

Meeting Themes
Watershed Assessment Forum – Water Quality Monitoring and Local Watershed Plan

June 9 and 10, 2009
Raleigh, North Carolina

Objectives of Forum:

- 1) To foster a better understanding of local watershed planning efforts being conducted by the NC Ecosystem Enhancement Program and the requirements of “Compensatory Mitigation for Losses of Aquatic Resources; Final Rule” [Department of the Army, Corps of Engineers 33 CFR Parts 325 and 332; and Environmental Protection Agency 40 CFR Part 230]
- 2) Raise awareness of users of water quality data regarding the strengths, weaknesses and costs associated with different types of water quality assessments.

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(A list of acronyms is on page 24.)

I. Executive Summary

Representatives from the NC Division of Water Quality (DWQ), NC Ecosystem Enhancement Program (EEP), NC Department of Transportation (DOT), US Army Corps of Engineers (COE), US Environmental Protection Agency (EPA), US Geological Survey (USGS), East Carolina University (ECU), and Triangle J Council of Governments (TJCOG) met in Raleigh NC on June 9 and 10, 2009 to discuss implications of the new administrative rules promulgated by the COE and EPA – “*Compensatory Mitigation for Losses of Aquatic Resources: Final Rule*,” in the context of watershed planning and water quality monitoring/assessment done by the EEP. The overarching purpose of the meeting was to assemble staff from a variety of agencies either affected by the new rule, or having expertise in water quality monitoring to discuss: 1) how watershed planning is conducted, and 2) the usefulness of a variety of water quality monitoring methods and how these results support watershed planning and compensatory mitigation project selection in the context of this new federal rule.

Representatives from the EEP, DWQ and DOT outlined expectations for the forum. These included conveying an understanding that EEP must comply with both state and federal laws regarding watershed planning to implement cost effective and scientifically sound monitoring methods that target mitigation sites within a watershed context and also integrate with DWQ’s basinwide planning.

An overview of watershed planning currently conducted by the EEP was provided, along with two case studies. Case studies provided synopses of what water quality monitoring methods were used, identification of stressors, watershed problems and management strategies. Assessing watershed functions and conditions provides the basis for sound watershed planning. Overviews of geomorphic and stream restoration assessments were provided, along with wetland functional assessments. The importance of scale, variation and condition was stressed, with a particular focus on reference-based watershed assessments in coastal watersheds was provided.

The intent of the COE/EPA rules was outlined by representatives from the COE and EPA. The rules requires a “watershed approach” for compensatory mitigation, and this approach must consider watershed needs, and inventories of historic and existing resources. The level of watershed planning is at the discretion of the COE. The ultimate goal of the watershed planning process is to maintain and improve the quantity and quality of aquatic resources through strategic selection of mitigation sites.

An overview of the costs of watershed monitoring to support the development of watershed plans was provided. Initial estimates, which can vary among the types of watersheds, indicate that water quality monitoring costs about \$100,000 per watershed. Monitoring includes a review of existing data, field work gathering new data from a suite of assessment methods and report writing. Factors that can reduce costs include reduction of report writing time, and not sampling for chemical constituents that do not provide useful information.

A breakout session among forum participants concluded the forum. Five different groups discussed the appropriateness of specific water quality monitoring methods. Methods discussed included chemical, biological (benthos, fish, periphyton), toxicological, hydrological, and geomorphologic assessments. The outcome of the breakout sessions was a matrix of methods and usefulness of results from specific methods. As a result of these discussions, it appears that some water quality assessment methods should always be completed (e.g. field methods for dissolved oxygen, specific conductance, etc.), other methods should be done on a case-by-case basis (e.g. chemical sampling for metals) and some methods were deemed inappropriate for watershed planning (e.g. periphyton). Consensus among the groups regarding the usefulness of specific watershed monitoring methods was not always achieved. The development of a standard suite of assessment methods to be used routinely during the initial phase of the DWQ’s support was proposed at this meeting. This was completed afterwards during subsequent meetings between DWQ, DOT and EEP. (It is presented as a ‘scope of work’ beginning on page 13.)

II. Summary

Hyperlinks to the power point presentations are inserted below.

A. Forum Perspectives (EEP, DWQ, DOT)

EEP (Recktenwald)

- EEP develops - River Basin Restoration Plans (RBRP); General; Required by state law
- Local Watershed Plan (LWP); Detailed; identifies priority projects for restoration (based on DOT mitigation needs)
- EEP is in transition to the federal (COE and EPA) mitigation rules
- The new rules promote “watershed plans” and/or a “watershed approach” for compensatory mitigation

DWQ (Dorney)

- Goal is to refine existing process of watershed monitoring. The watershed monitoring and assessment process has been underway for several years – time to reexamine process and make appropriate changes
- Need to focus on data collection and analysis that meets the following five principles:
 - Scientifically sound monitoring rather than research
 - Fiscally responsible -- given the state’s, DOT’s (and DWQ’s) budget constraints
 - Integrated with DWQ’s basinwide planning process by providing greater detail from focusing on smaller scales
 - Deliver information useful for mitigation in order to target mitigation types and sites
 - Meet requirements of state law and the new federal mitigation rule

DOT (Ellis)

- EEP does mitigation for DOT
- DOT understands need for watershed plans, but plans must be cost effective
- LWP’s should be done in areas with mitigation needs and with stakeholder involvement
- EEP not slush fund for lack of budget in other agencies, nor is EEP a funding source for other agency’s projects

B. Introductions and Forum Overview (S. Kroeger)

- Two broad themes
 - Water quality monitoring and assessments
 - Watershed planning
- There are NC and US legal references for watershed plans
- Results of DWQ assessments are summarized in reports
- Introductions (by group)
 - Forum participants represented Federal (EPA, COE, USGS), State agencies (DWQ, EEP, DOT) and local agencies (TJCOG) and universities (NCSU, ECU)
- WAT (DWQ’s Watershed Assessment Team); WAT conducts monitoring for EEP
- EEP; EEP implements compensatory mitigation for DOT
- DOT; DOT is required to compensate for losses of aquatic resources (uses) through permits issued by the US Army Corps of Engineers and certifications/permits by the NC Division of water Quality

