

Emerging Issues in Wetland Loss Mitigation:
A Policy Analysis in the Tar-Pamlico Basin

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ABSTRACT

Ecological functions of wetlands and streams provide valuable services to human societies, but conflicting societal objectives at times place greater value on conversion or destruction than on preservation of wetlands. Therefore, it is imperative that regulatory structures provide a system for environmental decision makers to weigh available science, stakeholder input, and economic factors in determining how to minimize and mitigate loss of these resources. This study utilized an environmental policy analysis framework to evaluate the success of North Carolina's wetland management system in achieving these goals, and to locate programmatic components for which performance could be improved. Comparison with past analyses revealed that the state's newest mitigation mechanism, the Ecosystem Enhancement Program, demonstrated high-level or enhanced performance over its first two years of operation in efficiency, the ability to incorporate scientific advancements, transparency, and watershed planning. Areas for continued improvement were identified as incorporating a functional assessment methodology into wetland evaluation for determining mitigation requirements and evaluating mitigation success, increasing the length of monitoring for restored and created wetland and stream projects, enhancing data availability and clarity, and applying a watershed approach in directing development toward areas of least environmental damage.

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LIST OF ACRONYMS

BIMS	Basinwide Information Management System
CWA	Clean Water Act
DWQ	Division of Water Quality (within NCDENR)
ED	Environmental Defense
EEP	Ecosystem Enhancement Program
FY2003	Fiscal year 2003 (July 1, 2003 – June 30, 2004)
FY2004	Fiscal year 2004 (July 1, 2004 – June 30, 2005)
HGM	Hydrogeomorphic (wetland assessment method)
NC	North Carolina
NCDCM	North Carolina Division of Coastal Management
NCDENR	North Carolina Department of Environment and Natural Resources
NCDOT	North Carolina Department of Transportation
NCSAM	North Carolina Stream Assessment Method
NCWAM	North Carolina Wetland Assessment Method
NEPA	National Environmental Policy Act
NNL	No net loss (of wetlands)
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRCS	Natural Resources Conservation Service
ppt	parts per thousand
PTRF	Pamlico-Tar River Foundation
SEPA	State Environmental Policy Act
TRLC	Tar River Land Conservancy
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

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INTRODUCTION

Wetland loss is a critical issue in the United States, which has seen the disappearance of the majority of its wetlands over the past 150 years (Mitsch and Gosselink, 2000). The recent devastation associated with Hurricane Katrina was a sober reminder of the importance of wetlands in protecting coastal areas. In fact, wetlands play multiple roles in regulating natural ecosystem processes that Americans depend upon for their livelihoods, nutritional needs, and recreational activities. North Carolina has lost one-half of its original 11.1 million acres of wetlands (Dorney, *et. al.*, 2004), and continues to lose wetland acreage every year. It is vital that the state's regulatory structure provides adequate protection of the valuable functions performed by its remaining wetlands. Ideally, this structure would also act to replace functions lost in the past. This analysis will examine how successful North Carolina's wetland policies have been at meeting these goals, and explore future implications for the state's wetland mitigation program.

Threats to wetlands

The greatest contributors to wetland loss are societal priorities and economic considerations, which favor urban development and conversion of wetlands for agriculture over wetland conservation. The impact of these land use changes on wetland functionality is two-fold; they both reduce the number of wetlands on the landscape and place additional stress on wetlands that remain. While one of the most valuable wetland functions is filtration and treatment of polluted water, excessive inputs can overload wetland capacities and cause damage. Land use changes, especially the increase of impervious surfaces, such as sidewalks and roads, or conversion of forests to agricultural lands can cause changes in stormwater runoff that reaches wetlands from the surrounding landscape. These changes tend to yield more intense runoff carrying heavier loads of pollutants, including metals, nutrients, organic chemicals, and eroded soils. Increased pollutant loads can negatively impact wetland vegetation, wildlife, and bacterial communities, leading to reduced stormwater treatment functionality and, thereby, exacerbate both wetland loss and water quality problems (USEPA, 2006b).

Wetland services contribute greatly to the welfare of humans. Based on the high proportion of worldwide ecological services that are provided by wetlands, continued impacts to these critical systems may also be a threat to our own well-being and the sustainability of human life on Earth. While we may argue that placing monetary value on wetland services or aesthetics is impossible, we do place value when we decide about the relative worth of a project that will result in wetland impacts. Costanza, *et al.* (1997) suggested that, in the decision-making process, "...ecosystem services lost must be weighed against the benefits of a specific project. Because ecosystem services are largely outside the market and uncertain, they are too often ignored or undervalued, leading to the error of constructing projects whose social costs far outweigh their benefits." If based on true ecosystem value, it is likely that fewer projects would merit construction. This type of oversight, overvaluing the relative importance of a project that requires draining or filling a wetland as compared with the services provided to society by that wetland, is likely leading to excessive wetland destruction and conversion that we may regret in the future as we begin to experience impacts on human welfare. "As natural capital and ecosystem services become more stressed and more 'scarce' in the future, we can only expect their value to increase. If significant, irreversible thresholds are passed for irreplaceable ecosystem services, their value may quickly jump to infinity" (Costanza, *et al.*, 1997).

United States history and regulation of wetlands

Prior to the mid-1970s, wetland functions were not widely understood. "For most of recorded history, wetlands were regarded as wastelands if not bogs of treachery, mires of despair, homes of pests, and refuges for outlaw and rebel. A good wetland was a drained wetland free of this mixture of dubious social factors" (Larson and Kusler, 1979). Over one-half of the estimated 200 million acres of pre-European wetlands in the conterminous United States were drained, as recommended by policies such as the Swamp Land Acts of the late 1800s, in order to be put into seemingly more productive use (Mitsch and Gosselink, 2000; Patrick, 1994).

As the appreciation of wetland values grew, so did a movement to protect those wetlands that remained. The Federal Water Pollution Control Act was enacted in 1972 and amended in 1977, becoming known as the Clean Water Act (CWA) (Mitsch and Gosselink, 2000). This act provides the backbone of water quality protection in the United States. Section 404 regulates “the discharge of dredged or fill materials into waters of the United States, including wetlands” (USEPA, 2006a). With assistance from USEPA and the US Fish and Wildlife Service (USFWS), USACE oversees permitting of these activities. To obtain a permit, an applicant must demonstrate that wetland impacts will be avoided or minimized “to the extent practicable” (USEPA, 2006a). For unavoidable impacts, the USACE permit will include assignment of compensatory mitigation requirements. Acceptable forms of mitigation include stream and wetland creation, restoration, enhancement, and preservation. While USACE requires a minimum one-to-one mitigation, it also acknowledges the varying effectiveness of different kinds of mitigation (28 March 2006, Federal Register 71:15519). Therefore, the ratio of required compensatory mitigation to impacted wetland acreage varies depending on the mitigation type (Table 1), in an attempt to maintain overall wetland functionality (Engler, 2005; NCDENR-DWQ staff, personal communication, October 4, 2006).

Table 1: Compensatory wetland mitigation requirements in North Carolina.

