City of Raleigh
Public Utilities Department

Sampling and Monitoring Program

January 2007

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Sampling and Monitoring Program
March 2006

The City of Raleigh has implemented sampling and monitoring plans as a result of various programs and initiatives implemented since the late 1990s. These sampling initiatives include the Lower Neuse Basin Association (LNBA) sampling program, National Pollutant Discharge Elimination System (NPDES) Phase I stormwater sampling, and voluntary benthic macro invertebrate sampling throughout the City limits and extraterritorial jurisdiction (ETJ).

The City is actively engaged in three major environmental reviews for upcoming projects: the Dempsey E. Benton Water Treatment Plant (WTP) on Lake Benson, the East Neuse Parallel Interceptor, and a major expansion to the Neuse River Wastewater Treatment Plant (WWTP). Select agencies in the Department of the Environment and Natural Resource (DENR) have commented during all three environmental review processes that they would like the City to clarify the existing sampling and monitoring program and expand the program to include certain areas of concern that are not covered under the current programs.

The attached table and figure summarizes the City of Raleigh's Sampling and Monitoring Program. The table highlights text in **bold** to indicate if a change is proposed to the existing sampling protocol. The corresponding sample site is circled on the figure, for reference. New sampling sites are highlighted in bold in the table and illustrated and labeled separately on the figure. The following text describes the details of the City's current program as well as descriptions of additional sampling initiatives that the City has proposed.

The City of Raleigh will commit to commencing the Sampling and Monitoring Program in August 2006, assuming construction of the Dempsey E. Benton WTP has begun. Based on a projected project completion date of 2009, the Program will provide approximately three years of background data prior to project operation.

Water Chemistry Sampling

The City currently samples water quality parameters at 35 locations. Temperature, dissolved oxygen (DO), pH, conductivity, metals, nutrients, turbidity, total suspended solids, and fecal coliform are monitored on a monthly basis. The City proposes to add seven new water quality sampling stations to be monitored on a monthly basis. One of the seven stations is located at Lake Benson dam. Sampling will include temperature, DO, pH, conductivity, nutrients, turbidity, total suspended solids, and fecal coliform. The City also proposes to install a United States Geological Survey (USGS) gauging station on Swift Creek with continuous monitoring of DO and temperature. A potential location is at sampling site NEW2 (Swift Creek at NC 42), a Division of Water Quality (DWQ) monitoring station and the location of a previous USGS station.

Stream Geomorphology

Several agencies requested that stream geomorphology data be collected. This data is typically collected for stream restoration and evaluation projects. Albeit the information collected in stream geomorphology studies is extremely valuable to stream restoration projects, this information is not the most cost effective or useful tool for evaluating long term trends to stream systems. In lieu of geomorphology studies, the

City proposes to initiate field observations and photo-documentation of select stream corridors in the service area once every two years. The field observations and photo-documentation will provide immediate feedback on the visible health and stability of streams in the watershed.

The stream corridors the City proposes to field survey are highlighted in yellow on the attached figure. The City will select an initial location at the upstream end of each corridor. The remaining locations along the length of the stream corridor will be selected at ± 2,000 foot (± ½ mile) intervals. The photo-documentation efforts will include the following parameters:

- The field study site locations within the 2,000 foot intervals will be selected based on professional judgment, which will include an evaluation of areas of potential concern. Each location will be fixed by documenting that point with GPS technology to ensure accuracy of subsequent field observations.
- Each location will be photographed on both sides of the stream as well as upstream and downstream of the location.
- This study will include specific observational notes about the physical characteristics of each segment, such as channel width, bank height, degree of erosion, mean water depth, substrate composition, presence of riffle pools, and presence of recent alluvial deposits.
- All of the field information will be summarized in a form that will be used to maintain consistency of the field observations. The form will contain a list of descriptors that will facilitate the documentation of trends.

The results of the photo-documentation studies will be summarized and reported to DWQ with copies to other DENR agencies. The City proposes to work collectively with DWQ and other DENR agencies to identify negative trends. If necessary, the City wishes to collaborate with DWQ to implement solutions for areas of concern.