C. Overview of Watershed Planning and Monitoring at EEP (M. Drostin)

Click [here](#) to view the power point presentation

EEP's mission is: "To restore, enhance, preserve, and protect the functions associated with wetlands, streams and streamside buffers, including, but not limited to those necessary for the restoration, maintenance, and protection of water quality and riparian habitats throughout North Carolina"

- Planning is done at different scales
- Targeted Local Watershed
 - Data broken out by 14-digit HU (Hydrologic Units)
- Local Watershed Planning (LWP)
 - Contain anticipated quantity and types of mitigation projects
 - Willingness of local resource professionals and other stakeholders to work with EEP
 - Consideration of scale and potential to evaluate water quality or habitat improvements
 - Local Watershed Plans are completed in phases
 - Phase I -- Preliminary characterization of watershed conditions and functional needs based on best available data
 - Phase II – Detailed assessment of watershed down to reach scale
 - Phase III – Developing the watershed plan; matching management strategies to implementation
 - Phase IV – Implementation

Case Study 1 – Fishing Creek (R. Breeding; *Fishing Cr. LWP is in Granville Co.; includes City of Oxford*)

Click [here](#) to view the power point presentation

- Physical/chemical, biological (benthos and fish), toxicological, periphyton, riparian, mussel assessments were conducted.
- Data were used for subwatershed ranking – preservation, stream restoration, stormwater management, target species.

Case Study 2 – Peachtree/Martins Creek (A. Leslie and S. Kroeger; *Peachtree/Martins Cr. is in Cherokee Co. near Murphy*) Click here to [view](#) the power point presentation.

- Physical/chemical, biological (benthos and fish), toxicological, channel/habitat assessments were conducted. Tennessee Valley Authority's Integrated Pollution Source Identification (IPSI) data were available.
- Functional scores for subwatersheds were developed based upon hydrology, habitat, and water quality.
- Scoring and prioritization for potential stream project sites was developed.
- Specific stressors, watershed problems and management strategies were identified.
- Water quality monitoring challenges included limited data from broad reconnaissance, small sample sizes.

D. Assessing Watershed Functions (M. Herrmann)

Click [here](#) to view the power point presentation.

- EEP has a programmatic commitment to conduct assessments through the MOA that established EEP.
- Watershed functions were identified through the Watershed Needs Assessment Team in 2003. Broad categories of function include hydrology, habitat and water quality.
- Function is measured through field work, landscape assessments and statistical/environmental models.

E. Geomorphic and Stream Restoration Assessments (B. Doll)

Click here to [view](#) the power point presentation.

- Nationally > \$1 billion have been spent on stream restoration; stream restoration can be required as part of compensatory mitigation; lack of post construction monitoring (are projects 'successful?')
- Assessments for geomorphology/stream restoration include:
 - Channel condition
 - Bank and riparian habitat
 - Aquatic Insects
 - Condition/function of structures.
- Stream restoration projects in NC have assessed to determine success, and identify factors needing improvement
- Results
 - Most projects meet intended goals
 - Problems include:
 - Poor riparian vegetation
 - Sedimentation from upstream areas
 - Stream bank erosion in critical areas
 - Some structure failures are due to poor construction.

F. NC Wetland Functional Assessment Method (NCWAM) (J. Dorney)

Click [here](#) to view the power point presentation.

- Currently streams and wetlands are regulated by length/area of without regard to value/function
- NC Wetland Assessment Method (NCWAM) was completed in 2009 through a collaborative effort among DENR, DOT, Corps of Engineers, others
- NCWAM assesses three wetland functions:
 - Hydrology
 - Water quality
 - Habitat
- Implementation - how NCWAM will be used:
 - Use decisions will be made by regulatory agencies
 - Avoidance and minimization
 - Mitigation and enhancement based on functional uplift
 - Watershed assessment
 - Wetland monitoring
- Avoidance, minimization and mitigation
 - In general, impacts to lower quality wetlands will require less mitigation and be easier to permit.
 - Impacts to higher quality wetlands will require more mitigation and be harder to permit.

- Essentially, will replace functions instead of acres for wetlands
 - Functional Uplift from Enhancement
 - Current state rules require 1:1 restoration or creation for mitigation to achieve no net loss
 - Possible to use NCWAM to calculate functional uplift from enhancement and count net gain of function towards no net loss
 - Calculate overall wetland function considering current condition, versus enhanced condition
 - Determine acreage increase in function using:
-

- Watershed Assessment (Indian and Howards Cr; Lincoln Co., NC)
 - Visited random sample (N=67) of all likely wetlands in watershed
 - Of the 67 sites visited 33 were jurisdictional wetlands; average size = 1.3 acres
 - NCWAM ratings (Overall rating)
 - 62% High
 - 14% Medium
 - 24% Low
 - Wetland Enhancement Opportunities
 - Uplift from Low to Medium – two sites
 - Uplift from Low to High – five sites
 - Uplift from Medium to High – one site
 - No change in uplift – four sites
 - Example of Enhancement Opportunity
 - Example site – Site 63 (1.5 acres)
 - Bottomland Hardwood Forest – heavily grazed
 - Current condition – Low
 - Enhanced condition – High (remove cattle and replant)
 - This functional uplift translates into 1.1 acres of restoration equivalents

G. Reference-based Watershed Assessments (M. Brinson)

Click [here](#) to view the power point presentation.