Mitigation Type	<u>Required Ratio</u>		<u>NC mitigation</u>
	<u>USACE</u>	<u>NC-DWQ</u>	<u>(acres per impacted acre)</u>
Restoration	1:1	1:1	2
Enhancement	2:1	3:1	2 + 1 acre restoration/creation
Creation	3:1	2:1	6
Preservation	5:1	5:1	5 + 1 acre restoration/creation

Realization of the economic and societal values of wetland services is helping to fuel the current movement toward wetland protection and restoration efforts. In 1988, the United States adopted a policy of “no net loss” (NNL) of wetlands. On Earth Day 2004, a further federal goal was set to “attain an overall increase in the quality and quantity of wetlands” by “restoring, improving, and protecting more than 3 million acres...in five years” (Dahl, 2006).

North Carolina's wetland management system

Activities resulting in wetland impacts in North Carolina require permits from both USACE and the NCDENR Division of Water Quality (DWQ), which specify mitigation requirements if impacts exceed regulatory thresholds for stream length or wetland area, currently 150 linear feet and one acre, respectively. Transportation-related impacts generate the majority of wetland mitigation requirements in NC. Historically, this mitigation was the responsibility of the state's Wetland Restoration Program (WRP), established in 1996. By 2000, concerns had been raised about WRP backlogs leading to delay of North Carolina Department of Transportation (NCDOT) projects. In 2001, a multi-agency initiative was launched to improve the environmental response processes, including fulfillment of wetland mitigation requirements, related to transportation projects in North Carolina (Reuter, 2003). Representatives from the North Carolina Department of Environment and Natural Resources (NCDENR), NCDOT, USACE, USEPA, USFWS, and the North Carolina Wildlife Resources Commission (NCWRC) worked to identify problems with, and develop solutions for, meeting wetland mitigation needs in the state. Rosenbaum (1980) noted that "unwieldy intergovernmental structuring" and "conflicting objectives" were primary causes of environmental policy ineffectiveness. Based on the findings of the task force in North Carolina, these appeared to be hampering the productivity of WRP. Problems were related to both bureaucratic and scientific issues within the permitting and mitigation processes. Challenges of a multi-agency system included communication, coordination, role and responsibility definition, timing, and process bottlenecks. These, combined with difficulties in mitigation assignment, design, site selection, construction, monitoring, and success determination resulted in an inefficient system for compensatory mitigation. Suggestions from the task force involved 1.) decoupling mitigation from permits to allow mitigation planning on a watershed scale and 2.) establishment of a new organization to perform this level of mitigation.

When policy development requires major changes in the behavior of bureaucratic agencies, a determinant of policy adherence is "the attitudinal receptivity of the affected government personnel." For new policies to be self-enforcing, it may be most

reasonable to “assign implementation responsibility to a group of government personnel who manifest enthusiasm about the development of a new program...through creation of a new agency,” rather than by attempting to rehabilitate an ineffective program (Rosenbaum, 1980). In 2003, the Ecosystem Enhancement Program (EEP) partnership between USACE, NCDENR, and NCDOT was established. The initial merger of NCDOT and WRP staff into the new EEP structure was difficult and somewhat contentious due to a lack of complete staff buy-in to the change. The new agency experienced a period of turnover in its early stages, then a long period of rebuilding staffing to its current level (EEP staff, personal communication, June 8, 2006). An initial two-year “transition period” was factored into development of EEP to accommodate this rebuilding and to focus on “catching up” with the backlog of required mitigation through acquisition of preservation properties. After the transition period, the program focus was expected to shift to the preferred mitigation methods of restoration and creation.

In addition to providing wetland, stream, and buffer mitigation to satisfy NCDOT dredge and fill permits, EEP partners with private companies statewide to provide other mitigation services needed in North Carolina (EEP, 2006a). A principal recommendation of the National Research Council (2001, p.139) was that “compensatory mitigation...should be in place concurrent with, and preferably before, permitted activity.” Upon EEP creation, a Memorandum of Agreement (MOA) between the sponsoring agencies established proactive mitigation processes for NCDOT impacts based on a seven-year planning horizon (NCDENR, *et al.*, 2003). A similar Memorandum of Understanding (MOU) expanded EEP activities to include an in-lieu fee (ILF) program to provide mitigation services for non-NCDOT clients within one year of permitted impacts. USACE and NCDENR-DWQ are responsible for issuing permits and assigning compensatory mitigation, while EEP is responsible for planning and completing the mitigation. EEP is now the agency responsible for well over 60% of compensatory mitigation in North Carolina (C. Karoly, personal communication, November 16, 2006).

EEP echoes the ideal of “no net loss”, strives to facilitate an increase in wetland acreage and functionality within the state, and suggests that permit-related mitigation should take place within the impacted river basin. While the program has been found to be an effective model for wetland mitigation programs, areas identified for improvement include the need for a functional assessment model for mitigation project evaluation, stream mitigation effectiveness, and program transparency (Engler, 2005). NCDENR, USACE, and NCDOT hope that, once fully implemented, EEP will “be established as a role model for positive interagency relationships and will set a nationwide standard for mitigation at the ecosystem level for unavoidable and minimized impacts resulting from transportation and other development projects” (NCDENR, *et al.*, 2002).

RESEARCH OBJECTIVES

The novel structure, involving cooperative efforts between regulatory and non-regulatory agencies, of North Carolina’s wetland management process has drawn nationwide attention, evaluation, and critique. The creation of EEP has provided a model that, if successful in meeting the state’s mitigation needs, may become a basis for programs in other states. Currently, there is intense interest in its degree of success.

This project sought to evaluate EEP performance by applying a policy analysis framework to a case study in a North Carolina river basin. Although initially envisioned as a simple quantification of recent wetland loss and mitigation in the basin of interest, data investigation revealed the need for deeper analysis of a complex system at the interface of wetland science and regulation. The objectives of this project were to:

1. Evaluate the effectiveness of North Carolina’s wetland mitigation policy, and
2. Provide suggestions for science and policy based initiatives aimed at improving this efficacy into the future.

The analysis took into account diverse factors, including the science and regulatory integration of wetland functionality, economic impacts, stakeholder involvement and communication, and the influence of policy design on mitigation outcomes.

Study area

At the request of the Pamlico-Tar River Foundation (PTRF), the Tar-Pamlico River basin (Figure 1) was used as a case study to evaluate the effectiveness of North Carolina's permitting and mitigation procedures. The area of interest is a diverse 5500-square-mile watershed located completely within the boundaries of North Carolina. Extending 140 miles across the Piedmont and Coastal Plain, the narrow, fast-moving Tar River travels southeast across the state from its source near Roxboro, eventually merging into the brackish estuarine Pamlico River near Washington (PTRF, 2006). The majority of land cover in the basin is comprised of forests, including those managed for timber production, and agricultural areas (Burgess, 2004). Open water (including 2335 stream miles) accounts for twenty percent of the basin (PTRF, 2006; stream miles based on 2000 305(b) report).

