City of Winston-Salem
NPDES Stormwater Permit Program

Permit Number NCS000247

Water Quality Recovery Plan
Salem Creek Fecal Coliform TMDL

Winston-Salem

June 2009

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Purpose

The purpose of this Water Quality Recovery Program (WQRP) is to reduce the levels of fecal coliform to the maximum extent practicable, in accordance with the assigned MS4 NPDES regulated Waste Load Allocation (WLA) identified in the approved Fecal Coliform Total Maximum Daily Load (TMDL) for Salem Creek.

The goals of this Water Quality Recovery Program (WQRP) are to identify BMP's, management strategies, time frames and costs necessary to address the MS4 NPDES regulated Waste Load Allocation (WLA) identified in the TMDL, which in turn will assist in returning the impaired segments to compliance with state water quality standards.

Background

Salem creek is located within the Yadkin-Pee Dee River Basin in the Piedmont physiographic region and is composed of class "C" waters. The Salem Creek Watershed is located entirely within Forsyth County and the majority of the watershed is located within the municipal limits of the City of Winston-Salem. The watershed is located within hydrologic unit 030400101170060 and DQW subbasin 03-07-04. Salem Creek is currently impaired for fecal coliform bacteria. The impaired segment of Salem Creek originates at the Salem Lake Water Supply Dam and travels in a southwesterly direction to the confluents with Muddy Creek. Brushy Fork Creek and Peters Creek are tributaries to Salem Creek. The impairment length of Salem Creek is 12.0 miles.

The Salem Creek Watershed measures 44,894 acres, or 70.15 square miles of drainage area. A significant portion is within the municipal limits of the City of Winston-Salem. Portions of the upper and middle Salem Creek watershed drain down-town Winston-Salem which would be considered an ultra urban land-use. Therefore, urban runoff can contribute significant amounts of pollutants to water bodies. However, much of this runoff is regulated with the NPDES Phase I and II program (EPA, 2000). This rule applies to a unit of government such as a city or county, which owns or operates a municipal separate storm sewer system (MS4). All medium and large municipalities which own or operate an MS4 are required a National Pollutant Discharge Elimination System (NPDES) permit in order to discharge stormwater to the water of the State. Stormwater discharged from the MS4 is considered a point source discharge. The City of Winston-Salem currently holds an NPDES permit to discharge stormwater to the waters of the State.

The TMDL for Salem Creek was developed by the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Water Quality and the United States Environmental Protection Agency (EPA) approved the TMDL on September 25, 2006.

Figure 1 below shows the watersheds within the City of Winston-Salem and figures 2-5 show the impaired reach and tributary streams, MS4 outfalls and land uses within the impaired watershed. Figure 6 on page 16 shows the WQRP life cycle process.