- Restoration of watersheds cannot be successfully accomplished by confining efforts to “waters/wetlands”
- Three factors should be considered for any condition-based assessment:
 - Scale - what is the unit being assessed and why?
 - Variation - how much classification is needed to control natural variation of the unit?
 - Condition - What is condition of the unit? Assumes that a reference system can be constructed
- Assessments can be done on various scales:
 - Stream-riparian - one approach is to assess stream segments as cross sections from uplands to streams longitudinally from low order to higher order streams
 - Stream-network -
 - Coastal watershed
- Determine ecological condition of coastal watersheds
 - Identify opportunities for improving ecological condition
 - Use the Coastal Habitat Protection Plan (CHPP) as guidance
 - Work toward the development of a scorecard for evaluating estuarine condition
 - Identify relationship between study area and downstream receiving estuarine waters
 - Identify watershed functions that need to be fixed
 - Focus – Water Column Habitat
- Toward better watershed assessment
 - Streams, wetlands and watersheds)
 - Integrating watershed planning and ecological performance standards

- (April 2008 Final Rule: “Compensatory Mitigation for Losses of Aquatic Resources”
- Integrating assessment scale and intensity
- NatureServe Ecological Integrity Assessment (EIA)
- Monitoring implementation
- Feedback into policy changes and more planning
- Scorecard for adaptive management
- Existing programs and stakeholders—how do they fit into science panel and implementation panel?
- Do we need other structures/mechanisms to improve?
- There are many methods ‘out there’ from which to choose. What is lacking is coordination at higher levels that allow “watershed condition assessment” to be approached in a coordinated fashion. Fragmentation among agencies and non-governmental organizations (NGOs) is a difficult problem that needs to be overcome.

H. Application – Implementation of the Federal Mitigation Rule (K. Matthews and S. McLendon)

- Purpose of the rule was to level the playing field for mitigation banks and in-lieu fee programs.
- Compliance with the rule is to be achieved by June 6, 2010.
- “Watershed approach” is required for in-lieu fee programs
 - Consider watershed needs
 - Analytical process
 - Inventories of historic and existing resources
 - Level of comprehensive watershed planning framework is at the discretion of Corps of Engineers with agency inputs.
- Ultimate goal is to maintain and improve quality and quantity of aquatic resources through strategic selection of mitigation sites.
- Watershed approach must consider watershed needs.

I. Monitoring Cost Review (S. Kroeger)

- Costs are beginning to be tracked
- Estimate \$100,000/watershed (This can vary)
- Factors that can reduce costs include:
 - Reduction of time to write reports
 - Not sampling for chemical constituents that do not provide any information (e.g. many metals)

J. Watershed Planning and Water Quality Monitoring Challenges (M. Herrmann)

- It is widely recognized that information on water quality is necessary in the development of a watershed plan.
- Information on water quality is partly based on data from water quality monitoring and assessments.
- What types of water quality data are needed for a “watershed approach” regarding compensatory mitigation?

III. Breakout Sessions – Water Quality Monitoring and Assessment methods

During the portion of the forum that focused on watershed planning there was some discussion on the usefulness of specific water quality monitoring and assessment methods. It was during this second portion of the forum that specifically focused on the methods used to assess water quality. At the beginning of the forum a list of water quality monitoring and assessment tools/methods was provided to the forum participants (Table 1). This list formed a basis for five breakout groups to discuss the merits of each method for meeting the goals of watershed planning and the goals of the federal rule “*Compensatory Mitigation for Losses of Aquatic Resources; Final Rule.*” The five breakout groups were established, a group leader was assigned, and directed to address the following four key questions:

- What assessments (or elements) are needed in ALL watershed plans?
- What recommendation would you make to improve watershed assessments?
- What assessments are not necessary in all watershed plans; when should those be used?
- What other comments or recommendations on the watershed planning process would you like to make?

Table 1. Water quality monitoring and assessment tools/methods

	Method/assessment type (element)
Aquatic toxicity	Instream monitoring with <i>Corbicula</i>
Bank Erosion Hazard Index	Metals
Baseflow sample	Nutrients (N and P)
Benthos (aquatic insects)	Periphyton
Copper	Pesticides
Enterococci	Review of existing data
Fecal coliform bacteria	Riparian assessment (coastal, ECU)
Field measurements (dissolved oxygen, pH, temperature, specific conductance)	Sediment toxicity
Field reconnaissance	Stormflow sample
Fish	Stream assessment (NCSAM)
Geomorphology	Total suspended solids
Habitat (DWQ)	Water chemistry
Hydrology (flow? Stage via Hobos?)	Wetland assessment (NCWAM)

At the conclusion of the group break-out discussions, the leader of each breakout group provided a ranking of the water quality monitoring/assessment methods (elements) listed in Table 1. All breakout groups grouped elements into three categories – 1) elements always needed, 2) elements sometimes needed and 3) elements never needed. The ranking of elements is provided in Table 2. One topic of discussion was the development of a standard set of water quality methods to be applied in any watershed planning area. This set of methods is provided as a scope of work (page 13) and was developed after the meeting in conjunction with the DOT.

Table 2. Results of the breakout sessions. (Note: As each group leader summarized the discussion held within each group, it was noted that definition of each water quality monitoring/assessment method was not clearly defined which may have led to misunderstanding of the value of each method to meet the goals of the federal mitigation rule.)

