



**Upper Neuse River Basin Association
Special Study Plan
Date Issued: September 2016**

Special Study Name, ID# and Origination:

High Flow Sampling, SS.LR.3

This Special Study originated in the Cardno FY 2015 monitoring contract (July 2014 through June 2015) and was extended into the FY2016 and FY2017 contracts to provide for additional water quality data collection representative of high flows. This Study Plan reflects updates to the High Flow Sampling program implemented for FY2017.

Responsible Contractor(s):

Cardno – Planning, management and oversight, field sampling, data review and analysis, reporting
Environment 1 – Laboratory analysis

Purpose of Study:

This Special Study is an extension of the Routine Monitoring effort intended to obtain supplementary water quality data from select tributaries to Falls Lake under high flow conditions. High flow conditions are qualitatively defined for this study as periods when stream flow increases markedly above normal flows in response to a rain event, generally characterized by faster water velocity, higher water levels and/or increased turbidity. Since high flow conditions are relatively rare (as compared to the daily flows at a specific site over a long period of record), they are not likely to be well-represented in the regular, pre-scheduled Routine Monitoring efforts of the Lake Loading Stations. This supplemental effort helps to ensure that data are available during high-flow events which can provide a significant amount of the total annual load because of the substantial volume of water they deliver to the lake. For instance, the highest flow conditions occurring just 10-15 percent of the time accounted for over 60 percent of the annual water load to the lake over the UNRBA's monitoring period. Data from this study will help to inform the updated modeling of Falls Lake, as well as provide general insight into water quality characteristics during typically under-represented sampling conditions.

This Special Study supports these objectives of the UNRBA Monitoring Program:

- Lake response modeling and watershed modeling
- Support of regulatory options
- Source allocation and estimation of jurisdictional loading

Anticipated Schedule:

The number of High Flow Monitoring Events in a given monitoring year is dictated by rainfall timing and magnitude, the scope of work, and the associated budget for that year. For FY2017, it is expected that High Flow Sampling will be conducted up to twelve times per year, distributed as evenly through the year as weather patterns allow. The timing of sampling events is dependent upon rain event magnitude and



the associated stream response. Cardno is responsible for determining when a sampling event occurs, based upon weather forecasts, observations, and the projected magnitude of the high flow event. This is discussed further below.

Summary of Study Methods:

Samples will be collected from the five locations listed in Table 1 during periods of high flow. These five stations typically deliver the most water to Falls Lake. Additional tributaries in the watershed may be sampled during high flow events as storm duration, spatial coverage, sampling logistics, and budget allow.

Samples will be collected as grab samples using the same field collection procedures and quality assurance considerations as are used for the Lake Loading Stations during Routine Monitoring. Grab samples provide more flexibility, reliability, and efficiency compared to the use of automated samplers which are more suited to in-depth site- and event-specific studies. Parameters to be measured include nutrients (ammonia, nitrate plus nitrite, total Kjeldahl nitrogen, and total phosphorus), chlorophyll a, total suspended solids, and total organic carbon, as well as field measurements of temperature, pH, specific conductance, and dissolved oxygen. Because of the extensive time required to filter turbid samples in the field, soluble nutrient data will not be provided by the study; this provides the greatest flexibility to get to as many sites as possible under favorable flow conditions while still providing the data necessary to estimate total nutrient loads. All five primary streams involved in High Flow Sampling have USGS gaging stations upstream of the sampling location, so water quality results can be linked to gaged flows; other tributaries that may be sampled during high flow events may not be gaged.

Table 1. Primary High-flow Event Sampling Stations¹

Environment 1 Site ID	Site ID	Stream	Location	Latitude	Longitude
LL01	KRC-4.5	Knap of Reeds Creek	at SGWASA WWTP	36.1280	-78.7985
LL02	FLR-5.0	Flat River	at Old Oxford Highway	36.1319	-78.8280
LL03	LTR-1.9	Little River	at Old Oxford Road	36.0817	-78.8547
LL04	ENR-8.3	Eno River	at Old Oxford Highway	36.0726	-78.8627
LL05	ELC-3.1	Ellerbe Creek	at Glenn Road	36.0596	-78.8322

¹Additional tributaries may be sampled as storm duration, spatial coverage, and budget allow.

Cardno developed a detailed evaluation of rainfall patterns and streamflow responses as part of the Storm Event Sampling Special Study (Special Study Plan available on the UNRBA website). The same general factors presented in that plan will inform the decision process for initiating a High Flow Sampling event. It is the general intent of this plan to attempt to collect samples while streamflow is significantly above “normal” conditions, as represented by markedly increased flows, water levels and/or turbidity as noted above. Samples will be conducted as close to the storm peak as possible, and additional samples may be collected on the rising and falling limbs of the hydrograph as storm duration and budget allow.

Because of the considerable spatial and temporal variability in tributary flows to Falls Lake, it is unlikely for any given rain event to result in the same degree of increase in stream flows for all of the target tributaries. Thus, selection of a rain event for sampling is designed for cost efficiency and based on weather forecasts and real-time USGS stream gage data, but is not based on a specific quantitative metric or trigger. In the event that sampling is initiated, but some of the target stations do not reflect substantially higher flows at the time of sample collection (e.g., as a result of spatial variability in rainfall amounts across the watershed), Cardno will limit sampling to only include tributaries with flows that are



experiencing high flow conditions. Thus, the tributaries that are sampled may vary across events. For the locations with USGS gages, Cardno will evaluate the stage or flow at the time of sample collection with respect to previously sampled conditions at those locations before submitting samples for laboratory analysis. For locations without gages, Cardno will evaluate precipitation data, nearby stream gages, and visual assessments of flow intensity conducted during sampling to determine if conditions are representative of high flows.

Quality Assurance/Quality Control:

All sampling and analysis for this special study occurs under the UNRBA Quality Assurance Project Plan (version 1.1). All pertinent QA/QC sampling considerations in place for the Routine Monitoring also apply to this Special Study. Laboratory analyses will be performed by the same state-certified lab that analyzes samples for the UNRBA Routine Monitoring and will follow the DWR-approved UNRBA Quality Assurance Project Plan for sample analysis.

Reporting/Deliverables:

Cardno will communicate with the UNRBA Executive Director on a regular basis on the progress of this Special Study. Status updates will be provided to the UNRBA Path Forward Committee and the Board of Directors at their regular meetings during Cardno's updates on the overall Monitoring Program status.

Discussion of the status and any available results from this Special Study will be included as part of the Interim and Annual Reports. Data generated by this Special Study will largely be used to inform future modeling efforts. Summary statistics and graphics will be developed to portray relationships between water quality and flow conditions. This summary high flow information will be included in the UNRBA Interim and Annual Reports.

Data from the High Flow Sampling will be included in the overall UNRBA database and will thus be available online to UNRBA members, agencies, and the general public.