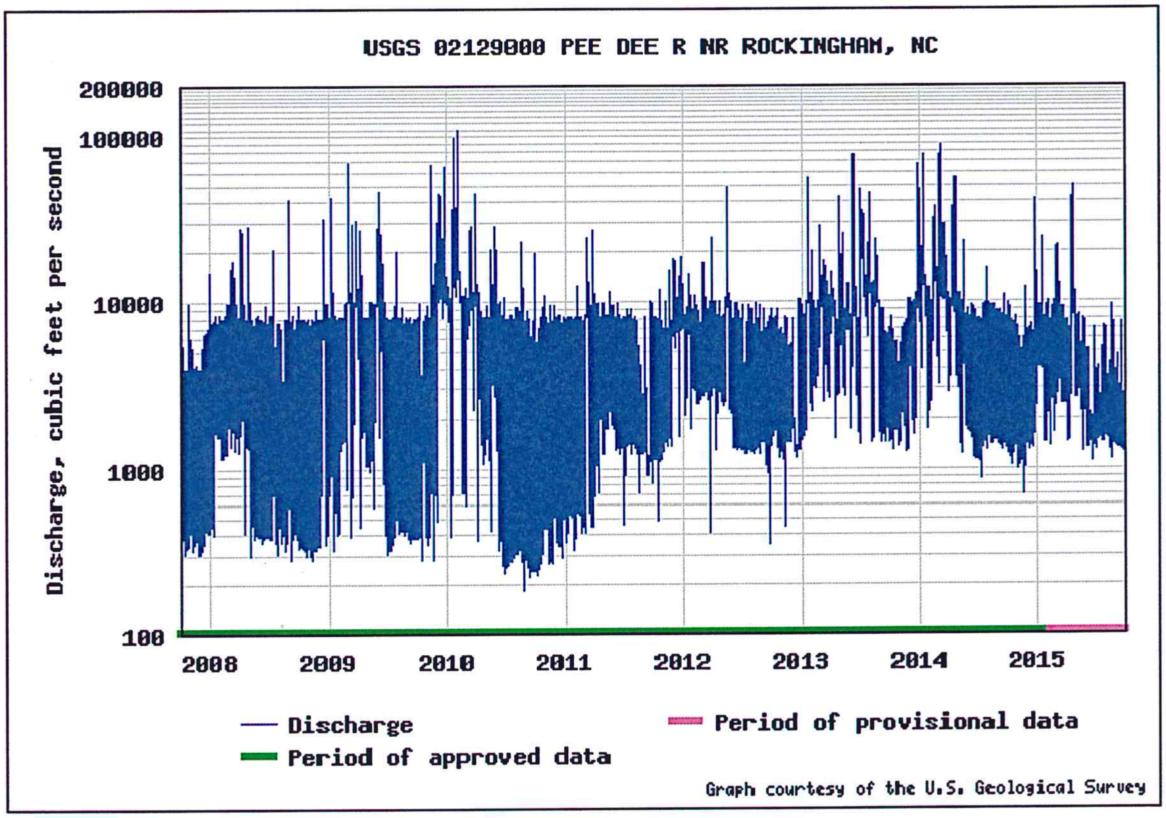
Anson County has recently assumed the role of sole water supplier for the Town of Wadesboro in addition to other communities that rely solely on Anson County for their potable water supply. We are also seeing signs of increased agribusiness development within our county. So, just like Union County, we want to be sure we have adequate water resources to meet the needs of our citizens and businesses now and into the future.

The draft EIS includes summary data from CHEOPS modeling performed for the various IBT scenarios. The conclusion of the report is that there would only be a "negligible" (as defined in the draft) impact to the downstream water intakes within Blewett Falls Lake and "minor" impacts to lake elevations and lake discharges, even under drought conditions. While the Yadkin Basin has not recently been in a period of severe drought, a September 18, 2015 release from ALCOA states that "Water inflow into the Yadkin Basin is down nearly 50 percent from historical averages" and "APGI requested and received a temporary variance from the Federal Energy Regulatory Commission (FERC) to conserve water by reducing required minimum flows out of the Yadkin Project".

Statements like these raise doubts in our minds as to what will happen in the future during periods of drought. ALCOA and Duke Energy work in conjunction to manage water levels and flows in the Yadkin River Basin. When low flow characteristics become more severe and prolonged droughts return, will adequate water still be available for release from Lake Tillery to maintain Blewett Falls Lake levels and releases below the dam? With competing demands for the water in the Yadkin system from its many users, long term future water demands have to be considered.