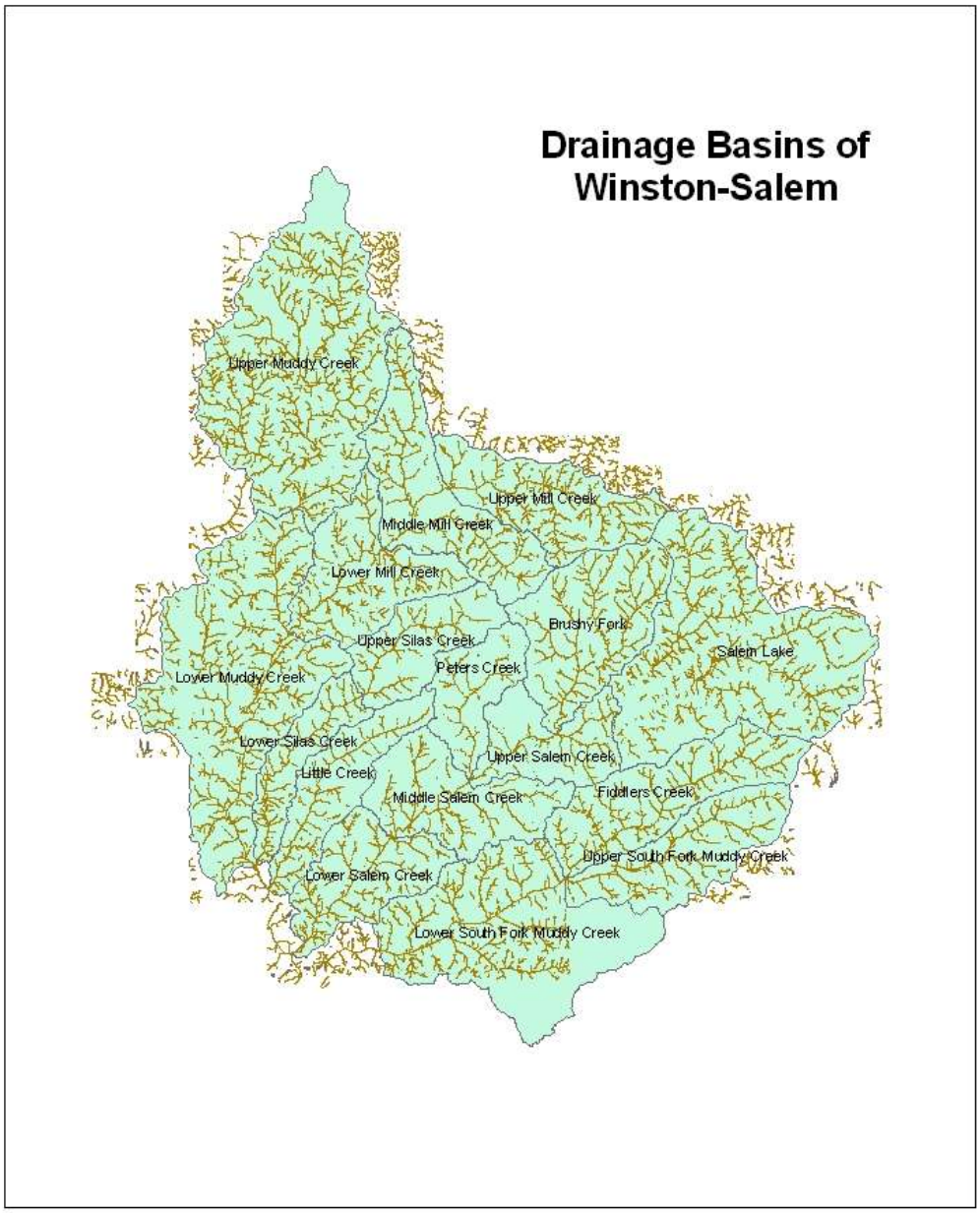
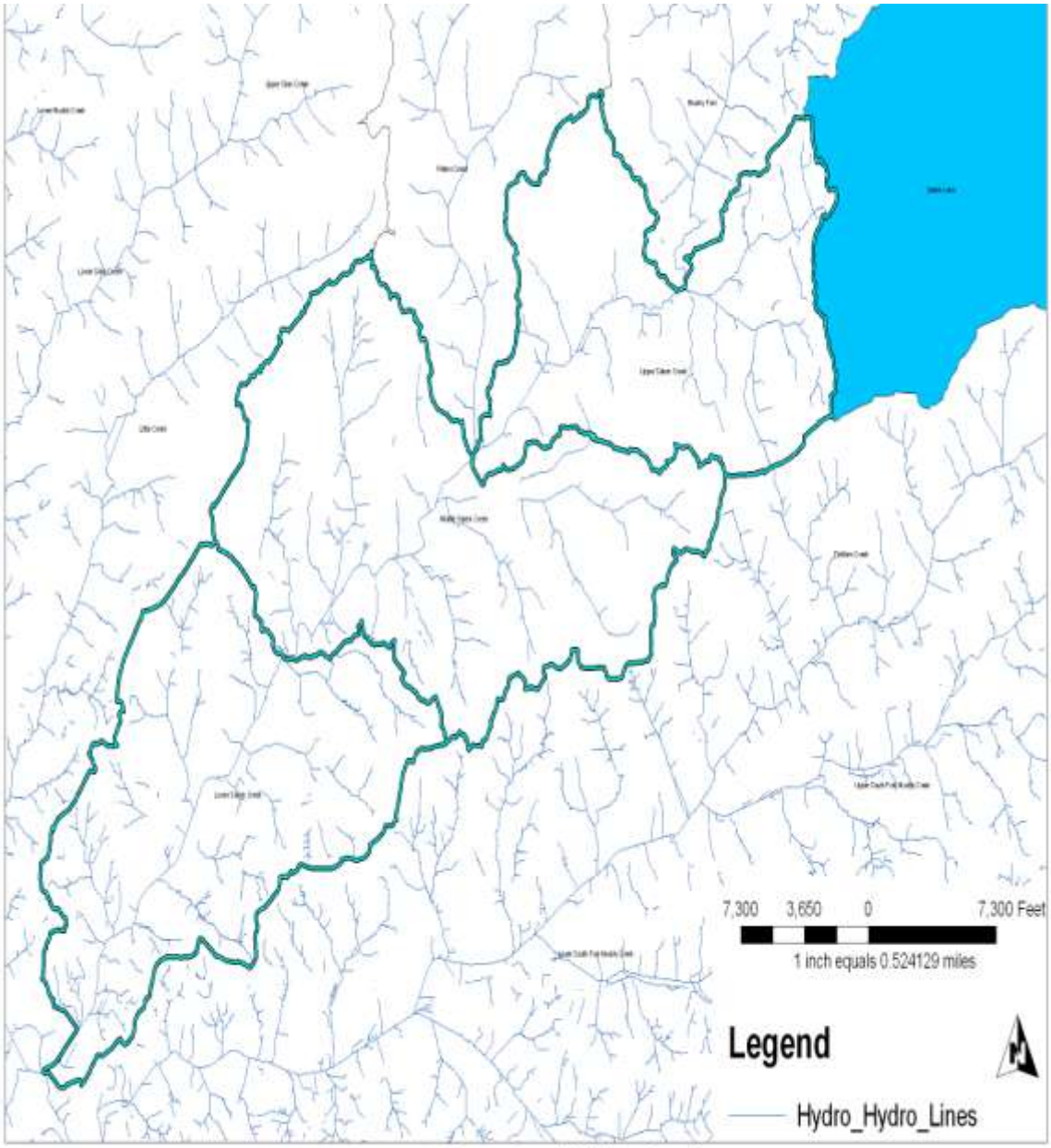