Assessment Type	Group Number					Total Score
	1	2	3	4	5	
NOTE →	Scores were assigned to rank assessment types:					
	1=Yes (e.g. always); 0.5=Case by Case (CxC; e.g. maybe); 0=No					
Review Existing Data	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	5.0
Benthos Assessments	Yes (1)	Yes (1)	Yes (1) (where feasible)	Yes (1)	Yes (1)	5.0
Field measurements (DO, pH, etc)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	5.0
Baseflow sample	Yes (1)	CxC (0.5)	Yes (1)	Yes (1)	Yes (1)	4.5
Fecal coliform bacteria	Yes (1)	Yes (1)	Yes (1)	CxC (0.5)	Yes (1)	4.5
Total suspended solids (TSS)	Yes (1)	Yes (1)	Yes (1)	CxC (0.5); use turbidity	Yes (1)	4.5
Field reconnaissance	Yes (1)	Scale?	Yes (1)	Yes (1)	Yes (1)	4.0
Nutrients	Yes (1)	Yes (1)	CxC (0.5)	CxC (0.5)	Yes (1)	4.0
Turbidity(Teams added turbidity)	-	Yes (1)	Yes (1) (if source)	Yes (1)	Yes (1)	4.0
Bank Erosion Hazard Index (BEHI)	No (0)	Yes (1)	Mitigation sites only (0.5)	Bank Height Ratio (0.5)	Yes (1)	3.0
Copper	CxC (0.5)	Yes (1)	CxC (0.5)	CxC (0.5)	CxC (0.5)	3.0
Fish Assessments	CxC (0.5)	CxC (0.5)	Yes (1) (where feasible)	CxC (0.5)	CxC (0.5)	3.0
Aquatic toxicology	CxC (0.5)	CxC (0.5)	CxC (0.5)	CxC (0.5)	CxC (0.5)	2.5
Metals	CxC (0.5)	CxC (0.5)	CxC (0.5)	CxC (0.5)	CxC (0.5)	2.5
Stormflow sample	Yes (1)	CxC (0.5)	No (0)	CxC (0.5)	CxC (0.5)	2.5

Assessment Type	Group Number					Total Score
	1	2	3	4	5	
Geomorphology	Define/No (0)	CxC (0.5)	Mitigation sites only (0.5)	Bank Height Ratio (0.5)	Bank Height Ratio (0.5)	2.0
Pesticides	CxC (0.5)	CxC (0.5)	No (0) (benthos better)	CxC (0.5)	CxC (0.5)	2.0
Riparian assessment (ECU method)	Define	CxC (0.5)	Mitigation sites only (0.5)	CxC (0.5)	Yes (1), define	2.0
Watershed modeling	CxC (0.5)	X (0)	CxC (0.5)?	CxC (0.5)	CxC (0.5)	2.0
Wetland assessment (e.g. NCWAM)	No (0)	CxC (0.5)	CxC (0.5)	CxC (0.5)	CxC (0.5)	2.0
Hydrology (flow, stage)	Define	CxC (0.5)	CxC (0.5)	CxC (0.5)	Define	1.5
Sediment toxicology	CxC (0.5)	CxC (0.5)	No (0)	CxC (0.5)	No (0)	1.5
Enterococci	No (0)	CxC (0.5)	No (0)	CxC (0.5)	No (0)	1.0
Periphyton	No (0)	CxC (0.5)	No (0)	CxC (0.5)	No (0)	1.0
Stream assessment (e.g. NCSAM)	No (0)	CxC (0.5)	Note 1	CxC (0.5)	Note 1	1.0

Note 1: NCSAM can be considered once the method is completed

IV. Future Considerations

- Evaluate/strengthen link between watershed plans and mitigation projects.
- Consider how to develop watershed plans that include 303(d) listed streams in a manner that meet EPA's nine-element plan criteria. Allowing watershed plans to be used in place of TMDLs.
- Do regulatory agencies need to adopt a broader focus (e.g. provide credit for "flexible mitigation" and BMPs)?
- Coordination is needed at higher levels that allow "watershed condition assessment" to be approached in a coordinated fashion. Fragmentation among agencies is a difficult problem that needs to be overcome
- Discuss/define success criteria for projects.

V. List of Participants

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¹ Attendance: X = present; - = absent

²Abbreviations:

USGS = US Geological Survey;
 COE = US Army Corps of Engineers;
 EPA = US Environmental Protection Agency;
 ECU = East Carolina University;
 NCSU = North Carolina State University;
 TJCOG = Triangle J Council of Governments

VI. Scope of Work

Scope of Work

**NC Division of Water Quality
Water Quality Assessments**
supporting the development of
**NC Ecosystem Enhancement Program
Local Watershed Plans**

NC Division of Water Quality
Watershed Assessment Team
June 23, 2010
Version 1.0

Introduction

This scope of work represents a portion of the outcome from the Watershed Assessment Forum held on June 9 and 10, 2009 in Raleigh NC, and subsequent discussions with the NC Department of Transportation (DOT). During this forum, NC Department of Transportation staff expressed a need for a written description and estimated costs for a standard suite of water quality assessments that could be conducted by the NC Division of Water Quality to support the development of local watershed plans by the NC Ecosystem Enhancement Program (EEP). This scope of work is a description of a standard suite of water quality assessments supporting the development of local watershed plans by the EEP. It was developed partially as a result of the discussions during the Forum and through subsequent discussions with the DOT. The assessments described below address the goal of a “watershed approach: *“The ultimate goal of a watershed approach is to maintain and improve the quality and quantity of aquatic resources within watersheds through strategic selection of compensatory mitigation sites.”* Additionally, the types and intensity of the assessments described below will vary among watersheds, but in all cases the strategy will be to answer these questions: 1) Are there water quality issues within the watershed? 2), If so, what are those issues/stressors? And, 3) where within the watershed are the sources of water quality stressors?”

This scope of work will:

- A. Identify specific state or federal legislation or administrative rules and goals that apply to watershed planning.
- B. Identify the key agencies and their roles/responsibilities.
- C. Identify and describe water quality assessments supporting the development of local watershed plans developed by the EEP.
- D. Describe the processes for quality assurance for water quality assessments.
- E. Identify risks to the successful completion of water quality assessments.
- F. Provide an estimate of costs.

A. State and Federal Legislation or Administrative Rules

North Carolina Statutes

NC General Statutes¹ § 143-214.8 through § 143.13 discuss watershed planning.

§ 143-214.10. Ecosystem Enhancement Program: development and implementation of basinwide restoration plans.