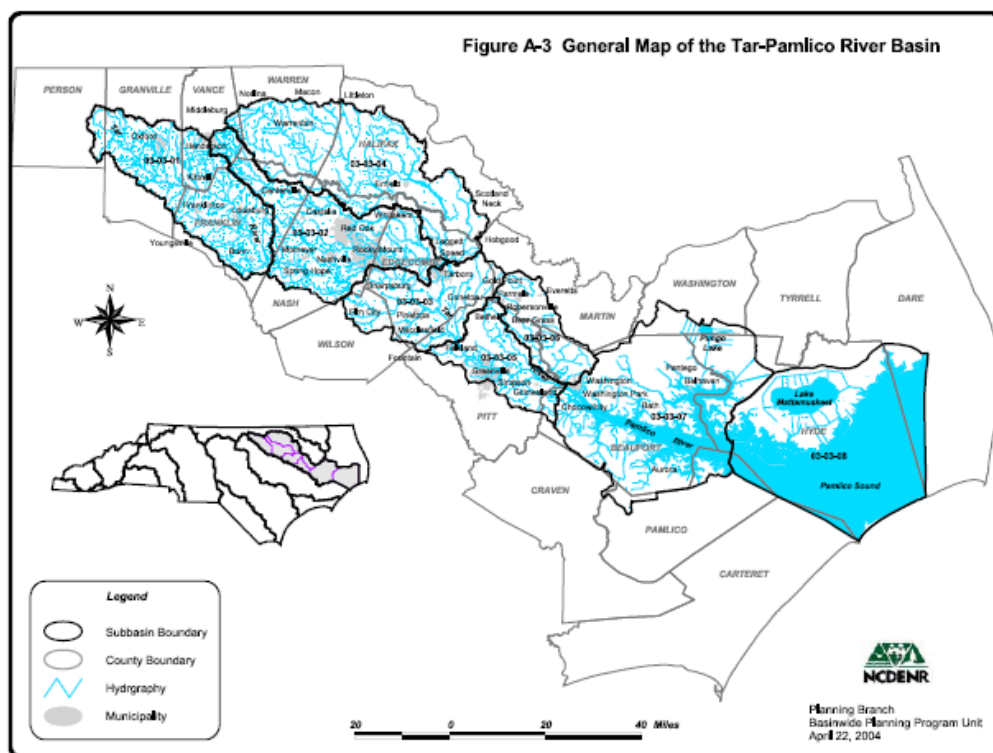


Figure 1: The Tar-Pamlico River basin; from NCDENR-DWQ Tar-Pamlico basinwide plan (2004).

Habitat in the basin is rich, providing homes to a multitude of animal and plant species, including the endemic Tar River spiny mussel and the endangered Atlantic white cedar ecosystem (NCDENR, 2002). By 1962, the wetlands in the lower Tar-Pamlico basin were recognized as some of the most valuable wildlife habitat in the state. Wilson (1962, p.35) listed the following as three of the top five areas with the most potential for preserving and increasing migrating waterfowl populations, such as those of tundra swans and snow geese, through enhancement of stopover habitat:

- Marshes in Carteret, Currituck, Dare, Hyde and Pamlico counties.
- Swamps in the Tar River watershed near Washington.
- Bottomlands along the Tar, Neuse, Cape Fear, and Northeast Cape Fear rivers.

One of the most productive North American fisheries, generating thousands of jobs and over \$1 billion dollars annually, is connected to the Albemarle-Pamlico Sound (Burgess, 2004). This estuary provides nursery areas, food, and protection that are directly related to the fish and shellfish populations that support coastal economies in this region (Stedman and Hanson). Historically a healthy ecosystem, the Sound is now experiencing degradation, and associated fisheries impacts, due to development and other land use pressures in the coastal area and throughout the Tar-Pamlico River basin (*Ibid.*; PTRF, 2002).

In addition to its agricultural and fisheries industries, North Carolina is experiencing population growth and related development pressures, especially in its coastal region. PTRF has identified multiple wetland impacting activities within the basin (H. Jacobs, personal communication, March 17, 2006; PTRF, 2006b). Along the Tar River in the Piedmont, primary impacts are due to road-building and commercial development along smaller creeks, especially around the growing city of Rocky Mount. Throughout the Piedmont and the Coastal Plain, high-nutrient runoff from various agricultural pursuits threatens to overload the river system and associated estuaries. Sources of nutrients include confined animal feeding operations (CAFOs, Figure 2), aquaculture ponds, and crop farming of corn, cotton, peanuts, soybeans, tobacco, wheat, and sorghum. The

Coastal Plain is feeling the strain of burgeoning population, and the region around the Pamlico Sound faces multiple wetland impacts related to residential influx and continued use of natural resources:

- Transportation impacts include an upcoming NCDOT highway bypass project around Washington, NC.
- While single family home building around the estuary has had relatively little impact, proposed developments with golf courses and equestrian systems will disturb much larger areas and create more potential for polluted runoff (Figure 3).
- Phosphate mining has been occurring in the Pamlico River basin for almost a decade. PCS Phosphate, Inc. proposes to expand the mine and has applied for a permit to impact over 2400 wetland acres next to the estuary (Figure 4).

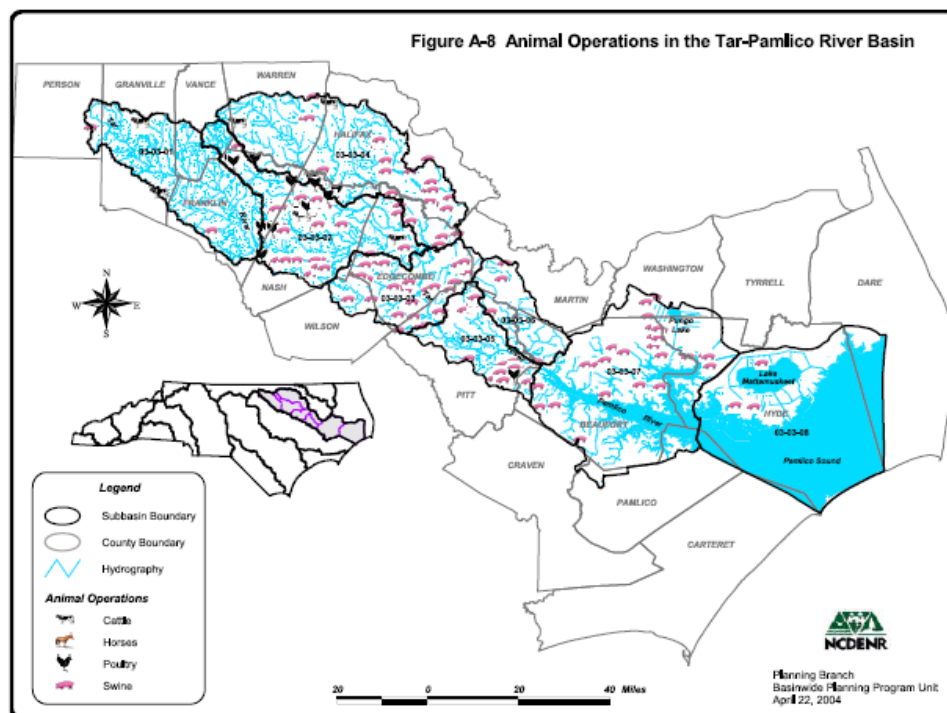


Figure 2: CAFOs in the Tar-Pamlico basin; from NCDENR-DWQ Tar-Pamlico basinwide plan (2004).