In Figure A below, the USGS stream gauge 02129000 near Rockingham shows stream flows varying from a normal high of approximately 8,000 CFS (5,169 MGD) to a low of less than 200 CFS (129 MGD). 23 MGD is an insignificant percentage of 5,169 MGD but it's over 10 percent of the 129 MGD low flow. This again gives us concern about the impact of the proposed IBT request. Anson County undertook a significant project in the past to create a new, emergency intake at a lower elevation in Blewett Falls Lake due to drought conditions, but it might not be possible to accomplish this type of project again should the lake levels be even lower than experienced in the past.

Figure A



As referenced previously, we understand that the draft EIS concludes that under normal circumstances, the proposed IBT should not have an adverse impact on Anson County's water consumers. While we view this as a reasonably supported conclusion, we want to be assured that as both Union and Anson County populations grow and business activity in the region increases in the future; that both jurisdictions are able to meet future water supply demands.

Sincerely,

Anna H. Baucom

Anna Baucom, Chairman
Anson County Board of Commissioners
Acting County Manager

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North Carolina
Department of Administration

Pat McCrory, Governor | Bill Daughtridge, Jr., Secretary

October 20, 2015

Ms. Kim Nimmer
NCDENR
Division of Water Resources
Water Quality Programs
1611 Mail Service Center
Raleigh, NC 27699-1617

Re: SCH File #16-E-4300-0064; DEIS; Proposed is a DEIS for the Union County Yadkin River Water Supply project. Project will transfer 23 mgd from the Yadkin River Basin to the Rocky River Basin based on 2050 projected water demands.

Dear Ms. Nimmer:

The above referenced environmental impact information has been reviewed through the State Clearinghouse under the provisions of the North Carolina Environmental Policy Act.

Attached to this letter are comments made in the review of this document. The comment(s) need to be addressed in the Final Environmental Impact Statement. This document should be submitted to the State Clearinghouse upon completion for compliance with the North Carolina Environmental Policy Act.

Sincerely,

Teresa Matthews
Teresa Matthews
State Environmental Review Clearinghouse

Attachments

Cc: Region F

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail state.clearinghouse@doa.nc.gov

Location Address:
116 West Jones Street
Raleigh, North Carolina

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: UNION

H12: OTHER

STATE NUMBER: 16-E-4300-0064
DATE RECEIVED: 08/28/2015
AGENCY RESPONSE: 10/07/2015
REVIEW CLOSED: 10/12/2015

MS CAROLYN PENNY
CLEARINGHOUSE COORDINATOR
DPS - DIV OF EMERGENCY MANAGEMENT
FLOODPLAIN MANAGEMENT PROGRAM
MSC # 4218
RALEIGH NC

SEP 0 2 2015

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DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION
DPS - DIV OF EMERGENCY MANAGEMENT

PROJECT INFORMATION

APPLICANT: NCDENR
TYPE: State Environmental Policy Act
Draft Environmental Impact Statement

DESC: Proposed is a DEIS for the Union County Yadkin River Water Supply project. Project will transfer 23 mgd from the Yadkin River Basin to the Rocky River Basin based on 2050 projected water demands. - View document at http://www.ncwater.org/?page=420

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☐ NO COMMENT ☒ COMMENTS ATTACHED

SIGNED BY: John D Burbaker

DATE: 09 Sept 2015

North Carolina Department of Public Safety

Emergency Management

Pat McCrory, Governor
Frank L. Perry, Secretary

Michael A. Sprayberry, Director

September 9, 2015

State Clearinghouse
N.C. Department of Administration
1301 Mail Service Center
Raleigh, North Carolina 27699-1301

Subject: Intergovernmental Review State Number: 16-E-4300-0064
Union County Yadkin River Water Supply Project

As requested by the North Carolina State Clearinghouse, the North Carolina Department of Public Safety Division of Emergency Management Risk Management reviewed the proposed project listed above and offers the following comments:

1) The Draft Environmental Impact Statement (DEIS) clearly and thoroughly outlines the impacts within the Special Flood Hazard Areas due to the proposed project. As noted in the DEIS, a floodplain development permit issued by the local jurisdiction will be required for all work within the SFHA. Please note that although mitigation or hydraulic analysis may not be required, permitting is still required for all work within the SFHA.