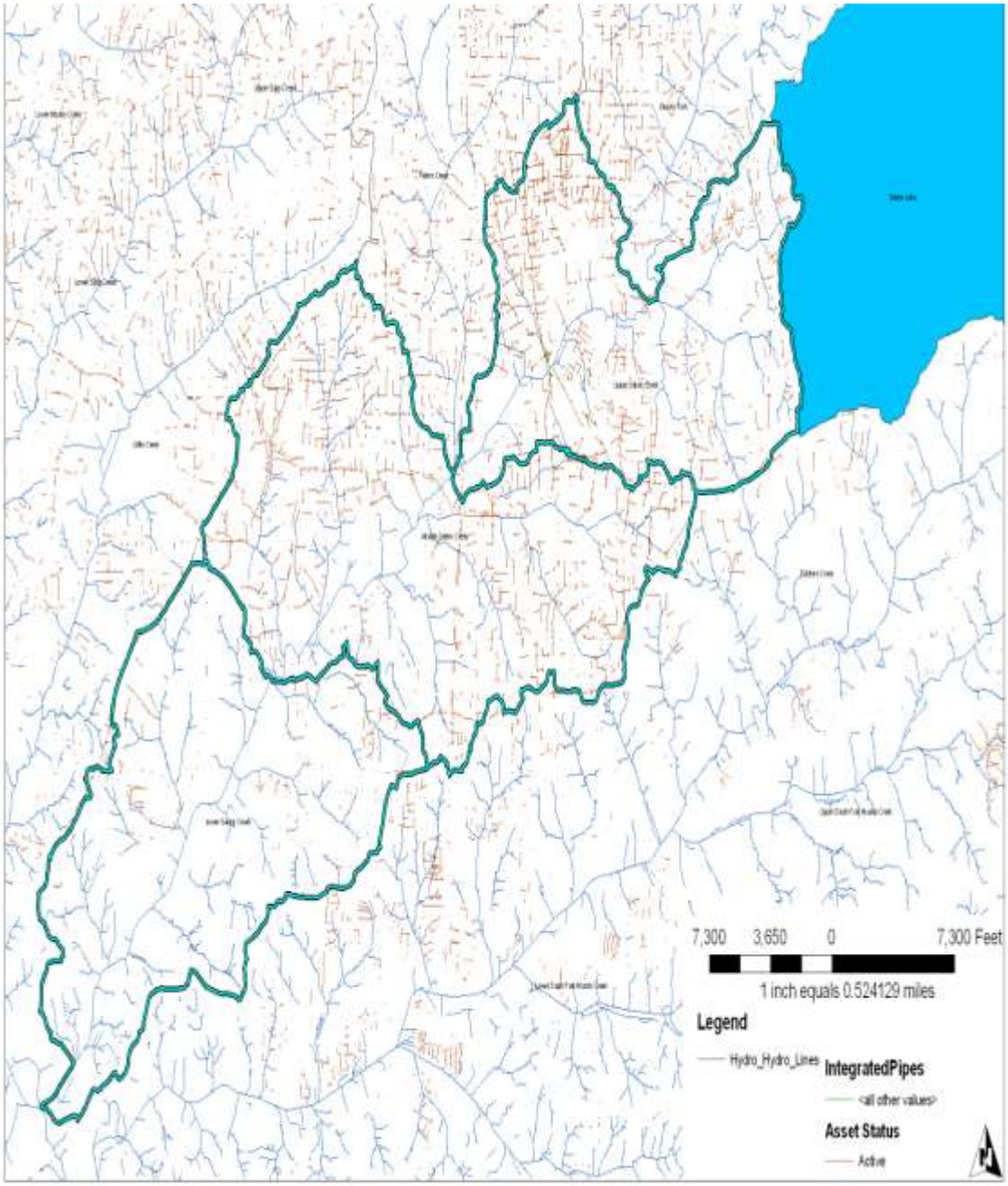