Figures 3 and 4: Multiple pressures in the Tar-Pamlico basin: Large residential developments, a proposed phosphate mine expansion near the Pamlico estuary; photo and map credit: H. Jacobs.

Analytical Procedures for Environmental Policies

Policies can be evaluated by looking at obvious factors, such as cost-benefit ratios and physical products. But implementing environmental policies also involves more esoteric factors, such as social justice, ecological impact, and community relationships.

Frameworks have been designed specifically for comprehensive evaluation of environmental policy impacts by taking into account social, scientific, economic, and other relevant outcomes. Looking at policies from this holistic viewpoint maximizes the opportunity for development of policies yielding the greatest good.

Due to the wide range of variables, some of which are measured subjectively, it can be difficult to assess the degree of policy success, and even more difficult to compare one policy to another. Environmental policy analysis frameworks provide a systematic approach for assigning quantitative scores to criteria related to policy outcomes. These scores highlight areas of success, expose areas that could be improved upon, and allow comparison of similar statutes. Adding a weighting system may further enhance this technique by engaging policy makers in reflection and discussion about priorities in environmental management. The following examples and selected framework for the present analysis highlight some of the systems that have been developed toward

meeting these goals. It is unfortunate that, due to time and budget constraints and the multitude of decisions being made in the environmental field at any given time, many policies do not receive this level of investigation.

Environmental policy analysis – examples

Downey's (1987) review of policy-making literature provided the basis for a five-point analytical framework. He recognized that, on the surface, environmental policies appear to be developed pragmatically and ad hoc. However, the actual influences and processes behind policy development are complex. Governments are constantly working to prioritize multiple issues that require attention. Downey (1987) believed that thorough environmental policy analysis needed to consider the political, economic, and societal setting within which policies were made. He summarized the suggestions of several policy analysts of the time for analytical criteria under five categories that were first proposed by Simeon (1976):

Broader context

This criterion provides information about availability of resources for policy implementation. Factors to consider include demographics, geography, level of urbanization and industrialization, and intergovernmental relationships.

Distribution of power

This criterion provides information about stakeholder influences on policy decision-making. Factors include interest group statements, corporate influences, citizen input, and government interests.

Ideas

This criterion provides information about societal assumptions regarding environmental problems and defines the range of plausible policy alternatives. Policy-maker consideration of (often conflicting) societal paradigms is what "puts the 'politics' into public policy" (Doern and Phidd, 1983 *in* Downey, 1987). Factors include societal values, perceptions, and beliefs; the level of citizen participation in the policy-making process; and the level of emphasis on economic growth.

Institutions

This criterion explores governmental impediments or supports for environmental policy-making. Factors include federal emphasis on centralization vs. decentralization, the governmental level responsible for environmental protection, partisan competition, how the state of the economy impacts governmental action, and business sector preferences for the role of government.

Policy process

This criterion helps to explain shifts in policies, the influence of the agendas and behaviors of decision-makers, and how the criteria above come together in policy development. Factors include how, and by whom, environmental problems are defined, the values and interests of those involved in policy-making, tactics and interactions during policy development, consideration of alternatives, and consequences of past decisions.

Downey (1987) concluded that in order for environmentalists to reach a position from which to determine necessary and possible policy changes, they must first perform a systematic policy analysis. The analysis should consider: 1.) the relative influence of the many policy determinants, and 2.) policy outcomes in relation to the economic, social, and political frameworks surrounding policy development. Following this process will provide understanding of why present policies were adopted, what alternatives may be plausible, and what conditions or actions may be necessary to achieve desired reforms.

In 1980, Rosenbaum developed a statutory structure assessment framework to analyze the potential success of implementing policies that involved a substantial change in bureaucratic routines, such as the transition from WRP to EEP. He applied the framework to the wetland impact permitting regulations of sixteen states, at the time when USACE's jurisdiction over wetlands was relatively new and wetland management decisions were still largely dependent upon state policies. The analysis assigned

quantitative values to two sets of variables, designed to evaluate two key components of statutory structure:

Specificity

This criterion is measured by the clarity vs. ambiguity of:

- The statement of statutory objectives and mandates,
- Legal geographic boundaries of the policy,
- Exemptions from the mandates, and
- Variables involved in the permit approval process, including project impacts on water quality, fish and wildlife, recreation, aesthetics, and natural hazard protections.

Enforceability

This criterion evaluates the likelihood of policy adherence, based on:

- Procedural requirements for review of relevant information, such as environmental impact statements and/or site plans, in permit decision-making,
- Mandatory requirements for mitigation of environmental impacts in the areas of water quality, fish and wildlife, recreation, and natural hazard protections,
- Severity of administrative penalties for non-compliance with permit specifications, and
- Maximum potential fine that could be levied through judicial action for non-compliance.

When analytical outcomes (the sum of the variable scores) were compared across the state policies, Rosenbaum (1980) found that most state statutes demonstrated good specificity in defining wetlands and protection goals but left penalties and mandatory mitigation requirements too vague to ensure enforceability of wetland policies.

MATERIALS AND METHODS

Analytical framework

Engler (2005) developed a policy analysis framework for state and regional wetland mitigation programs by expanding on the work of Bardach (2000). Designed to produce a “snapshot” of program status, Engler’s (2005) framework contained elements similar to those of both Rosenbaum (1980) and Downey (1987), providing a semi-quantitative method for evaluating social, economic, and scientific outcomes of the policy of interest. The analysis was formulated to “ensure the end goal of compensatory wetland/stream mitigation success” by determining “the success or failure of the [state or regional mitigation program] in light of programmatic goals, federal and state wetland mitigation mandates, scientific practice, and the successes and failures of other state wetland mitigation programs” (Engler, 2005). By comparing snapshots from different agencies or states, understanding can be gained about the most effective mitigation policies. By comparing snapshots of the same agency over time, changes in programmatic policies and activities can be evaluated.

The analytical framework consists of eleven criteria used to evaluate various elements of a wetland mitigation program. Engler (2005) developed formulas that yield a score in the range of 0 through 1 for each criterion. The criteria and associated formulas are:

1. **Efficiency:** a measure of overall program performance, as defined by the relationship between total mitigation output and total programmatic costs per fiscal year.
 - Mitigation output includes wetland or stream mitigation that was physically constructed (or secured, in the case of preservation) during the fiscal year.

$$\text{Equation 1: } \textit{Efficiency} = \left[1 - \frac{\textit{Total annual mitigation output}}{\textit{Total annual programmatic costs}} \right]$$

2. **Effectiveness-Stream:** a measure of the program's stream mitigation implementation in relation to the amount of related stream impacts during the fiscal year.

- Mitigation implementation includes completed projects.
- Although Engler's analysis involved only a mitigated linear feet to impacted linear feet ratio, the current analysis will divide mitigation totals by the appropriate current mitigation ratio for each mitigation type. For example, preservation mitigation totals will be divided by 5; restoration totals, by 2; etc. This will provide a better determination of whether or not EEP is meeting mitigation requirements and associated assumed functional replacement.

$$\text{Equation 2: Stream Effectiveness} = \frac{\text{Annual stream mitigation units completed}}{\text{Annual stream impact incurred}}$$

3. **Effectiveness-Wetland:** a measure of the program's wetland mitigation implementation in relation to the amount of related wetland impacts during the fiscal year.