2) A hydraulic analysis will be required for new grading, construction, or the storage of equipment or materials within a floodway or non-encroachment area. A No-Rise Certification is required if the proposed element of the project does not increase flood levels during the base flood discharge. A Conditional Letter of Map Revision (CLOMR) will be required if the project results in an increase in flood levels during the base flood discharge. No structures may be impacted by an increase in flood levels.

3) Critical facilities should be protected to the 0.2% (500-year) flood level or the Regulatory Flood Protection Elevation, whichever is higher.

4) Please coordinate with this office if the project results in any changes to the hydrology of the Yadkin River or adjoining basins.

Thank you for your cooperation and consideration. If you have any questions concerning the above comments, please contact me at (919) 825-2300, by email at dan.brubaker@ncdps.gov or at the address shown on the footer of this document.

MAILING ADDRESS:
4218 Mail Service Center
Raleigh NC 27699-4218
www.ncem.org

GTM OFFICE LOCATION:
4105 Reedy Creek Road
Raleigh, NC 27607
Telephone: (919) 825-2341
Fax: (919) 825-0408

Sincerely,

John D. Brubaker, P.E., CFM
NFIP Engineer
Risk Management

cc: John Dorman, Program Manager
John Gerber, NFIP State Coordinator

File

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: UNION

H12: OTHER

STATE NUMBER: 16-E-4300-0064
DATE RECEIVED: 08/28/2015
AGENCY RESPONSE: 10/07/2015
REVIEW CLOSED: 10/12/2015

MS RENEE GLEDHILL-EARLEY
CLEARINGHOUSE COORDINATOR
DEPT OF CULTURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
MSC 4617 - ARCHIVES BUILDING
RALEIGH NC

ER 13-2841
Draft letter — ΠΜ 9/4/15
A
Due ~~9/10/15~~ 9/18/15

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DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION
DPS - DIV OF EMERGENCY MANAGEMENT

PROJECT INFORMATION

APPLICANT: NCDENR

TYPE: State Environmental Policy Act
Draft Environmental Impact Statement

Due 9/18/15 S SEB CNRS AEL 9/17/15

DESC: Proposed is a DEIS for the Union County Yadkin River Water Supply project. Project will transfer 23 mgd from the Yadkin River Basin to the Rocky River Basin based on 2050 projected water demands. - View document at http://www.ncwater.org/?page=420

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☐ NO COMMENT ☒ COMMENTS ATTACHED

SIGNED BY: Renee Gledhill-Earley DATE: 9/28/15

OCT 2015 RECEIVED Secretary's Office DOA

SEP 02 2015

North Carolina Department of Cultural Resources
State Historic Preservation Office
Ramona M. Bartos, Administrator

Governor Pat McCrory
Secretary Susan Kluttz

Office of Archives and History
Deputy Secretary Kevin Cherry

September 25, 2015

Vickie M. Miller
HDR
3733 National Drive, Suite 207
Raleigh, NC 27612

Re: Yadkin River Water Supply Project, Interbasin Transfer, Union County, ER 13-2841

Dear Ms. Miller:

Thank you for your submission of September 1, 2015, regarding the above-referenced undertaking. We have reviewed the materials submitted and offer the following comments.

The preferred alternative chosen for the proposed undertaking is Alternative 1A. As stated in our previous letter, this alternative has the potential to adversely affect the Norwood Commercial Historic District (ST0531), which is considered eligible for listing in the National Register of Historic Places. However, if the undertaking is conditioned to occur wholly within existing DOT or utility rights-of-way, it is unlikely the work will adversely affect the historic district or archaeological resources. However, if earth moving activities associated with the project impinges on previously undisturbed areas then an archaeological investigation may be warranted.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

cc: State Clearinghouse

Location: 109 East Jones Street, Raleigh NC 27601 **Mailing Address:** 4617 Mail Service Center, Raleigh NC 27699-4617 **Telephone/Fax:** (919) 807-6570/807-6599

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: UNION

H12: OTHER

STATE NUMBER: 16-E-4300-0064
DATE RECEIVED: 08/28/2015
AGENCY RESPONSE: 10/07/2015
REVIEW CLOSED: 10/12/2015

MS LYN HARDISON
CLEARINGHOUSE COORDINATOR
DENR LEGISLATIVE AFFAIRS
GREEN SQUARE BUILDING - MSC # 1601
RALEIGH NC

REVIEW DISTRIBUTION

CENTRALINA COG
DENR LEGISLATIVE AFFAIRS
DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION
DPS - DIV OF EMERGENCY MANAGEMENT