Stream Hydrology

Several DENR agencies have requested that stream flow be measured in a different manner than with USGS gauging stations. Some agencies feel that USGS gauging stations are not calibrated with sufficient frequency. One agency's proposed alternative to the USGS gauging station was setting a weir and automated samplers in riffle areas of streams. A permit from the U.S. Army Corps (USACE) and/or a permit to dam streams may be required for this action. Furthermore, the City feels that the impact of installing weirs in streams is far greater than the perceived benefit of measuring stream flow to a hundredth of a unit. Furthermore, the USGS is the legal authority for flow measurement in the United States and their gauging stations are installed with minimal impact to streams. Precipitation and evaporation data is collected by the National Oceanic and Atmospheric Administration (NOAA) as well as various USGS monitoring stations.

Specific to the Dempsey E. Benton WTP minimum flow release, the City proposes to measure the flow of water released directly from the dam with a meter. The City has also agreed to install a USGS gauging station downstream of Lake Benson dam in Swift Creek at a location determined in consultation with the

U.S. Fish and Wildlife Service (FWS) and DENR agencies (sampling site NEW2 at Swift Creek and NC 42 may be a candidate). The City also agrees to install a USGS gauging station at or near site J5620000 on Little River. Additionally, the City funds ten USGS gauging stations in Wake County. The locations of these sites are shown on the attached figure.

Benthic Macro Invertebrate and Fish Community Sampling

Several agencies recommended both benthic macro invertebrate and fish community sampling as indices of biological integrity in streams. The City of Raleigh annually monitors benthic health in streams at 22 locations in the service area since 1999. City staff collects samples and a private contractor identifies and counts the different benthic species. This benthic count method is not currently performed according to the DWQ standard. However, the City proposes to use the DWQ method for benthic sampling at these 22 current locations. In addition, the City proposes to perform annual benthic surveys at six new locations (per the DWQ standard) in Swift Creek, Middle Creek, Marks Creek, and Buffalo Creek watersheds. The City also proposes to add benthic monitoring at seven LNBA sampling sites. Four of these seven LNBA sites are existing DWQ benthic sampling stations. The City's data at these sites would augment an existing DWQ database with more frequent sampling events. The proposed monitoring stations are illustrated on the attached figure as an independent symbol. The modified sampling protocol at the existing LNBA sampling sites is illustrated with a purple dot surrounded by a red circle on the attached map. The City will work with DWQ to become certified for benthic sampling. Alternatively, the City may elect to send samples to a certified laboratory for evaluation.

The City will add fish community surveys at five locations to be sampled once every five years, including site J5620000 on Little River (or the location of the new USGS gauging station on Little River). Fish community populations will change rapidly due to natural causes as well as man-made causes. The City believes that benthic macro invertebrate sampling is a more valuable assessment tool; however, the City does concur with DWQ that an additional trophic sampling level may provide some valuable data.

Mussel Surveys

The City has agreed to perform 250 man-hours of mussel survey every five years in the Swift Creek watershed from Lake Benson dam to the confluence with Middle Creek. Allowances will be made so that surveys are conducted during suitable times of the year and under acceptable flow and water clarity conditions. The Biological Assessment proposes to conduct mussel surveys in Swift Creek according to the following protocol:

a) An initial baseline survey shall be conducted prior to initiation of Project construction.
b) A follow-up mussel survey must occur within 12 months following initiation of Project operations, and subsequent surveys must be performed at five year intervals thereafter for a total of 20 years. The level of effort expended for each survey must not exceed 250 person-hours.
c) Additional mussel surveys must be promptly performed whenever the minimum flow releases from Lake Benson Dam are maintained at Tier 3 (1.0 cfs) for more

> than seven (7) consecutive days or more than fourteen (14) days within any thirty (30) consecutive day period. The level of effort for each survey must not exceed 40 person-hours, and no more than one low flow triggered mussel survey would occur in any year. Four (4) such low-flow mussel surveys will be conducted. Following the annual report that includes the fourth low-flow mussel survey results, the City and the Service will determine if further low-flow mussel surveys are warranted.

The City also proposes to conduct 100 man-hours of mussel surveys in each of the Little River watershed and the Middle Creek watershed once every five years.

"Triggers" if Water Quality Data Indicate an Impairment

A "trigger" for an action on water quality impairment should be based on a regulatory standard and not on arbitrary determination. Therefore, the City proposes that the Sampling and Monitoring Program data be evaluated on the five year cycle of the Neuse River Basinwide Water Quality Management Plan. The City proposes to work with DWQ to analyze the data resulting from this sampling program and establish a timeline so that the data reporting coincides with the DWQ assessment period for the Neuse River basin. However, the City recognizes that there may be instances where immediate action could be taken if the City discovers impairment from a particular source or activity that could be immediately addressed. Therefore, the City commits to working through the appropriate channels and/or authorities to help rectify these situations at the time of discovery.