- Mitigation implementation includes completed projects.
- As for stream effectiveness, the current analysis will divide wetland mitigation acreage totals by the current mitigation ratio required for each mitigation type.

$$\text{Equation 3: Wetland Effectiveness} = \frac{\text{Annual wetland mitigation units completed}}{\text{Annual wetland impact incurred}}$$

4. **Adaptability (inclusion of current science):** a measure of the inherent ability of the program to incorporate the best available mitigation science into its operations. This criterion involves evaluation of five equally weighted sub-criteria:

- **A₁**: A means to observe accepted wetland resource mitigation practices, whether this is an internal scientific advisory board or established relationships with respected professionals in the field.
- **A₂**: Formal recommendations provided from internal scientific review groups on a regular basis (at least annually).
- **A₃**: Annual review of the scientific advisory team or professionals' recommendations by program staff for potential acceptance and program inclusion.
- **A₄**: Contribution to local, regional, or national mitigation forums or conferences for peer feedback and response.
- **A₅**: Other means to review mitigation practices on a regular basis.

The presence of a programmatic mechanism or activity meeting a sub-criterion earns a score of 0.2, while lack thereof earns 0. The total adaptability score is the sum of the sub-criteria values.

$$\text{Equation 4: } \textit{Adaptability} = \sum_{i=1}^5 A_i$$

5. **Transparency**: a measure of public review, comment, and response mechanisms. This criterion involves evaluation of four equally weighted sub-criteria:

- **T₁**: Regular reporting (at least twice annually).
- **T₂**: Report format derived from public input and programmatic requirements.
- **T₃**: Public review and comment window after report release.
- **T₄**: Report consistency.

The presence of a programmatic mechanism or activity meeting a sub-criterion earns a score of 0.25, while lack thereof earns 0. The total transparency score is the sum of the sub-criteria values.

$$\text{Equation 5: } Transparency = \sum_{i=1}^4 T_i$$

6. **Stakeholder acceptability:** a measure of ease of program implementation, based on its fit within the current regulatory structure, institutional setting, and atmosphere of the affected community.

$$\text{Equation 6: } Stakeholder\ Acceptability = \frac{Positive\ views}{Total\ views}$$

7. **Inter-group coordination:** a measure of the level of commitment, as evidenced by legal documents or regulations, demonstrated by the parties contributing to meeting mitigation goals. Scoring is based on three tiers:

$$\text{Equation 7: } Inter - group\ Coordination = \begin{cases} No\ formal\ agreement \rightarrow 0 \\ A\ legal\ document\ has\ been\ signed \rightarrow 0.5 \\ Regulation\ promulgation \rightarrow 1 \end{cases}$$

8. **Financial stability:** a measure of long-term funding security, based on the number of funding sources and the relative distribution of financial support.

Equation 8: Considering all program funders (1,2,3,...,x):

$$Financial\ Stability = \frac{\sum_{i=1}^x (Contribution\ \% \text{ difference from biggest funder})_i}{Total\ number\ of\ funders,\ x}$$

9. **Watershed planning:** a measure of the programmatic incorporation of state or local level watershed planning into mitigation decision-making. Scoring is based on three tiers:

$$\text{Equation 9: Watershed Planning} = \begin{cases} \text{Watershed planning is not part of the program} \rightarrow 0 \\ \text{Watershed planning is partially implemented} \rightarrow 0.5 \\ \text{Watershed planning is well-established} \rightarrow 1 \end{cases}$$

10. **Long-term monitoring:** a measure of the importance placed on mitigation maintenance and monitoring, as compared with the federal minimum requirement.

$$\text{Equation 10: Long-term Monitoring} = \frac{(\text{Years per program}) - (\text{Years per regulations})}{\text{Years per regulations}}$$

11. **Wetland success:** a measure of achievement of replacing, through mitigation, the ecological functions lost from impacted wetlands and streams.

- Components of interest include performance during mitigation wetland development, time to maturity of mitigation projects, and a comparison of the functional value of the impacted and mitigation wetlands.
- This criterion was not evaluated by Engler (2005), nor will it be part of the current analysis, due to a lack of necessary methodology and data. However, functional assessment methods are under development that will allow this criterion to be evaluated in future analyses.
- The information needed for this type of evaluation will generally be collected on a site- or project-specific basis, then aggregated for program evaluation.

Evaluation of EEP

Engler (2005) utilized the framework's eleven program evaluation criteria to analyze the performance of the fledgling EEP. Evaluation during the first year of EEP's transition

period found the program to be successful in the areas of reporting mechanisms, group participation, and watershed planning, but needing improvement in the areas of financial stability, transparency, and commitment to long-term monitoring (Engler, 2005). To meet this study's objectives, Engler's (2005) analytical framework was customized for the Tar-Pamlico River basin. Basin-specific data and information were used to evaluate each criterion, except where such data could not be extracted from statewide totals. The policy analysis focused on mitigation coordinated through EEP.

Data Collection

A literature review was performed to gather relevant information about wetland functions and values, regulations and permitting procedures, the efficacy of various methods for wetland functionality and restoration success evaluation, the applicability of environmental policy analysis methods to wetland management programs, and the characteristics of wetlands within the Tar-Pamlico River basin. Informational interviews were conducted with staff of the agencies listed below to determine regulatory processes and issues of concern in regard to North Carolina wetland management, in addition to historical and present evaluation methods and mitigation status:

- North Carolina Department of Environment and Natural Resources (NCDENR), Division of Water Quality (DWQ), Surface Water Protection Section, Wetlands and Stormwater Branch;
- Ecosystem Enhancement Program (EEP);
- United States Army Corps of Engineers (USACE), Wilmington Regulatory Division, Washington field office;
- Pamlico-Tar River Foundation (PTRF); and
- Environmental Defense (ED), North Carolina regional office.

Data were compiled from EEP annual (EEP, 2005c) and quarterly (EEP, 2004; EEP, 2005d; EEP, 2006d) reports from July, 2003 through March, 2006, and from Tar-Pamlico River basin specific information queried from EEP mitigation spreadsheets and project tracking database by EEP staff (J. Stanfill, personal communication, July 26,

2006; C. Kiley, personal communication, September 13, 2006). EEP data grouped initial impacts into the categories warm, cool, or cold stream; riparian wetland; non-riparian wetland; and coastal marsh. Completed mitigation was grouped into stream (warm, cool, or cold), riverine, nonriverine, and coastal marsh restoration, enhancement (I or II), creation, or preservation. Buffer impacts and mitigation were also separate categories. The majority of USACE permits (general and nationwide permit types) do not require public notice; therefore, data associated with permitted projects is not accessible without a significant amount of paperwork, time, and administrative fees. However, supplemental information on the specific types (i.e. pocosin, bottomland swamp, etc.) and locations of wetlands impacted was gleaned from public notices issued as part of the application process for the few projects requiring an individual permit from USACE. Since proposed impacts are often reduced through the USACE review and permitting process, the wetland acreage and stream footage values from EEP databases were taken as the actual impacts.