Develop Basinwide Restoration Plans. – The Department shall develop basinwide plans for wetlands and riparian area restoration with the goal of protecting and enhancing water quality, flood prevention, fisheries, wildlife habitat, and recreational opportunities within each of the 17 major river basins in the State. The Department shall develop and implement a basinwide restoration plan for each of the 17 river basins in the State in accordance with the basinwide schedule currently established by the Division of Water Quality. (1996, 2nd Ex. Sess., c. 18, s. 27.4(a); 2005-386, s. 3.3.)

Federal Regulations

The U.S. Army Corps of Engineers and U.S. Environmental Protection Agency jointly released a new rule “*Compensatory Mitigation for Losses of Aquatic Resources; Final Rule*”² to clarify how to provide compensatory mitigation for unavoidable impacts to the nation's wetlands and streams. The rule will enable these agencies to promote greater consistency, predictability and ecological success of mitigation projects under the Clean Water Act. The rule encourages that compensatory mitigation decisions be made from a watershed perspective in which the type and location of compensatory mitigation follows from an analytically-based watershed assessment to assure that the proposed compensation furthers watershed goals. This assessment may take the form of a watershed plan, which typically involves an intensive regional planning effort involving many stakeholders. It may also be a less formal “watershed approach,” involving the analysis of data concerning regional environmental issues, efforts to inventory historic trends in aquatic resource condition, and the prioritization of aquatic resource restoration opportunities. Such an approach involves consultation with stakeholders, resource agencies and environmental experts as appropriate.

The US Environmental Protection Agency's website (<http://www.epa.gov/wetlandsmitigation/>) provides information on the rule in addition to a hyperlink to the rule itself: http://www.epa.gov/owow/wetlands/pdf/wetlands_mitigation_final_rule_4_10_08.pdf

B. Agencies Involved and Responsibilities

1. *NC Division of Water Quality (DWQ)* -- The North Carolina Division of Water Quality (DWQ) in the NC Department of Environment and Natural Resources is the agency responsible for statewide regulatory programs in groundwater and surface water protection. The mission of the DWQ is “to protect and enhance North Carolina's surface waters and groundwater resources for the citizens of North Carolina and future generations.”

Within this scope of work, the DWQ supports the development of the NC Ecosystem Enhancement Program (EEP) local watershed plans by conducting water quality assessments funded through financial support provided by the EEP (and/or the DOT). Currently, direct support represents the funding for the salaries of seven DWQ staff, the supplies and equipment needed

¹ http://www.ncleg.net/EnactedLegislation/Statutes/HTML/ByChapter/Chapter_143.html

² DEPARTMENT OF DEFENSE, Department of the Army, Corps of Engineers, 33 CFR Parts 325 and 332 and ENVIRONMENTAL PROTECTION, AGENCY 40 CFR Part 230

to conduct watershed assessments, and any information needed regarding the concentrations of pollutants in surface waters provided by the DWQ Laboratory Section. Five staff supported by the EEP represent the Watershed Assessment Team (WAT). The sixth staff member is in the DWQ Biological Assessment Unit.

In addition to the direct support, DWQ provides indirect support – that is, DWQ efforts NOT funded by EEP and/or DOT. This indirect support includes the coordination of watershed planning efforts between the EEP and the DWQ Basinwide Planning Unit and Modeling/TMDL Units. The indirect support also includes the efforts provided by, but not limited to, DWQ management (Central and Regional Offices) and Administration (e.g. budget office).

The DWQ Laboratory Section is used to perform the chemical analyses of water samples. The Laboratory Section provides results for analytes such as nutrients, fecal coliform bacteria and turbidity.

2. NC Ecosystem Enhancement Program (EEP): The mission of the EEP is “to restore, enhance, preserve and protect the functions associated with wetlands, streams, and riparian areas, including but not limited to those necessary for the restoration, maintenance and protection of water quality and riparian habitats throughout North Carolina.” The EEP was created through a tri-party agreement among the NC Department of Transportation, NC Department of Environment and Natural Resources, and the US Army Corps of Engineers. The EEP fulfills many of the NCDOTs compensatory mitigation needs and serves as the lead agency in the development of local watershed plans.
3. NC Department of Transportation (DOT). The mission of the DOT is “Connecting people and places in North Carolina – safely and efficiently, with accountability and environmental sensitivity.” The DOT relies on the EEP to fulfill many of its compensatory mitigation obligations required under COE permits and/or Section 401 water quality certifications issued by the DWQ. Additionally, the DOT supports the development of local watershed plans by the EEP by providing qualified staff to conduct surveys of aquatic organisms (e.g. fish, mussels).
4. US Army Corps of Engineers (COE) The mission of the COE is to “Provide vital public engineering services in peace and war to strengthen our Nations security, energize the economy, and reduce risks from disasters.” Within the context of this scope of work, the COE promulgated, in partnership with the EPA “Compensatory Mitigation for Losses of Aquatic Resources; Final Rule” 33 CFR Parts 325 and 332. Additionally, the COE was a signatory partner in the tri-party agreement which created the EEP.
5. US Environmental Protection Agency (EPA) The mission of the EPA “is to protect human health and the environment.” Within the context of this scope of work, the EPA promulgated, in partnership with the COE, the “Compensatory Mitigation for Losses of Aquatic Resources; Final Rule” 40 CFR Part 230.
6. Others: Others may include:
 - a. Universities (e.g. North Carolina State University; NCSU),
 - b. Councils of Government (COGs),
 - c. County Governments,
 - d. Municipal governments,
 - e. Private consultants,

Agencies/organizations in this group usually serve, in addition to the EEP and the DWQ, as part of the planning team. The planning team generally oversees the planning needed to develop a local watershed plan.

C. Water Quality Assessment Tasks

The following tasks represent an outline of the assessment approach along with *estimated* costs base upon past watershed monitoring efforts conducted by the DWQ for the EEP. Actual costs will vary depending on watershed size, location of the watershed, and assessment needs.