PROJECT INFORMATION

APPLICANT: NCDENR

TYPE: State Environmental Policy Act
Draft Environmental Impact Statement

DESC: Proposed is a DEIS for the Union County Yadkin River Water Supply project. Project will transfer 23 mgd from the Yadkin River Basin to the Rocky River Basin based on 2050 projected water demands. - View document at http://www.ncwater.org/?page=420

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☑ NO COMMENT ☐ COMMENTS ATTACHED

SIGNED BY: Lyn B. Hardison DATE: 10-7-15

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

~~Reuben Crummy~~
Anil Panicker

COUNTY: UNION

H12: OTHER

STATE NUMBER: 16-E-4300-0064
DATE RECEIVED: 08/28/2015
AGENCY RESPONSE: 10/07/2015
REVIEW CLOSED: 10/12/2015

MS CARRIE ATKINSON
CLEARINGHOUSE COORDINATOR
DEPT OF TRANSPORTATION
STATEWIDE PLANNING - MSC #1554
RALEIGH NC

REVIEW DISTRIBUTION

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DPS - DIV OF EMERGENCY MANAGEMENT

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AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☑ NO COMMENT ☐ COMMENTS ATTACHED

SIGNED BY: ANIL PANICKER

DATE: 09/17/2015

SEP 2015 RECEIVED

North Carolina Department of Environmental Quality

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

October 28, 2015

MEMORANDUM

FROM: Harold Brady, SEPA Review Coordinator - DWR

TO: Jonathan Williams, HDR Inc.

SUBJECT: Union County–Draft Environmental Impact Statement (EIS) for a requested Interbasin Transfer Certificate transferring water from the Yadkin IBT basin into the Rocky IBT basin.

The Division of Water Resources has reviewed the Draft Environmental Impact Statement (EIS) document and has the following additional comments from those submitted in May 2015.

Harold Brady (Water Supply Planning Branch):

- Section 5.12: Please identify the source of the performance measures criteria for the hydrologic modeling and document the background information on the source. As well, please provide the source for the interpretation criteria of the results from the hydrologic modeling. In particular the source for the ranges selected for the minor, moderate, and major categories used needs to be documented. Additional explanation for each table related to the hydrologic modeling needs to be included to avoid misinterpretations of the data presented. This should be done in the text prior to or following each table. This information will provide the reader as well as the lead agency with confidence in the presentation of the results from the hydrologic modeling activities and allow for greater understanding of any hydrologic impacts.
- Section 5.12.1.4, second paragraph, last sentence: Please change "UFWS" to "USFWS".
- Appendices: Please include water balance tables for current year (or year used for baseline within document) and each ten-year increment for 30-years, at a minimum.

Please contact Harold Brady (919-707-9005, harold.m.brady@ncdenr.gov) if you have questions regarding these comments.

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Williams, Jonathan

Subject: Lake Tillery/Union County

AMServiceURLStr: https://Slingshot.hdrinc.com:443/CFSS/control?view=services/FTService

From: Tom Okel [mailto:tom@catawbalands.org]
Sent: Monday, November 16, 2015 4:32 PM
To: Nimmer, Kim <kim.nimmer@ncdenr.gov>
Cc: Matt Covington <matt@catawbalands.org>
Subject: Lake Tillery/Union County

I am the Executive Director for the Catawba Lands Conservancy. As it relates to the proposed inter-basin transfer agreement between Lake Tillery and Union County, CLC would be pleased to work with Union County, the Town of Norwood and others to increase protection of Lake Tillery and the Yadkin/Pee Dee River Basin to ensure that the environmental impact is minimized and that the quantity and quality of basin is protected through land conservation. Please feel free to contact me if you would like to discuss.