Reporting

The City proposes to submit the initial report to DWQ in 2007, in conjunction with the Neuse River Basinwide Plan cycle. A summary report will be submitted every five years following. DWQ will assess the location of the current monitoring sites in 2012 to determine if any revisions are needed.

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Sampling and Monitoring Program – January 2007

Station ID	Location	Comments	County	Summary of City of Raleigh's Sampling and Monitoring Plan											
				Temp	D.O.	pH	Cond.'ty	Nutrients (NH_3, NO_3, TKN, TP)	Metals (Al, As, Cd, Total Cr, Cu, Fe, Hg, Ni, Mn, Pb, Zn)	Turbidity	Total Suspended Solids	Fecal Coliform	BOD/ COD	Benthic Surveys	Fish Community Sampling
J2230000	Smith Creek at SR 2045 Burlington Mill Rd. NR Wake Forest	LNBA Station, DWQ Ambient Water Quality Monitoring Station	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly		**Annually**	
J2330000	Neuse River at SR 2215 Buffalo Rd NR Neuse	LNBA Station, DWQ Ambient Water Quality Monitoring Station, Approx. 7 miles downstream of Wake Forest WWTP	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly			
J2360000	Neuse River at Milburnie Dam NR Raleigh	LNBA Station, DWQ Ambient Water Quality Monitoring Station	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly		**Annually**	
J3000000	Crabtree Creek at SR 1795 NR Umstead State Park	DWQ Ambient Water Quality Monitoring Station	Wake	Monthly				Monthly	Quarterly	Monthly	Quarterly	Monthly		**Annually**	
J3210000	Crabtree Creek at Lassiter Mill dam at Raleigh	LNBA Station, DWQ Ambient Water Quality Monitoring Station, Downstream North Cary WRF, DO sag	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly		**Annually**	
J3251000	Crabtree Creek at SR 2000 Old Wake Forest Road NR Raleigh	DWQ Ambient Water Quality Monitoring Station	Wake	Monthly					Quarterly	Monthly	Quarterly	Monthly			
J3300000	Pigeon House Branch at Dortch St at Raleigh	DWQ Ambient Water Quality Monitoring Station	Wake	Monthly					Quarterly	Monthly	Quarterly	Monthly			
J3470000	Crabtree Creek at SR 2036 New Hope Church Road NR Wilders Grove	LNBA Station	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly			
J3970000	Walnut Creek at SR 2551 Barwell Rd NR Raleigh	LNBA Station, DWQ Ambient Water Quality Monitoring Station, Urban 303d	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly	Monthly	Monthly	Monthly	Monthly		**Annually**	
J4050000	Neuse River at SR 2555 Auburn Knightdale Rd NR Raleigh	LNBA Station, DWQ Ambient Water Quality Monitoring Station, Upstream Neuse River WWTP	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly	Monthly	Monthly	Monthly	Monthly			
J4080000	Poplar Creek at SR 2049 Bethlehem Rd NR Knightdale	LNBA Station, DWQ Ambient Water Quality Monitoring Station, Last bridge before Neuse	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly		**Annually**	