A Microsoft Access database was utilized to consolidate EEP project data from the various sources. The most recent set of data sufficient for analysis with Engler's (2005) framework was from fiscal year 2004 (FY2004) which covers the range of dates from July 1, 2004 through June 30, 2005. FY2004 was the second year of EEP's transition period, marking the end of the initial focus on securing preservation to "catch up" on mitigation requirements, and movement toward a greater emphasis on restoration, enhancement, and creation projects. Comparison with Engler's (2005) results for FY2003 provided an indication of EEP's progress over time.

Supplemental data collection

In addition to policy analysis with Engler's (2005) framework, data about additional impacts permitted by NCDENR-DWQ and USACE were also compiled to complete the discussion of wetland policy performance in the state. Data queries of the DWQ Basinwide Information Management System (BIMS) database focused on small unmitigated impacts to wetlands, streams, and riparian buffers to allow estimation of cumulative effects of impacts below regulatory area thresholds in the Tar-Pamlico basin.

RESULTS AND DISCUSSION

Policy Analysis Framework

Engler's (2005) FY2003 analysis evaluated EEP's performance in the entire state of North Carolina, and the current FY2004 analysis focused on the Tar-Pamlico river basin. While the analyses were not identical, comparison of the two sets of results yields a measure of the program's change over time (Table 2). It is likely that EEP activities and results do not vary vastly from one basin to another, and many criteria are shared by all NC basins. An assumption can be made that EEP's FY2004 performance in the Tar-Pamlico basin was similar to its overall statewide performance; therefore, increases or decreases in criterion scores indicate areas of programmatic performance improvement or decline, respectively. The discussion covers the data and reasoning behind the criterion ratings, areas in which EEP has shown improvement, and suggestions for further program enhancements. Emerging issues in the field of wetland mitigation regulation were highlighted during the analysis. These are discussed at greater length after the review of analytical results.

Table 2: Comparison of FY2003 and FY2004 results.

<i>Criteria</i>	<i>FY2003</i>	<i>FY2004</i>
Efficiency	0.99	1.0
Effectiveness-Stream	0.31	1.0
Effectiveness-Wetland	1.0	0.66
Adaptability	0.4	0.8
Transparency	0.25	1.0
Stakeholder Acceptability	0.5	0.63
Inter-group Coordination	0.5	0.5
Financial Stability	0.48	0.44
Watershed Planning*	0.66	1.0
Long-term Monitoring	0	0
Wetland Success	N/A	N/A
Total	5.1	7.0

*If evaluated as in the current analysis, the FY2003 (Engler, 2005) watershed planning score would have been 1.0; points were deducted because NCDOT did not utilize watershed planning in siting of transportation projects, but this factor was not specified in the criterion evaluation procedure.

Efficiency

Efficiency was difficult to customize for the Tar-Pamlico basin because EEP MOA program expenditures, such as overhead & administrative costs, were not divided by basin. To achieve an idea of efficiency within the basin, the MOU In-Lieu Fee (ILF) program was evaluated for cost to client vs. amount of mitigation achieved.

$$\text{Efficiency} = \left[1 - \frac{\text{Total annual mitigation output}}{\text{Total annual programmatic costs}} \right] = \left[1 - \frac{5.96 \text{ mitigation units}}{\$133141} \right] > 0.99$$

As in Engler's (2005) analysis, EEP achieved an extremely high efficiency score, indicating a high level of mitigation accomplishment per unit of program operating cost. Efficiency, in general, is a criterion of questionable informative value. While it can express the relativity of program successes to costs, it can also misrepresent the output of a program with extremely high or low output or expenditures. As Engler (2005) notes, the efficiency value could be misleading and should be considered in the context of the other ratings, especially Effectiveness.

However, increasing the efficiency of wetland mitigation within North Carolina was one of the factors supporting development of EEP (NCDENR, *et al.*, 2002), and it is considered to be a major improvement over other mitigation processes. Its efficiency is elevated due to several factors, which lower costs as compared with a traditional private mitigation bank (Kenny, 2005):

- Partnering with other agencies, such as land trusts and consulting companies,
- Focusing on large projects to address cumulative impacts, and
- Spending caps provided by its status as a governmental entity.

Recommendation: *EEP is currently successful in achieving cost-efficient mitigation, primarily through high-quality preservation. Future analyses should continue to consider this criterion in light of mitigation effectiveness, and recognize that it may*

become more difficult for EEP to accomplish mitigation at the same cost as the program's focus shifts to restoration and creation projects.

Effectiveness-Stream

$$\text{Effectiveness} - \text{Stream} = \frac{\text{Annual stream mitigation completed}}{\text{Annual stream impact incurred}} = \frac{5534.9 \text{ mitigation units}}{1715 \text{ linear feet}} > 1$$

When the total linear feet of mitigation completed was compared with stream losses, EEP scored > 1 in the stream effectiveness category. When mitigation totals were first divided by current mitigation ratios, the stream effectiveness score remained greater than 1, indicating that excess stream mitigation credits were generated that will be available to apply to future impacts. This is certainly an EEP accomplishment to be applauded.

The concern, however, is that the vast majority of stream mitigation during FY2004 was accomplished via preservation (Table 3). Pros and cons of preservation as mitigation are explored later in the discussion. Based on the EEP MOA (NCDENR, *et al.*, 2003), high-quality preservation was expected to be a major focal point of mitigation activities during the two-year transitional period following start-up of the new agency.

Table 3: EEP FY2004 projects in the Tar-Pamlico river basin.

HUC-8	County	EEP Project	Project Type	Project Status	Stream Restoration (feet)	Stream Enhancement (feet)	Stream Preservation (feet)	Riverine Preservation (acres)	Nonriverine Preservation (acres)	Coastal Marsh Preservation (acres)
03020101	Franklin	Cypress Creek (Langley)	HQP Wetland/Stream	Easement acquired			1459	19.72		
03020101	Granville	(Guthrie/Shelton Creek)	HQP Stream	Easement acquired			7850			
03020101	Franklin	Swift Creek (O'Neal-Sandy)	HQP Wetland/Stream	Easement acquired			775	4		
03020101	Franklin	Swift Creek (Harper-Sandy)	HQP Stream	Easement acquired			2300			
03020101		Billy's Creek	Stream (non-HQP)	Monitoring (Year 1)	1901	200				2.6
03020102		Fishing Creek (Lynn Capps)	HQP Stream	Easement acquired			3300			
03020102	Franklin	Shocco Creek (Lester Capps)	HQP Stream	Easement acquired			1506			
03020102	Franklin/Warren	Little Shocco (O'Neal)	HQP Wetland/Stream	Easement acquired			1770		2.3	
03020101		Little Shocco Creek (Shocco Creek LLC)	HQP Stream	Easement acquired						
03020101	Granville	Shelton Creek (Tucker-Daniels 2)	HQP Stream	Easement acquired			907			
03020102	Granville	Shelton Creek (Peterson)	HQP Stream	Easement acquired			2555			
TOTALS: Mitigation Units:					1901	200	22422	23.72	2.3	2.6
					950.5	100	4484.4	4.744	0.46	0.52

Recommendation: *It is recommended that this type of environmental policy analysis be performed annually to verify the movement of EEP productivity toward restoration and enhancement over the timeframe following FY2004-2005.*

Effectiveness-Wetland

$$\text{Effectiveness - Wetland} = \frac{\text{Annual wetland mitigation completed}}{\text{Annual wetland impact incurred}} = \frac{5.72 \text{ mitigation units}}{8.63 \text{ acres}} = 0.66$$

When the total acreage of mitigation completed was compared with wetland losses, EEP scored > 1 in the wetland effectiveness category. However, when mitigation totals were first divided by current mitigation ratios, wetland effectiveness dropped to 0.66, indicating that while mitigation maintained NNL of wetland area in FY2004, it may not have maintained NNL of wetland functionality. This is a critical issue in wetland management, and indicates both the failure of mitigation ratios as proxies for functional replacement of impacted wetlands, and the necessity for inclusion of functional assessment methodology in determining mitigation requirements. Additionally, all of the wetland mitigation completed in the Tar-Pamlico basin during FY2004 was preservation (Table 3). The arguments and suggestions discussed in regard to stream preservation mitigation apply to wetlands, as well.