Tom Okel
Executive Director
Catawba Lands Conservancy
Leading the Carolina Thread Trail
New Address:
4530 Park Road, Suite 420
Charlotte, NC 28209
T: 704.342.3330 ext. 202
F: 704.342.3340
catawbalands.org
carolinathreadtrail.org

Connect with the Conservancy:

Connect with the Thread Trail:

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THE
CONSERVATION FUND

PO Box 271
Chapel Hill, NC 27514

Phone: 919-967-2223
Fax: 919-967-9702
www.conservationfund.org

November 16, 2015

Mr. Bill Puette
Environmental Management Commission
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

Ms. Kim Nimmer
Interbasin Transfer Program Coordinator
NC Division of Water Resources
1611 Mail Service Center
Raleigh, North Carolina 27699-1611

Re: Draft Environmental Impact Statement on Union County Public Works Water System Request for a Certificate for an Interbasin Transfer from the Yadkin River Basin to the Rocky River Basin

Dear Mr. Puette & Ms. Nimmer:

Thank you for the opportunity to speak at the September 16, 2015 public hearing in Norwood on the draft environmental impact statement (DEIS) in support of Union County Public Works Water System's Request for a certificate from the Environmental Management Commission to transfer up to 23,000,000 gallons of water per day from Lake Tillery in the Yadkin River Basin to the Rocky River Basin.

I am writing on behalf of The Conservation Fund (The Fund) to provide more detailed comments on the DEIS and IBT request.

The Fund commends Union County for planning for its water supply needs for 2050 and beyond and for collaborating with the Town of Norwood on a solution with mutual benefits.

The Fund will be respectfully urging Union County and the Town of Norwood to build upon their regional water supply planning collaboration to work with land conservation organizations and other local governments: 1) to develop a plan to increase protection and restoration of Lake Tillery and other important reservoirs in the Yadkin/Pee Dee River Basin, and 2) to begin to reserve and invest funds in land conservation and restoration in the Lake Tillery watershed. Their investments in land conservation and restoration will increase source water protection and would leverage other public and private funds.

The Fund respectfully asks the Division of Water Resources and the Environmental Management Commission to also urge Union County and Norwood to work with land conservation organizations, such as The Fund, the Land Trust for Central North Carolina, and the Catawba Lands Conservancy to develop a plan to increase protection of Lake Tillery and to invest in protecting Lake Tillery.

The Fund also recommends that Union County, Norwood, other water utilities, Duke Energy and Alcoa consider creating an organization similar to the Catawba-Wateree Water Management Group (CWWMG) to facilitate long term planning and collaboration on water supply and water quality problems. CWWMG updated its 50-year Water Supply Master Plan in June, 2015. It's a great model for river basin wide planning and collaboration by water utilities, electric utilities and key stakeholders.

The Fund notes that CWWMG plans to study and model the benefits of land conservation in reducing sedimentation/preserving reservoir capacity and in maintaining stream flows in 2016 as it begins to implement the options identified in its Water Supply Master Plan. The Fund recommends that Union County, Norwood and other utilities consider a similar study and model in the Yadkin/Pee Dee River Basin.

<u>Preferred Alternative Identified by DEIS</u>

The Fund has reviewed the DEIS prepared by HDR in August, 2015 and agrees with many of its conclusions. The Fund believes that the environmental assessment and review process conducted under the State Environmental Policy Act (SEPA) worked well. The environmental and economic costs and benefits of many alternatives were carefully considered.

The preferred alternative takes advantage of Lake Tillery, an existing reservoir, and avoids building a new reservoir and the environmental damage associated with building new impoundments. The preferred alternative also avoids increasing water withdrawals and interbasin transfers from the stressed Catawba-Wateree River Basin. The preferred alternative requires collaboration between Union County and The Town of Norwood and will provide benefits to both local governments.

Under the preferred alternative Union County will make substantial investments in a new intake on Lake Tillery and in a new water distribution and treatment system. The DEIS does not adequately address policies and measures to protect the source water, Lake Tillery, or other reservoirs in the Yadkin/Pee Dee River Basin.

The DEIS also does not adequately address policies and measures to reduce and mitigate the secondary environmental impacts that will be the result of the new growth in Union County enable by new water capacity and infrastructure.

Union County is one of the fastest growing counties in North Carolina. The NC Office of State Budget & Management projects that Union County's population will increase to 243,620 from 201,307 or by 21.0% between 2010 – 2020 and will increase to 289,766 from 243,620 or by 18.9% between 2020 – 2030.

<u>Source Water Protection</u>

A variety of preventable disasters threatened drinking water supplies across the United States in 2014. In response to these threats Representative Rick Catlin from New Hanover County and others sponsored HB 894, An Act to Improve Source Water Protection Planning, in the 2014 General Assembly. The General Assembly enacted and Governor McCrory signed SL 2014-41. GS 130A-320 strengthens the State's existing source water protection program and *requires* public water suppliers to develop source water protection plans. Investments in land conservation and restoration will help Union County, Norwood and other local governments comply with GS 130A-320.