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J4130000	Neuse River at SR 1700 Covered Bridge Rd NR Archers Lodge	Approx. 6.5 miles downstream Raleigh WWTP, upstream of Clayton WRF	Johnston	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly	Monthly	Monthly	Monthly	Monthly			
J4170000	Neuse River at NC 42 NR Clayton	Downstream of Clayton WRF, DWQ benthic and fish station, USGS gauge	Johnston	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly	Monthly	Monthly	Monthly	Monthly		**Annually**	**Once Every 5 years**
J4414000	Swift Creek at SR 1152 Holly Springs Rd. NR Macedonia	LNBA Station, 303d, upstream of Lake Wheeler, USGS gauge	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly		**Annually**	
J4980000	Middle Creek at SR 1006 Old Stage Road NR Holly Springs	LNBA Station, Downstream and Terrible Creek and Terrible Creek WWTP	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.						Monthly	Monthly	Monthly			
J4590000	Swift Creek at NC 210 NR Smithfield	LNBA Station	Johnston	pH and Cond. Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly		**Annually**	**Once every 5 years**
J5010000	Middle Creek at NC 210 NR Smithfield	LNBA Station, Just upstream of Neuse River	Johnston	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly		**Annually**	**Once every 5 years**
J5620000	Little River at SR 2333 Smithfield Rd. NR Benson	LNBA Station	Wake	Monthly + Twice Monthly in May, June, July, August, and Sept.				Monthly		Monthly	Monthly	Monthly		**Annually**	**Once every 5 years**
J5630000	Little River at SR 2333 Smithfield Road NR Zebulon	LNBA Station													
MI-4	Walnut Creek(1)	Started in 1999 as part of City's sampling initiatives	Wake											Annually **(to DWQ Standard)**	
MI-8	House Creek	Started in 1999 as part of City's sampling initiatives	Wake											Annually **(to DWQ Standard)**	
MI-10	Marsh Creek	Started in 1999 as part of City's sampling initiatives	Wake											Annually **(to DWQ Standard)**	
MI-11	Pigeon House Branch(1)	Started in 1999 as part of City's sampling initiatives	Wake											Annually **(to DWQ Standard)**	
MI-12	Mine Creek	Started in 1999 as part of City's sampling initiatives	Wake											Annually **(to DWQ Standard)**	
MI-14	Perry Creek	Started in 1999 as part of City's sampling initiatives	Wake											Annually **(to DWQ Standard)**	
MI-18	Rocky Branch	Started in 1999 as part of City's sampling initiatives	Wake											Annually **(to DWQ Standard)**	