1. **Review of Existing Data**

Product: Report; GIS data

Purpose: The goal of this report is to gather information regarding what is known about a watershed through a review of existing water quality data from the LWP planning area. Results will be used to help identify where assessments efforts should be directed.

Description: The intent of this review is to summarize existing water quality information from DWQ reports (e.g. DWQ basin assessment reports, and DWQ basinwide plans) and review water quality data collected within the LWP area. Water quality data collected from the LWP area are reviewed in order to identify existing problems, determine temporal patterns (trends) and identify spatial patterns of the results from any previous water quality assessments. It is possible that some data sources may not be summarized simply due to the fact that the source(s) of the data were not known (e.g. articles published by scientists).

The data review will include summaries of water quality data collected from the DWQ's ambient monitoring system, any coalition of NPDES dischargers, results of previous DWQ biological assessments, and any other water quality data collected from any organization including universities, the NC Department of Transportation, the US Geological Survey, and citizen monitoring groups. Additionally results from water quality assessments close to, but outside the LWP area, may be summarized too. This is done mainly since many LWP areas have few to no results available from existing water quality management programs. Obtaining these data aid in the interpretation of the results acquired from assessments completed to support the development of the local watershed plan.

The DWQ Basinwide Information Management System (BIMS) will be queried for information on permitted wastewater and stormwater dischargers. The Potential Contaminant Sources (PCS) database³ will be queried to determine the locations of potential contaminants.

Once existing data have been obtained, a comprehensive list of identified data sources will be developed and shared with the planning team overseeing the development of the local watershed plan. The watershed planning team will determine if any additional data sources exist and whether causes and sources of any water quality problems or impairments can be identified. The existing data summary may be presented to stakeholders to help develop watershed goals.

Estimated Time for completion: Six weeks (allows for external reviews and subsequent revisions).

Estimated Cost: 240 hours x \$31/hour = \$7,444

2. **Watershed Reconnaissance**

Product: Memorandum; GIS data

³ Database maintained by the NCDENR Public Water Supply Section.
http://swap.deh.enr.state.nc.us/Swap_app/viewer.htm

Purpose: The goals of a watershed reconnaissance are to: 1) ascertain existing and likely water quality problems and their sources, and 2) to identify opportunities for compensatory mitigation. Outcomes include: 1) identifying where more focused water quality assessments should occur, 2) determining whether sites have sufficient flow for taking chemical samples and/or conducting biological assessments, and 3) determining whether sites are safely accessible for future assessments.

Description: A reconnaissance survey consists of driving through the watershed, making a written record of observations, obtaining the latitude and longitude of sites visited, taking photographs, and documenting spatial patterns from the observations and results of the field measurements. Approximately 30 to 90 sites will be visited. A “site” is usually a bridge crossing that provides safe and convenient access to surface waters.

Field measurements for dissolved oxygen, pH, specific conductance and water temperature will be done at bridge crossings or other easily and publicly available access points. If warranted, the field crew may take water samples or use alternative methods ([Hach](#) or [CHEMets](#) kits) to estimate concentrations of parameters of concern.

Time for completion: Four weeks

Estimated Cost:

Field work: ten days, two staff: 160 hours x \$31/hour = \$4,960
Office-Technical memorandum writing and internal review:
10 days, one staff: 80 hours x \$31/hour = \$2,480
Total Estimated Costs (\$4,960+ \$2,480) = \$7,440

3. **Physical/Chemical Assessments**

Product: Memorandum; GIS data

Purpose: Physical and chemical assessments may determine specific pollutants that may be an issue and the watersheds from which they originate. The goal is to identify the sources of pollution at the smallest geographic scale possible.

Description: Focus will be on determining whether nutrient and fecal coliform pollution are present and identifying the sources of the pollution. Metals and organic contaminants will not be sampled unless potential problem areas for these are identified through the review of existing data, the field reconnaissance, and/or stakeholder input.

Sites will be selected for data collection (usually this consists of ten to twelve but may vary, up or down, depending on the watershed and goals of the local watershed plan) to be assessed, usually ranging two to three months. Afterwards data collection at these sites will cease. New sites could be selected and data collected for two to three months (upstream of the original sites) after the initial data collection with the goal of identifying the sources of pollution. In conjunction with, or as an alternative to submitting water samples to the DWQ Laboratory Section, measurements could be taken in the field using [Hach](#) or [CHEMets](#) kits.

Explicit reasons why sites were selected for monitoring/assessment will be stated in an assessment plan.

Parameters to be monitored (and reasons why):

Field measurements:

- i. Dissolved oxygen (DO), (easily measured; there is a NC state standard for DO)
- ii. pH, (easily measured; there are NC state standards for pH)
- iii. Water temperature, (easily measured)
- iv. Specific conductance (easily measured; high values can suggest pollution)

Nutrients (Nutrients are a widespread water quality problem)

- i. Ammonia as nitrogen (NH₃)
- ii. Total Kjeldahl nitrogen (TKN)
- iii. Nitrite+nitrate as nitrogen (NO₂+NO₃)
- iv. Total phosphorus (TP)

Fecal Coliform Bacteria (There is a NC state water quality standard for fecal coliform bacteria)

Turbidity (There is a state water quality standard for turbidity; results are also used to help interpret results for nutrients)

Time for completion: Seven to nine months

Estimated Costs:

Minimal costs for field measurements⁴

Laboratory Costs (current cost is \$12.56 per result) for nutrients, fecal coliform bacteria, and turbidity.

Six results per site (NH₃, TKN, NO₂+NO₃, TP, fecal coliform bacteria, turbidity), 10 initial sites, 10 follow up sites, each site monitored once during three consecutive months

6 results x (10 initial sites + 10 follow-up sites) x 3 (months) x \$12.56 = \$4,522

Staff time for field work

Four hours, 1 staff, for preparation (getting supplies ready) for each sampling trip
4 hours x 6 trips = 24 hours x \$31/hour = \$744

Eight hours, 2 staff for sampling
8 hours x 2 staff x 6 trips x \$31/hour = \$2,976

Staff time for office work

Eighty hours, 1 staff for data entry, compile GIS data, write/revise memoranda including internal reviews.