North Carolina's Source Water Assessment Program in the Division of Water Resources considers Lake Tillery to have a *moderate* inherent vulnerability rating, a *moderate* contaminant rating and a *moderate* susceptibility rating. Land conservation will reduce the risk of potential contamination.

The Environmental Management Commission has classified Lake Tillery as WS-IV, which provides minimal protection from stormwater pollution and land use change. Local initiatives and investments will be required to enhance source water protection in Lake Tillery.

<u>EMC May Require Mitigation Measures</u>

The EMC may require applicants for IBT certificates to mitigate impacts of the IBT pursuant to GS 143-215.22L (m). For example in its July, 2001 decision to approve a temporary increase in IBT from Jordan Lake in the Haw River Basin to the Neuse River Basin, the EMC set out a number of conditions to mitigate the impacts of the IBT. The EMC also gave the applicants credits for their policies and programs that exceeded state minimum standards.

<u>FERC Review</u>

The Fund notes that Union County and Norwood will have to file an amendment with Duke Energy Progress and the Federal Energy Regulatory Commission (FERC) to increase water withdrawals from Lake Tillery. The Fund believes and effective and collaborative watershed protection plan will be positively considered by FERC.

Thank you for your consideration.

Sincerely,

Bill Holman
North Carolina Director

C: Mr. Edward Goscicki, Union County
Mr. Bryan Bowles, Town of Norwood
Ms. Crystal Cockman, Land Trust for Central NC
Mr. Tom Okel, Catawba Lands Conservancy

846 West Fourth St.
Winston-Salem, NC 27101
Telephone : 336-722-4949

November 16, 2015

VIA EMAIL AND U.S. MAIL

Nin Kimmer
Division of Water Resources
1611 Mail Service Center
Raleigh, NC 27699
nin.kimmer@denr.gov

Re: Yadkin River Water Supply Project Interbasin Transfer
Pump Station, Access Roads and Pipe Corridor
Draft Environmental Impact Statement

Dear Sir,

Yadkin Riverkeeper submits these comments on the proposed Yadkin River Water Supply Project(YRWSP) Interbasin Transfer Draft Environmental Impact Statement. The Yadkin Riverkeeper is a 501c(3) organization whose mission is to protect drinkable, fishable, swimmable water in the Yadkin basin. We are a membership-based organization and have members whose use and enjoyment of the waters of the Yadkin/Pee Dee within the project area are affected by the proposed YRWSP Interbasin Transfer.

YRK supports water from a given hydrologic unit staying within its natural watershed. If we are to have sustainable long-term growth in North Carolina, our communities must exist within the carrying capacity of their natural systems. To reach, as the proposed alternative does, outside of the Rocky River basin in which the majority of the projected growth will fall, creates unnecessary costs and environmental impacts. For this reason, we raise a number of concerns about the preferred Alternative 1A favored by the Draft EIS. While we agree that Union County must "secure a reliable water supply" we disagree that Alternative 1A is the most efficient means of doing so, either in cost to ratepayers or in terms of environmental impact.

1. Assumptions

a. Projected Growth in Union County

The Draft is inconsistent in its descriptions of induced growth related to the proposed project. Specifically, the Draft states that the no action alternative would lead to economic stagnation, but then when estimating the impacts of alternatives, the Draft estimates the impacts of growth from the IBT will be "minor" or "insignificant". If the projected growth cannot occur without one of the action alternatives being chosen, the environmental impacts of that growth must be factored into the "Secondary" and "Cumulative" impact analyses.

If alternatives themselves will dictate growth, a consideration of meaningful alternatives must then consider different patterns of induced growth paired with different potential water sources.

b. Projected Need for Water

The EIS takes as a given the 28.9 MGD Maximum Monthly Average Projected Water Demand. However, this is not the only reasonable definition of the project's "Purpose and Need". Nowhere in the EIS is a different growth path considered, and how the various projects might satisfy a different target. Given that growth rates in Union County have fluctuated widely in the last decade, it is only prudent, when considering the largest capital expenditure Union County faces, to evaluate the alternatives in relation to a range of growth scenarios.