Figure 1: Watersheds of Winston-Salem



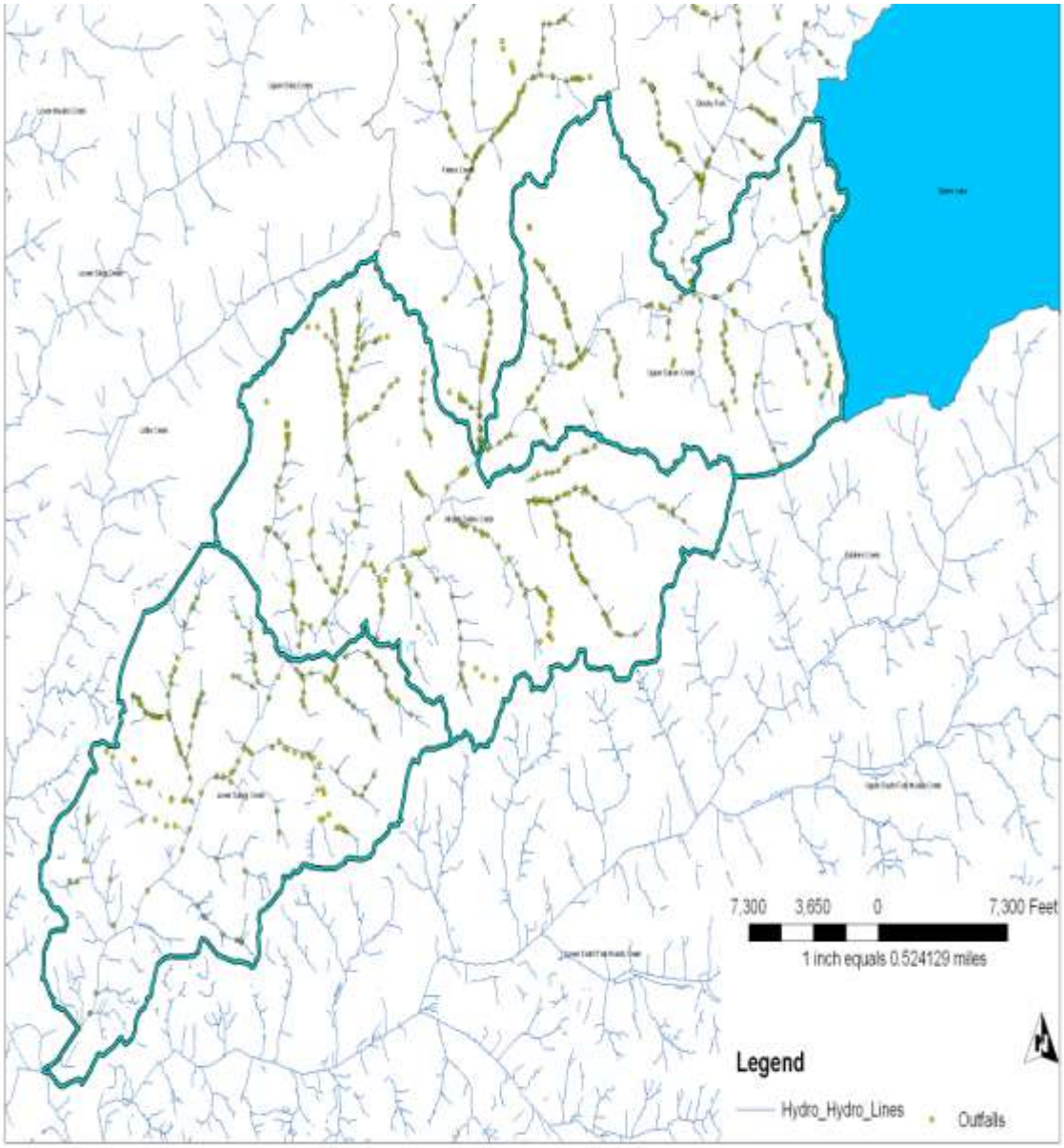
Salem Creek Watershed

Figure 2: Steams and Tributaries of the Salem Creek Watershed



Salem Creek Watershed

Figure 3: Storm Sewer Inventory



Salem Creek Watershed

Figure 4: MS4 Outfalls within the Salem Creek Watershed

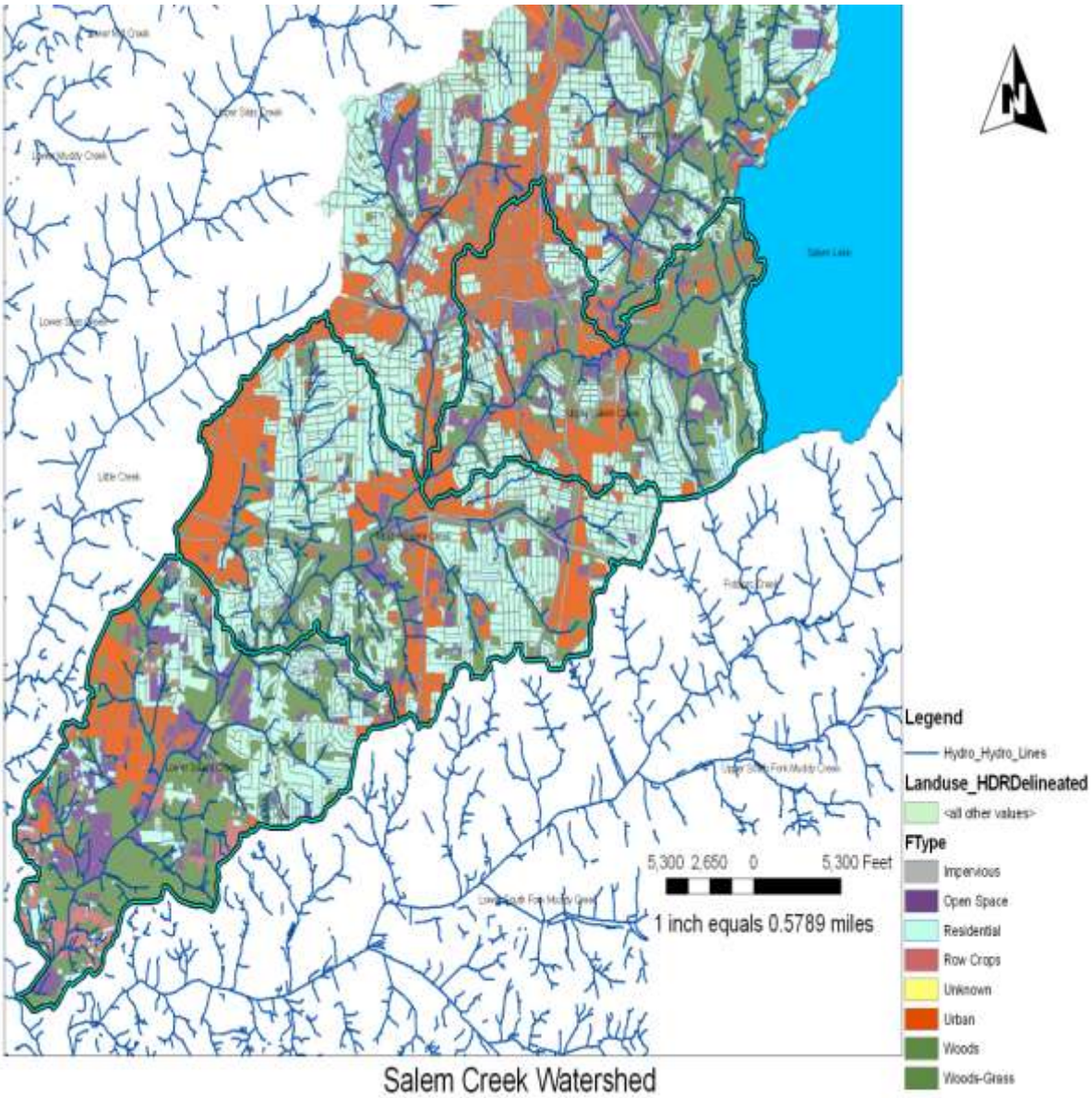


Figure 5: Land uses within the Salem Creek Watershed

TMDL WQRP Implementation Team

During year 3 of the WQRP plan, a team of representatives will be assembled from various City and County agencies with a vested interest in the TMDL process. With fecal coliform as the pollutant of concern (POC), it is expected that City agencies such Stormwater, Utilities, Streets, Sanitation, Engineering and Inspections will be part of the implementation team. In addition, County agencies such as the Forsyth County

Department of Health and Forsyth County Extension Services would be represented in the TMDL WQRP implementation team. However, it is expected that the Stormwater Services Division, as the NPDES oversight entity would be responsible for sampling and monitoring efforts, program implementation, data, interpretation, BMP implementation, program effectiveness, reporting requirements and overall coordination of the WQRP.

Public Education and Outreach Program

During year 3 of the WQRP, a Public Education and Outreach Program will be established and maintained to provide information concerning the WQRP centered on the POC. At a minimum, a website will be established to document and distribute information, programs and results. Additional items may be included such as:

- Participation in public events such as Earth Day, Fairs, etc.
- Presentations to Schools, Special Interest groups and other interested organizations.
- Adopt-a-Stream and Storm Drain Stenciling and Marking activities.
- Door hangers in neighborhoods or other special interest areas.
- TV13 advertisements.

Pollutant of Concern

The pollutant of concern and the focus of the WQRP are fecal coliform outputs from the MS4. The loading of the pollutant of concern represents the waste load portion of the TMDL. Requirements under state water quality standards require that fecal coliform bacteria counts shall not exceed a geometric mean of 200/100 ml (membrane filter count) based upon at least five consecutive samples examined during any 30 day period, nor exceed 400/100 ml in more than 20 percent of the samples examined during such period. Overall reduction is based on the instantaneous standard of 400 cfu/100ml and is assumed to be more stringent than the geometric mean standard.

The approved Salem Creek TMDL has a WLA of 7.49E10 (colony forming units (cfu)/day), and a TMDL allocation of 9.14E11 (colony forming units (cfu)/day) and requires an 84% overall reduction.