Recommendation: *It is critical that functional assessment methods, rather than generic mitigation ratios, be incorporated into evaluation of stream and wetland impacts and mitigation projects.*

Adaptability

$$\text{Adaptability} = \sum_{i=1}^5 A_i = (0.2 + 0.2 + 0.2 + 0.2 + 0) = 0.8$$

The concept of adaptive management should be applied to policies guiding wetland mitigation activities. As the science of ecological mitigation methods develops and improves, mitigation programs must have mechanisms to incorporate these advances in order to maximize replacement of lost wetland functions. Engler's (2005) framework

includes five sub-criteria to evaluate this criterion. During FY2003, EEP's processes included two of the five, earning a score of 0.4:

- The means to observe accepted mitigation practices through an internal scientific advisory board, and
- The use of formal recommendations provided from internal scientific review groups.

In FY2004, EEP met four of the five, and the rating increased to 0.8. Evaluation of this criterion was largely dependent upon the Program Assessment and Consistency Group (PACG) component of EEP operational structure. Additional considerations were EEP activity in the broader field of mitigation, and cooperative efforts with local research institutes.

Scores for individual sub-criteria:

A₁: *A means to observe accepted wetland resource mitigation practices, whether this is an internal scientific advisory board or established relationships with respected professionals in the field.*

This sub-criterion scored 0.2 due to the EEP programmatic component Program Assessment and Consistency Group (PACG). EEP utilizes input from PACG to guide operational development. According to EEP staff (B. Satler, personal communication, June 8, 2006), this advisory council is a big part of the EEP program, providing guidance for decision-making on specific problems and holistic review of EEP projects. Members of the PACG include representatives from various divisions of NCDENR and EPA, the NC Wildlife Resources Commission, USFWS, and the National Oceanic and Atmospheric Administration (NOAA). This group considers the current science of mitigation, as well as policy and regulatory issues, in evaluating and making recommendations for EEP operations. According to the PACG roster (EEP, 2005), "Key objectives of the PACG are to:

- Identify, prioritize and address issues.
- Provide guidance to EEP for standards and procedures.
- Evaluate the program and recommend actions.
- Identify streamlining actions and process improvements for all participants, and
- Identify partnering opportunities, and frame technical research that will support program objectives.”

EEP also solicits input from, and works at partnering with, stakeholders through its Liaison Council, comprised of representatives from diverse groups including The Nature Conservancy, the NC Natural Heritage Program, the Clean Water Management Trust Fund, and the Coastal Land Trust.

A₂: *Formal recommendations provided from internal scientific review groups on a regular basis (at least annually).*

This sub-criterion scored 0.2 based on regularly scheduled PACG meetings and reporting requirements. PACG meetings occur quarterly and interim communication about EEP activities is conducted via email and online posting of information. PACG receives the same quarterly reports as USACE. Updates on EEP operations are provided to the Liaison Council two to three times per year. These updates are presented at open meetings, where stakeholders have the opportunity to provide feedback.

A₃: *Annual review of the scientific advisory team or professionals' recommendations by program staff for potential acceptance and program inclusion.*

This sub-criterion scored 0.2 due to the reciprocal, ongoing nature of EEP-PACG communication (NCDENR, *et al.*, 2003), and the involvement of EEP's Executive Director, Bill Gilmore, as a member of the PACG (EEP, 2005a). EEP presents PACG with information about potential projects within each watershed, then PACG provides

recommendations on mitigation site selection. EEP is responsible for taking PACG site selection criteria suggestions into account, and for submitting mitigation site plans and monitoring reports to PACG for review.

A₄: *Contribution to local, regional, or national mitigation forums or conferences for peer feedback and response.*

This sub-criterion scored 0.2 due to presentations by three EEP staff members at the National Mitigation Banking conference in Charlotte, NC in April, 2005 (EEP, 2005b).

A₅: *Other means to review mitigation practices on a regular basis.*

This sub-criterion scored 0 because it is not apparent that EEP has other regularly scheduled means of reviewing current mitigation practices. However, there is evidence that the agency initiates cooperative efforts with universities and other research institutions. In FY2004, EEP contracted a University of North Carolina at Wilmington study (slated for completion at the end of 2006) to examine the biophysical and economic factors involved in mitigation costs. EEP also partnered with Research Triangle Institute (RTI) International to develop a Policy, Process, and Procedures Manual (PPPM, in development) according to ISO 9001-2000 standards.

Recommendation: *It is recommended that EEP continue to enhance its partnering initiatives and take advantage of the many environmental research opportunities available in North Carolina.*

Transparency

$$\text{Transparency} = \sum_{i=1}^4 T_i = (0.25 + 0.25 + 0.25 + 0.25) = 1$$

Scores for individual sub-criteria:

T₁: Regular reporting (at least twice annually).

This sub-criterion scored 0.25 due to quarterly and annual reports on EEP activities that are provided to USACE, PACG (NCDENR, *et al.*, 2003), and are publicly available on the EEP website (EEP, 2006c).

T₂: Report format derived from public input and programmatic requirements.

This sub-criterion scored 0.25 because:

- Stakeholder input on reporting format improvements was continually solicited through the website (EEP, 2006b),
- Stakeholder input was considered in developing the reporting formats currently in use (EEP, 2006b; B. Satler, personal communication, June 8, 2006), and
- Reports included the data required for reporting to USACE per the EEP MOA (NCDENR, *et al.*, 2003).

T₃: Public review and comment window after report release.

This sub-criterion scored 0.25. Reports were released to the public for review (EEP, 2006c). While past reports were not modified based on public comments, the format of future reports took comments into account.

T₄: Report consistency.

This sub-criterion scored 0.25 because reporting formats have generally become standardized, so trends over time can be assessed.

Since scoring low in transparency in FY2003 (Engler, 2005), meeting only one of four criterion components during its first year of operation, EEP has strived to increase transparency. The last three sub-criteria scores indicate improvement in transparency

from FY2004 through FY2005. Standardization of reporting formats was extremely important because it will allow for analyses like this to be repeated on a regular (i.e. annual) basis to evaluate EEP's progress as it develops beyond the transition period. However, although EEP scored 1 based on Engler's (2005) framework, the synthesis of mitigation project data is still challenging. Necessary information is scattered between several different tables and report sections, making it difficult to piece together the program's performance outcomes.