In particular, the stated Purpose and Need, set at 23 MGD, forecloses the possibility of a water supply within the Rocky River subbasin because a withdrawal of that size would, "necessitate a large portion of the total water within the Rocky River be withdrawn at this location[Just above Highway 205]." Draft EIS, p. 276

Given that Alternative 5is, by far, the lowest cost option at almost $50 million cheaper than Preferred Alternative 1A($190 to $239 million), an alternatives analysis is not complete without a study of what level of water could be withdrawn from the Rocky while achieving minimal environmental impacts.

c. Finding a watershed carrying capacity

Ultimately, the most sustainable long-term supply of water for the area will come from its local ground and surface waters. By reaching outside of this area, Union County puts itself in long-term competition for Yadkin River water with other municipalities and opens itself to the possibility that, as with its current agreement with Anson County, a change in local politics will require additional investment in the future. Indeed, the Draft admits that the Preferred Alternative 1A was selected not because it was the most cost efficient or because it had the least environmental impact but because of the current political environment, “"...Union County held discussions with numerous entities along the Yadkin river regarding partnerships for water supply. Of all those contacted, the Town of Norwood was the only political jurisdiction who expressed a desire to participate in a partnership with mutual benefits for both parties." Draft EIS August 2015, p. 25

2. Local Impacts

The preferred alternative 1A is not the option with the least environmental impacts either during construction or after. Alternative 1A will impact 551 acres, Alternative 5 will impact only 67. Draft EIS, p. 225 Alternative 5 will impact less than 10% as much land, permanently and during construction compared to 1A. Alternative 5 is the only alternative outside of modifying existing current WTPs that will not impact any current agricultural land. In terms of Significant Natural Heritage Areas Alternative 5 impacts 5.5 acres while Alternative 1A will impact 7.2 acres of significant Natural Heritage Area. Alternative 5 does not impact any perennial streams, only 1,343 feet of intermittent stream on 3 crossing vs. 11,014 feet of intermittent stream via 20 crossings and 2,848 ft of perennial streams via 11 crossings.

By the majority of environmental impact indicators, then Alternative 1A is not the least environmentally damaging option. The primary area it differs from Alternative 1A is that it would withdraw water from the Rocky River rather than a reservoir on the Yadkin, like Lake Tillery.

The feasibility of re-classification of the Rocky River as a drinking water supply should be more thoroughly investigated in the Draft EIS, in conjunction with looking at whether the Purpose and Need could be met with a conjunction of efficiency measures combined with a smaller Maximum Monthly Average withdrawal.

Before attempting to take clean water from a distant reservoir, the County must come to terms with the impact current growth is having on its own Rocky River, which is impaired for copper, turbidity and biological integrity. Draft EIS, p.281. We would respectfully submit that when local waters are impaired, the long-term solution to them is not to seek water elsewhere but to protect those waters to the point where they are a viable water supply. An assessment of the cost of mitigating the impacts of a low-head dam on the Rocky River are not included in the Draft EIS, nor are any estimate of what stormwater and land conservation measures would be necessary to bring the Rocky into line with state water supply guidelines.

3. Water Efficiency

The Draft EIS takes 125 gallons per capita per day as its baseline used to project demand upon the municipal water system. By contrast, the United States Geological Survey estimates per capita per day usage at 80-100 a day for the average American. The Draft itself averaged acknowledges that historical data shows per capita usage in Union County, "between 110 to 120 gpcd, with slightly lower values in the most recent years due to ongoing mandatory water restrictions, increased conservation efforts, and more favorable climate conditions (more annual rainfall and slightly lower annual temperature averages)." Draft EIS, P.15 We would urge that those hard-won lower averages be taken as the new norm and that used to estimate, in conjunction with slowing growth, a variety of projected water demand levels by which the project alternatives can then be meaningfully evaluated.

Conclusion

The alternatives proposed do not explore the full extent of options available. Instead of choosing the local, low-cost option of drawing water from the Rocky River in conjunction efforts to reduce per capita usage, the Preferred Alternative is more expensive, more dependent upon politics and more damaging to streams and land across Union County than other available options.

Sincerely,

William M. Scott

Yadkin Riverkeeper

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E

APPENDIX E – APPENDICES ON COMPACT DISC

CD-1 Local Ordinances and Drought Management Information

CD-2 Yadkin-Pee Dee River Basin Modeling Results

CD-3 Catawba River Basin Modeling Results

CD-4 Yadkin River Basin Model Reference Files

CD-5 Yadkin- Duke Energy Progress Shoreline Management Plan