TMDL Allocation Summary: Fecal Coliform (colony forming units (cfu)/day						
Watershed	Existing Exceeding Load	WLA	LA	MOS	TMDL	Percent Reduction
Salem Creek	5.74E12	7.49E11	7.37E10	9.14E10	9.14E11	84.1%

Point sources of fecal coliform consist primarily of large and small industries, wastewater treatment plants, and MS4s. As authorized by the Clean Water Act, the DWQ regulates the NPDES permit program to control water pollution due to point sources. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. NPDES-Regulated Municipal and Industrial Wastewater Treatment Facilities Discharges from wastewater treatment facilities may contribute fecal coliform to receiving waters. Municipal treatment plants and industrial treatment plants are required to meet surface water quality criteria for fecal coliform in their effluent. When effluent coliform concentrations exceed surface water quality criteria, and result in permit violations, action will be taken through the NPDES unit of North Carolina's Division of Water Quality. NPDES general permitted facilities are required to develop pollution prevention plans to discharge domestic wastewaters from single-family residences and other domestic discharges. The permitted flow of these facilities may not in any case exceed 1,000 gallons per day. The facilities are required to measure BOD5, total suspended residue, fecal coliform, and total residual chlorine (NCDENR).

Fecal coliform from nonpoint sources include those sources that cannot be identified as entering the water body at a specific location. Nonpoint source pollution can include both urban and agricultural sources and human and non-human sources. The nonpoint sources of fecal coliform in the water bodies include wildlife, livestock (land application of agricultural manure and grazing), urban development (stormwater runoff, including sources from domestic animals), failing septic systems, and sewer line systems (illicit connections, leaky sewer lines and sewer system overflows).

Potential Sources of Fecal Coliform Bacteria in Urban and Rural Watersheds.
(Source: Center for Watershed Protection, 1999)

- Combined sewer overflows
- Sanitary sewer overflows
- Illegal sanitary connections to storm drains
- Sewered watershed
- Illegal disposal to storm drains
- Failing septic systems
- Poorly operated package plant
- Landfills
- Human Sources
- Non-sewered watershed
- Marinas
- Domestic animals and urban wildlife
- Dogs, cats, rats, raccoons, pigeons, gulls, ducks, geese
- Livestock and rural wildlife Cattle, horse, poultry, beaver, muskrats, deer waterfowl
- Hobby farms

Land use can contribute to fecal coliform runoff. Agricultural land alongside a stream would contribute fecal coliform from livestock and manure applications. In addition, when cattle have direct access to streams, feces may be deposited directly into a stream. Runoff from urban surface is also a potentially significant source of fecal coliform loadings. Urban lands may contribute fecal coliform from pets such as dog and cats. Wildlife feces in runoff may be a frequent source of fecal coliform loading where forest dominates the streamside.

Fecal coliform can originate from various urban sources. These sources include pet waste, runoff through stormwater, sewers, illicit discharges/connections of sanitary waste, leaky sewer systems, and sewer system overflows. Fecal coliform contamination can be profound when sewer pipes are clogged or flooded by stormwater. Infiltration of rainfall can enter the sewer system through cracks and leaks in pipes. This additional flow volume, in combination with the existing sewer flow, can exceed the capacity of the system resulting in a sanitary-sewer-overflow (SSO) (TMDL Final Report NCDENR Salem Creek Watershed).

A study based on Antibiotic Resistance Analysis (ARA) was conducted by Map Tech and HDR in the Salem Creek and Muddy Creek Watersheds and the presence of human, livestock, wildlife and pet sources were confirmed. Dependant on the sample location, all major categories had a significant presence, however, other than human, no discernable pattern could be obtained as to the dominate source type. (Pathogen Source Assessment for Salem Creek 2003).

MS4 Major Outfall Identification

During year 3 of the WQRP, an inventory and map will be developed detailing the location of known major outfalls (as defined in the NPDES permit) within the NPDES MS4 jurisdictional area that have the possibility of discharging the pollutant of concern to the impaired segments or it's tributaries as defined by the MS4 permit. The City of Winston-Salem is well under way with this process.

During year 4 of the WQRP, a schedule will be developed to locate the position of unknown major outfalls within the watershed that may discharge the pollutant of concern to the impaired stream segment or its tributaries.

Monitoring Plan

During WQRP year 5, a monitoring plan will be developed for fecal coliform and submitted to DWQ for approval. The goals of the WQRP monitoring plan will be to:
1. Identify the significant sources of the pollutant of concern related to MS4 regulated WLA.
2. Evaluate the performance of BMPs utilized in the WQRP, where possible.
3. Assess progress toward the goals of the WQRP at the TMDL identified compliance point.

The monitoring plan will include components such as:
1. Written description and GIS map of sample locations
2. Monitoring methods
3. Sample type and frequency
4. Seasonal considerations
5. Sample analytical methods
6. Quality assurance
7. Record keeping

The monitoring plan shall include in-stream and/or major outfall monitoring at locations deemed necessary to support assessment of activities in the WQRP to address the MS4 NPDES regulated Waste Load Allocation (WLA) identified in the TMDL. Where appropriate, the permittee may reduce the monitoring burden by proposing to monitor in-stream sites and/or major outfalls that the Division would consider substantially similar to other in-stream sites and/or major outfalls in the defined TMDL watershed. The monitoring plan shall be adjusted as additional in-stream sites and/or major outfalls are identified in accordance with the schedule required in the Storm Water Management Plan and as accumulating data may suggest.