80 x \$31/hr = \$2,480

Total Estimated Costs = \$4,522 + \$744 + \$2,976 + \$2,480 = \$10,722

⁴ Costs include, but are not limited to calibration standards, equipment depreciation, maintenance, etc.

4. **Biological Assessments**

Biological assessments can include 1) benthic macroinvertebrate assessments and/or 2) fish community assessments. Biological assessments for benthic macroinvertebrates can be conducted by the NC Division of Water Quality – Biological Assessment Unit (DWQ-BAU) and/or DWQ Watershed Assessment Team (DWQ-WAT) staff. Fish assessments resulting in indices of biological integrity are conducted only by DWQ-BAU. DOT staff have also conducted fish and mussel assessments.

Product: Memorandum; GIS data

Purpose: Biological assessments will determine how well a body of water supports aquatic life and may help identify types of impacts to instream communities.

Description: Biological assessments are evaluations of the condition of waterbodies using surveys and other direct measurements of resident biological organisms (macroinvertebrates and/or fish). Biological assessment results are used to answer the question of whether waterbodies support survival and reproduction of desirable fish, shellfish, and other aquatic species -- in other words, if the waterbodies meet their designated aquatic life uses. The number of sites that can be sampled by three BAU biologists varies depending on transportation time and the type of sample method⁵ being used. Estimates of the number of sites that can be sampled in one week are:

- 20 sites using the EPT sample method.
- 17 sites using the Qual-4 sample method.
- 13 sites using the Swamp sample method
- 12 sites using the Full Scale (Standard Qualitative Method) sample method
- 10 sites using the Coastal B (Boat) sample method

Site Selection: Many factors are considered in order to select sites for sampling. These include:

- Sites provide safe access to surface waters for staff.
- Sites may have been sampled as part of DWQ's basinwide sample program in which sites may be sampled on a 5-year rotation.
- Information from the review of existing data and/or watershed reconnaissance.
- Sites may be co-located with any physical and chemical assessment sites.
- Sites may be located in subwatersheds with a range of land uses (e.g. urban vs. rural).

Explicit reasons why sites were selected for monitoring/assessment will be stated in an assessment plan

Time for completion: One week for field work; Report completed within three months after field work:

⁵ Sample methods are described in "Standard Operating Procedures for Benthic Macroinvertebrates. Biological Assessment Unit. July 2006. <http://h2o.enr.state.nc.us/esb/BAUwww/benthossop.pdf>

Estimated Costs (Benthic Macroinvertebrate): Number of sites assessed within an LWP planning area can vary.

Field work: Three DWQ-BAU staff 40 hours. 3 staff x 40 hours = 120 hours

Taxa ID, data entry: One staff 120 hours

Technical memorandum writing and internal QA/QC: 40 hours

280 hours x \$31/hour = \$8,680

5. **Stressor Source Identification/Follow-up**

Product: Memoranda; GIS data

Purpose: Purposes are to identify: 1) the smallest geographic area or specific location of any pollution source, 2) areas of water quality and/or habitat degradation, 3) high quality areas, and 4) opportunities for compensatory mitigation. Some of these may be achieved through the field reconnaissance.

Description: This task may include walking portions of streams to identify areas of concern and opportunities for compensatory mitigation. Hach kits and/or field measurements may be used to in this process. Staff in the field have the primary responsibility to identify sources of water quality stressors, but also have the opportunity to identify high quality areas and opportunities for compensatory mitigation.

Estimated Costs:

Field work: Staff time: Two staff members working together for three weeks; 2 x 120 hours = 240 hours x \$31/hour = \$7,440

Office work: Staff time: One staff member – 60 hours x \$31/hour = \$1,860

Total cost estimate = \$9,300

6. **Other Assessments**

Product: Memoranda; GIS data

Purpose: Purposes may be specific to watershed area and the type of assessment chosen. Types of other assessments include, but are not limited to:

Description: Description is dependent on the purpose and the assessment method chosen to address the purpose.

- i. NC Wetland Assessment Method (NCWAM)⁶
- ii. DWQ aquatic habitat assessment,
- iii. Bank Erosion Hazard Index (BEHI),
- iv. Identification of Stream Origins and Flow regimes⁷ "NC "Methodology for Identification of Intermittent and Perennial Streams and their Origins"
- v. Others, e.g. Center for Watershed Protection's "Unified Stream Assessment" (USA) and "Unified Subwatershed and Site Reconnaissance" (USSR)
- vi. Stream walks/visual assessments/photographs

⁶ Two DWQ-WAT staff have been trained to use NCWAM

⁷ Six DWQ-WAT staff have been certified through the Surface Water Identification Training and Certification (SWITC) program mandated by NC Session Law 2001-404 to make a legal determination of stream origins and identify surface waters subject to buffer rules enacted by the NC Environmental Management Commission.

Estimated Costs: Costs will vary depending on assessment needs and the type of assessment chosen.

7. **Planning and Stakeholder Meeting Attendance**

Product: In most cases there is no specific product. PowerPoint presentations may be developed to convey the results of the assessments. In all cases, results of meetings organized by the DWQ will be summarized and will include a copy of the agenda, a list of participants and the agencies they represent and a summary of the discussion including outcomes, action items and the date/time and location of any follow-up meetings. These meeting minutes will be disseminated to all invited participants.

Purpose: Communication among members of the planning team and stakeholders

Estimated Costs:

Staff time: 160 hours – meeting/PowerPoint preparation, meeting attendance
160 hours x \$31/hour = \$4,960

8. **Final Report**

Product: Report

Report Content: The final report will represent a compilation of any memoranda produced, any new material, and an executive summary.