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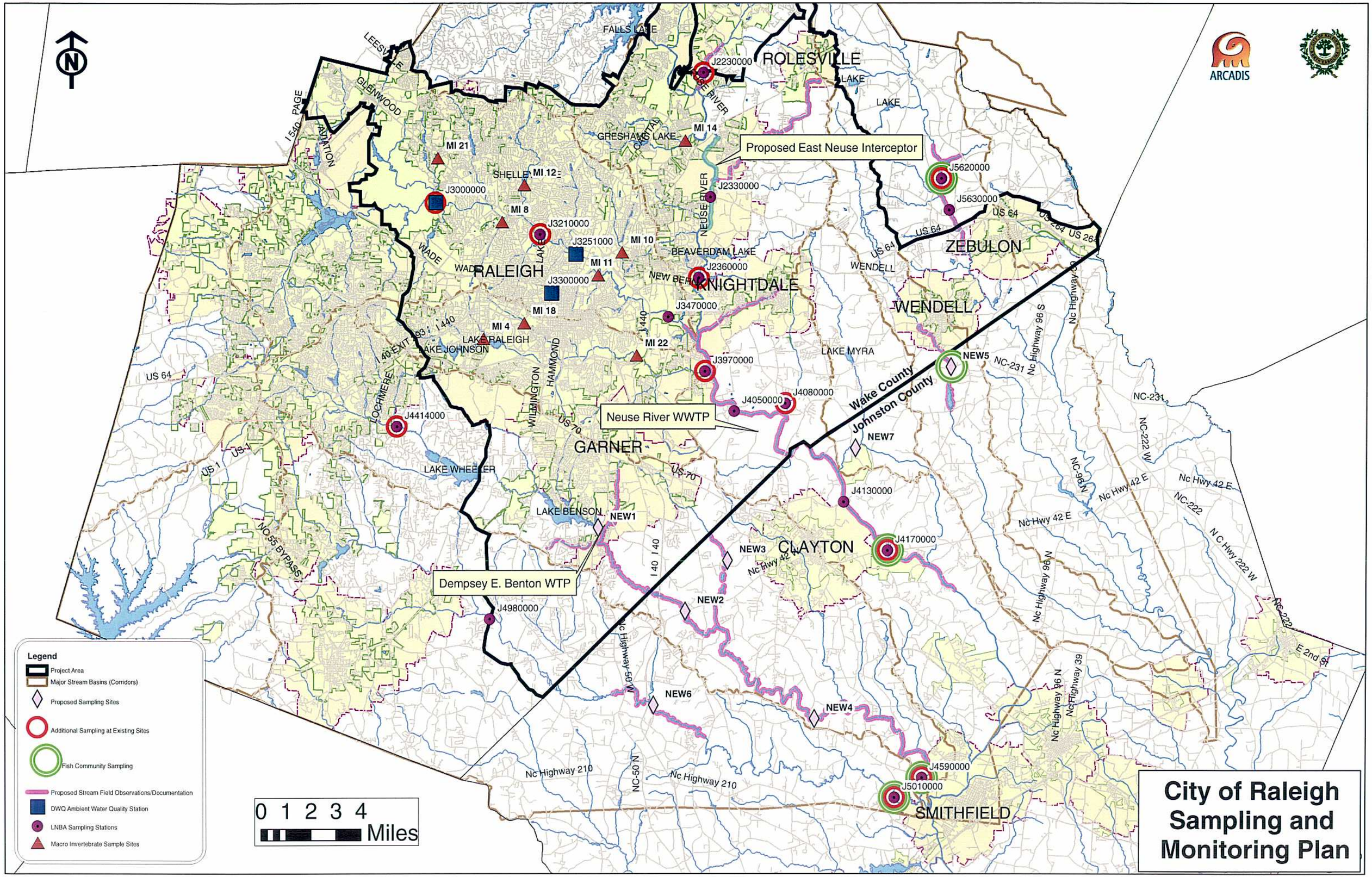
MI-21	Turkey Creek	Started in 1999 as part of City's sampling initiatives	Wake											Annually **(to DWQ Standard)**	
MI-22	Walnut Creek(2)	Started in 1999 as part of City's sampling initiatives	Wake											Annually **(to DWQ Standard)**	
NEW1	**At Lake Benson Dam**	**Included in City's Biological Assessment for endangered DWM**	**Wake**	**Daily**	**Daily**	**Daily**	**Daily**	**Monthly**		**Daily**	**Daily**	**Monthly**		**Annually**	
NEW2	**Swift Creek**	**New sampling point (DWQ benthic station, site of former USGS gauging station)**	**Wake**	**Add USGS Gauging Station (Continuous D.O. and Temperature), Monthly + Twice Monthly in May, June, July, August, and Sept.**				**Monthly**		**Monthly**	**Monthly**	**Monthly**		**Annually**	
NEW3	**White Oak Creek**	**New sampling point**	**Johnston**	**Monthly + Twice Monthly in May, June, July, August, and Sept.**				**Monthly**		**Monthly**	**Monthly**	**Monthly**		**Annually**	
NEW4	**Swift Creek**	**New sampling point**	**Johnston**	**Monthly + Twice Monthly in May, June, July, August, and Sept.**				**Monthly**		**Monthly**	**Monthly**	**Monthly**		**Annually**	
NEW5	**Buffalo Creek watershed downstream of Wendell**	**New sampling point**	**Johnston**	**Monthly + Twice Monthly in May, June, July, August, and Sept.**				**Monthly**		**Monthly**	**Monthly**	**Monthly**		**Annually**	**Once every 5 years**
NEW6	**Middle Creek**	**New sampling point**	**Johnston**	**Monthly + Twice Monthly in May, June, July, August, and Sept.**				**Monthly**		**Monthly**	**Monthly**	**Monthly**		**Annually**	
NEW7	**Marks Creek watershed**	**New sampling point**	**Wake**	**Monthly + Twice Monthly in May, June, July, August, and Sept.**				**Monthly**		**Monthly**	**Monthly**	**Monthly**		**Annually**	


City of Raleigh Sampling and Monitoring Plan
ARCADIS
Proposed East Neuse Interceptor
Neuse River WWTP
Dempsey E. Benton WTP
Wake County
Johnston County
RALEIGH
ROLESVILLE
ZEBULON
WENDELL
KNIGHTDALE
GARNER
CLAYTON
SMITHFIELD
FALLS LAKE
GRESHAMS LAKE
BEAVERDAM LAKE
LAKE RALEIGH
LAKE JOHNSON
LAKE WHEELER
LAKE BENSON
LAKE MYRA
NEUSE RIVER
J2230000
J2330000
J2360000
J3000000
J3210000
J3251000
J3300000
J3470000
J3970000
J4050000
J4080000
J4130000
J4170000
J4414000
J4980000
J4590000
J5010000
J5620000
J5630000
MI 4
MI 8
MI 10
MI 11
MI 12
MI 14
MI 18
MI 21
MI 22
NEW1
NEW2
NEW3
NEW4
NEW5
NEW6
NEW7
Legend
Project Area
Major Stream Basins (Corridors)
Proposed Sampling Sites
Additional Sampling at Existing Sites
Fish Community Sampling
Proposed Stream Field Observations/Documentation
DWQ Ambient Water Quality Station
LNBA Sampling Stations
Macro Invertebrate Sample Sites
0 1 2 3 4
Miles