BMP Identification and Associated Costs

During WQRP year 4, the results of the watershed and water quality data analysis and outfall identification will be utilized to develop initial BMP strategies aimed at addressing the MS4 NPDES regulated Waste Load Allocation (WLA) identified in the TMDL. As part of the BMP identification, existing programs, ordinances, initiatives, etc., will be evaluated for applicability and use within the WQRP. Further assessment in future WQRP years will evaluate if any additional BMPs should be employed to address the MS4 NPDES regulated Waste Load Allocation identified in the TMDL to the maximum extent practicable. This assessment will be based on factors such as cost/benefit analysis, MEP standards, water quality data trends, status of activities & accomplishments relative to defined end-point in the WQRP, etc.

Initial BMP strategies may include:

- Existing regulatory strategies and ordinances
- Targeted public education and outreach programs
- Development of a WQRP specific webpage
- Targeted public participation programs
- Increased IDDE efforts-stream walks, outfall inspections, etc
- Targeted municipal storm system maintenance activities
- Increased site inspections where applicable
- Targeted monitoring and complaint response
- Implementation of strategies/requirements for structural BMPs
- Low Impact Design (LID) strategies

During WQRP year 7, an assessment of available data and cost benefit analysis will be performed to determine effectiveness of BMP strategies.

Program Implementation Schedule

Program elements and associated activities identified in the WQRP will be conducted in various permit years within the current and future MS4 NPDES 5-year permit terms. The proposed implementation schedule for this WQRP is as follows:

1. Identify the purpose and goals of the TMDL Water Quality Recovery Program (WQRP) by the end of year 2, (June 30, 2009).

2. Identify the watershed and provide brief description by the end of year 2, (June 30, 2009).

3. Assemble a team of staff representatives from affected municipal agencies by the middle of year 3, (January 30, 2010).

4. Establish a Public Education and Outreach Program by the end of year 3, (June 30, 2010).

5. Identify location and map major known outfalls in TMDL watershed by the end of year 3, (June 30, 2010).

6. Conduct an assessment of the available data by the end of year 3, (June 30, 2010).

7. Develop and submit a schedule to discover and locate all other MS4 major outfalls within the MS4 jurisdictional area that may be discharging the pollutant(s) of concern to the impaired stream segments, to their tributaries, and to segments and tributaries within the watershed contributing to the impaired segments by the end of year 4, (June 30, 2011).

8. Develop non-structural and structural BMP strategies by the end of year 4, (June 30, 2011).

9. Develop a WQRP monitoring plan for the pollutant of concern and submit to DWQ for approval by the end of year 5, (June 30, 2012).

10. Develop a schedule to implement appropriate regulatory strategies, non-structural BMPs, and structural BMPs to control the pollutant(s) of concern to the maximum extent practicable by the end of year 5, (June 30, 2012).

11. Conduct Year 6 WQRP assessment by the end of year 7, (June 30, 2014 and annual thereafter).

12. Conduct a cost-benefit analysis by the end of year 7, (June 30, 2014 and annual thereafter).

13. Define the end point of the WQRP within MEP standards by the end of year 7, (June 30, 2014).

Implementation of the Program to the Maximum Extent Practicable

During WQRP year 7, an assessment of available data, BMP strategies, cost benefit analysis, and WQRP effectiveness will be conducted and utilized to define the end point of the WQRP within MEP standards. As part of this, activities being conducted to address the MS4 NPDES regulated Waste Load Allocation (WLA) identified in the TMDL will be evaluated and defined as to their contribution toward reaching the end point in the WQRP. The results of the analysis and definition will be used to prioritize locally limited funding aimed at elimination of the greatest MS4 waste load allocation reduction for the least amount of expenditure.

WQRP Assessment

During WQRP year 3, an assessment of available watershed and water quality data will be performed and utilized to assist in developing initial BMP strategies. Subsequently during WQRP year 7, an assessment of activities conducted under the WQRP will be performed to evaluate the overall progress of the WQRP. The assessment will include a review of programmatic management measures, existing water quality data, watershed data, cost benefit analysis, monitoring data and other relevant data. The assessment will be used, where possible, to evaluate the performance of existing BMPs and identify additional BMP strategies as necessary.

WQRP Reporting

Activities and assessments conducted under the WQRP will be reported to DWQ along with the annual report submitted each year for the MS4 NPDES permit. Annual compliance with the WQRP implementation schedule will constitute compliance with the overall WQRP. The annual report for the WQRP will include, as applicable per WQRP schedule, the following:

- The initial WQRP and subsequent components based on Implementation Schedule.
- Discussion on the status of the WQRP and schedule.
- Discussion of activities conducted for WQRP and progress made toward meeting program elements during report year.
- Annual cost of WQRP.
- An assessment of available data collected under the monitoring plan for each pollutant of concern.
- An assessment of the performance of BMPs employed, where possible.

- A map showing the location of major outfalls in TMDL watersheds with the potential for discharging the pollutant of concern.
- A schedule for locating currently unknown major outfalls that may potentially discharge the POC in TMDL watersheds.
- Identification of in-stream and outfall sampling locations.
- Identification of additional BMPs, if necessary.