Purpose: The report will integrate the results of all the assessments completed, referencing source memoranda as needed.

Intended Recipients: EEP, DWQ (e.g. Basinwide Planning Unit, Modeling/TMDL Unit), DOT. Report will be posted on the DWQ-WAT website. Once the report is posted, an email will be sent to interested parties advising them that the report is available.

Estimated Costs:

Staff time: 160 hours (including internal reviews)
160 hours x \$31/hour = \$4,960

D. **Quality Assurance**

1. Benthic macroinvertebrate sampling will be completed in accordance with current DWQ Standard Operating Procedures. (<http://h2o.enr.state.nc.us/esb/BAUwww/benthossop.pdf>)⁸
2. Any benthic macroinvertebrate assessments conducted by DWQ-WAT staff that will result in the assignment of bioclassifications will have a sampling plan completed in conjunction with, and approved by the DWQ-Biological Assessment Unit. DWQ-WAT staff will have been trained in DWQ-BAU methodology.
3. DWQ-BAU will have the opportunity to review any DWQ-WAT report pertaining to macrobenthos

⁸ Hyperlinks with “h2o.enr.state.nc.us” as part of the URL may be changed due to the DWQ implementing a new web pages in early 2010.

4. Chemical sampling will be completed in accordance with current DWQ Laboratory Section and Intensive Survey Unit Standard Operating Procedures (see: <http://portal.ncdenr.org/web/wq/lab> and (<http://h2o.enr.state.nc.us/esb/documents/PHYSICAL-CHEMICAL%20SOP.pdf>))
5. A “blind” duplicate set of chemical samples will be collected from one site and submitted to the Laboratory Section. This does not represent a split sample, but represent results from two samples from the same site taken at the same time or within minutes of one another, and are referred to as duplicates in this document.
6. Field meters will be calibrated daily. If post sampling calibrations do not meet documented QA criteria (see SOPs), then all results for that sampling event will be qualified. Field notes and meter calibration logs will be maintained.
7. Data entry will be checked manually and by graphing data (checking for outliers, or atypical results). Raw data will be forwarded to EEP and/or third parties upon request. If any results appear atypical, then DWQ will investigate possible reasons (e.g. data entry error) and correct if needed. If any other results are deemed atypical, and for which a reason cannot be found, EEP will be informed.
8. Written deliverables (memoranda/reports) will be reviewed by at least one other person other than the author.

E. Risks

These represent some of the factors that may prevent DWQ from performing work on schedule:

1. Staff changes: Staff could resign or other factors (e.g. sickness or injury) could prevent staff from performing work. The DWQ will attempt to identify alternative staff for sample collection if unforeseen events prevent primary staff from completing sample collections.
2. State budget: State budget issues could result in curtailing equipment purchases and/or nonessential travel. The term “nonessential” would likely be defined for NC government staff by administrators. The DWQ will provide written communication (email) to the DOT and the EEP if travel and/or any state imposed travel restrictions affect any activities that require travel.

F. Cost Estimates - Summary

A summary of the cost estimates for monitoring and assessment for a “typical” LWP project is shown in the table below.

Task	Description	Estimated Cost
1	Review of Existing Data	\$7,440
2	Watershed Reconnaissance	\$7,440
3	Physical/Chemical Assessment	\$10,722
4	Biological Assessment	--
	Benthic Macroinvertebrate	\$8,680
	Fish	To be determined
5	Stressor Source Identification/Follow-up	\$9,300
6	Other Assessments ^a	To be determined
7	Planning/Stakeholder meetings	\$4,960
8	Final Report	\$4,960
Tasks: Subtotal		\$53,502
Indirect Costs	13.10%	\$7,009
Subtotal	Cost for Tasks + Indirect Costs:	\$60,511
Estimate-Total Costs:		\$60,511

Other Costs NOT included above include, but are not limited to:

Management, coordination, tracking (5%)	?
Transportation (example:5000 miles at \$0.45/mile) ^b	\$2,225
Overnight travel per staff per day ^c	\$101.05
Consumables (calibration standards)	\$200
Equipment depreciation	?
Office Supplies	\$50

^a One week of work (40 hours) for one staff is 40 x \$31 = \$1,240 (field work does not include preparation in the office, or data entry, etc.).

^b 5000 miles is an estimate. Costs per mile depend on vehicle used.

^c Travel Subsistence Rate Revision Effective July 1, 2009 (Charles E. Perusse Memo: July 7, 2009)

List of Acronyms

Acronym	Definition
BAU	Biological Assessment Unit
BEHI	Bank Erosion Hazard Index
BIMS	Basinwide Information Management System
BMP	Best Management Practice
CFR	Code of Federal Regulations
CHPP	Coastal Habitat Protection Plan
COE	Corps of Engineers
COG	Council of Government
DENR	Department of Environment and Natural Resources
DO	Dissolved Oxygen
DOT	Department of Transportation
DWQ	Division of Water Quality
ECU	East Carolina University
EEP	Ecosystem Enhancement Program
EIA	Ecological Integrity Assessment
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera
GIS	Geographic Information System
HU	Hydrologic Unit
LWP	Local Watershed Plan
MOA	Memorandum of Agreement
NC	North Carolina
NCSAM	North Carolina Stream Assessment Method
NCSU	North Carolina State University
NCWAM	North Carolina Wetland Assessment Method
NGO	Non-Governmental Organization
PCS	Potential Contaminant Source
QA/QC	Quality Assurance/Quality Control
RBRP	River Basin Restoration Plan
SOP	Standard Operating Procedure
SWITC	Surface Water Identification Training and Certification
TJCOG	Triangle J Council of Governments
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
US	United States
USA	Unified Stream Assessment
USGS	United States Geological Survey
USSR	Unified Subwatershed and Site Reconnaissance
WAT	Watershed Assessment Team