Following any review and comment by the Division on the TMDL Water Quality Recovery Program, the permittee shall incorporate any necessary changes into the program. The permittee shall incorporate the revised TMDL WQRP into the Stormwater Management Plan.

Water Quality Recovery Program Life Cycle

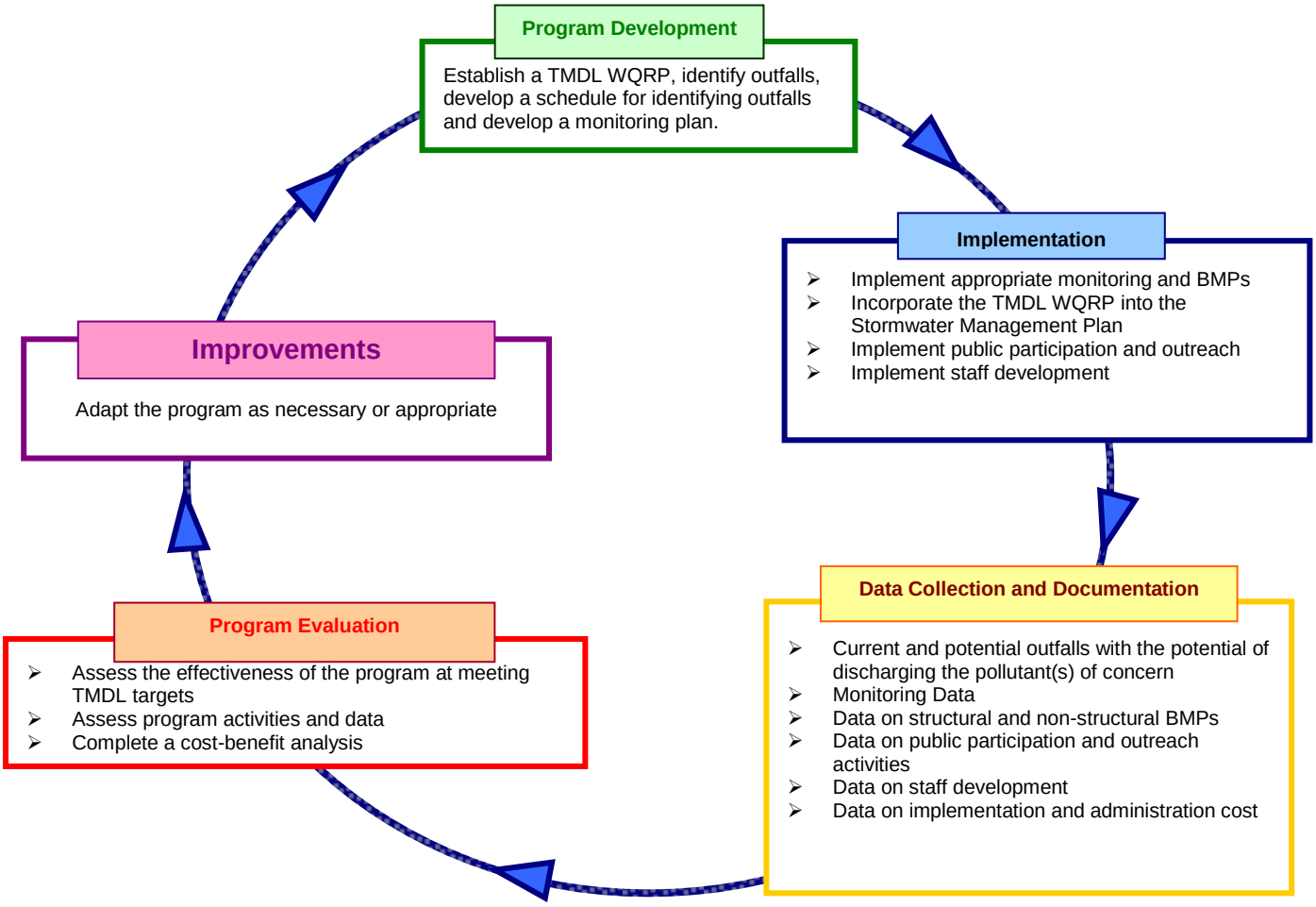


Figure 6: Water Quality Recovery Plan Life Cycle

REFERENCES

NCDENR- Division of Water Quality, Final Report, September 25, 2006 Total Maximum Daily Load for Fecal Coliform for Salem Creek and Turbidity for Grants Creek in North Carolina.

Pathogen Source Assessment for TMDL Development and Implementation in Salem and Muddy Creek Watersheds, Winston-Salem, North Carolina. MapTech and HDR 2003.

Center for Watershed Protection, 1999, Sources of fecal coliform bacteria.

United States Environmental Protection Agency (USEPA). 2000. Revisions to the Water Quality Planning and Management regulation and revisions to the National Pollutant Discharge Elimination System Program in support to the water quality planning and management regulation: Fed. Reg. 65:43586-43670.