It should be acknowledged that, as with everything else related to wetlands, the EEP system is complicated. The process of targeting local watersheds leads to a lot of projects in EEP's database that are exploratory in nature. Ecologically, this method maximizes mitigation benefits by allowing larger projects to meet multiple mitigation requirements, and it helps to maintain connectivity of wetlands within each watershed. However, due to the process of exploring the feasibility of all possible mitigation sites, the snapshot of projects and their status may change substantially over time. Finding a compact way to express current status without promoting expectations for projects that might eventually be determined unviable is difficult.

Recommendation: *EEP should work toward developing a reporting structure that makes obvious the chain of events from permitting → mitigation requirements → mitigation projects → long-term monitoring of project success. Some suggestions are:*

- *For established projects in the design, construction, or monitoring stages, lists of the permit numbers, impact quantities, and mitigation requirements being met by the projects could be included in project descriptions, which are available on the EEP website.*
- *A parallel list of permit numbers, watershed of impact, associated EEP mitigation responsibilities, and the mitigation project(s) meeting the requirements could be presented in a format similar to Appendix C (Compensatory Mitigation Payments & Requirements) in the EEP 2004-2005 Annual Report (EEP, 2005c). This could be accomplished with slight modifications and additions to the Appendix F tables*

in the quarterly reports to USACE (EEP, 2006d) which are made available to the public online.

Stakeholder Acceptability

$$\text{Stakeholder Acceptability} = \frac{\text{Positive views}}{\text{Total views}} = \frac{5}{8} = 0.625$$

This criterion was primarily based on published stakeholder opinions regarding EEP activities in the Tar-Pamlico basin during FY2004. The limited available sample size was supplemented with statewide, programmatic, and slightly more recent comments to include a broader range of stakeholders. Stakeholder opinions were collected from landowners, area residents, advocacy groups, land trusts, mitigation contractors, and transportation researchers. The collected comments concerned economics, ecological effectiveness, policy, and partnering related to EEP.

Proponents: Land trusts, creative governance awards

EEP has been lauded by land trusts because of its enormous contribution toward preservation during the transition period. In a Franklin Times article (Johnson, 2005), a Tar River Land Conservancy (TRLIC) representative discussed EEP projects in Warren, Franklin, and Granville counties. TRLIC concerns included stability of state funding and slowing of preservation activity once mitigation catches up with needs projections, but overall land trusts were thrilled with the boost in preservation funding provided during EEP's transition period.

The Center for Transportation and the Environment (CTE) reported EEP's selection for a 2005 Innovations in American Government Award by the Ash Institute for Democratic Governance and Innovation at Harvard University's Kennedy School of Government and the Council for Excellence in Government of Washington, DC (McDermott, 2005).

Mixed reviews: Citizens, mitigation contractors

An Ecosystem Marketplace (Kenny, 2005) report details comments from mitigation bank contractors. Jim Buck of Buck Engineering cites major accomplishments of EEP during its initial phases, and expresses that the EEP process leads to prompter payment of contractors than traditional methods of mitigation banking. George Kelly of Environmental Banc & Exchange (EBX) dislikes EEP's "constrained market approach" but feels that it is better to have EEP in place than to not. Problems cited by mitigation contractors include market limitations imposed by EEP's preselection of preferred mitigation sites, ceilings on contract amounts, and concentration of mitigation through a single state agency. They also voice concerns that tight budgets could impact project quality.

Citizens impacted by restoration projects returned split opinions. The Raleigh News & Observer (Masakadza, 2004; Wise, 2005) ran articles chronicling the restoration of Third Fork Creek in Forest Hills Park in Durham, NC. Many residents supported the restoration and felt that the project would improve water quality; others felt that the newly planted vegetation disturbed the open view of the park and questioned project quality.

Concerns: Environmental groups, regulators

Advocacy groups are generally supportive of the concepts upon which EEP is based, such as focusing on watershed health and improving mitigation quality and effectiveness, but are cautious about trusting that the agency can handle the workload. ED and PTRF are two groups that have commissioned interns to perform outside evaluation of EEP during its early phases. They feel that EEP could provide a clearer picture of its overall accomplishments and that the agency should be open about any struggles to meet mitigation requirements so that they can be addressed. Advocacy groups are fully supportive of EEP receiving and utilizing whatever assets are necessary to meet the goals of NNL. As previously mentioned, a specific area of concern involves the use of preservation as a mitigation tool.

Members of the NC regulatory community are waiting for EEP to prove itself in keeping up with mitigation needs over the coming years. Since there has not been enough time since EEP's inception for construction of many projects to be completed, EEP's success cannot yet be fully evaluated. There is concern that the agency will be overwhelmed by mitigation demands as WRP was.

There is a growing recognition that stakeholder synthesis of environmental program data will help agencies to meet accountability expectations, and that transparency of information will enhance public perception and trust of mitigation programs under governmental oversight. Brouwer, et al. (2003) note that, among other benefits, "socially and politically sensitized forms of integrated assessment are an important step towards...increasing awareness about the complex nature of the interdependency between our physical and socially constructed environment" and "increasing public support for and trust in decisions because of greater transparency in the ex ante evaluation phase." Greater availability of information will lead to deeper levels of public understanding about the intricacies and importance of wetlands, which could broaden support for their protection.

Recommendation: *Essential actions for EEP to enhance stakeholder support are: 1.) to continue toward full disclosure of program responsibilities, activities, and outcomes; and 2.) to maintain providing high-quality mitigation products as the primary programmatic focus.*

Inter-group Coordination

Inter – group Coordination = A legal document (MOA) has been signed → 0.5

The EEP MOA is a formal agreement between NCDENR, NCDOT, and USACE, but it is not an act of North Carolina legislature (NCDENR, *et al.*, 2003). The score for this criterion remained 0.5, the same rating received in FY2003. The only way for EEP to improve would be to formalize the MOA and MOU as acts of North Carolina legislature. Engler (2005) predicted that this would improve program performance by placing legal

pressure on each of the partners. Inadequate enforcement authority has been cited as a major contributor to ineffective outcomes of ambitious environmental statutes (Rosenbaum, 1980). On the other hand, adding another layer of bureaucracy could inhibit success by distancing EEP from stakeholders and distracting from the program focus on mitigation. Bardach (1998) cautions against “heavy-handed regulation as [a] primary programmatic method” for implementing environmental policies (p.101) and acknowledges the difficulties of consensus building between regulators and regulated parties.

Recommendation: *Since mitigation is already legally enforceable through USACE, creating an act of NC legislature to enforce the EEP MOA and MOU should be reserved until program evaluation indicates that greater enforcement may be necessary to ensure mitigation success.*

Financial Stability

$$\text{Financial Stability} = \frac{\sum_{i=1}^x (\text{Contribution \% difference from biggest funder})_i}{\text{Total number of funders, } x} = \frac{3.95}{7} = 0.44$$

The score of 0.44 for financial stability was similar to Engler’s (2005) FY2003 result because the majority of funding still came from NCDOT (Figure 5). Diversification of funding sources is unlikely because NCDOT is EEP’s primary client. Meeting NCDOT mitigation needs is the main reason that the program exists, and thus it would actually be inappropriate for substantial funding to come from anywhere else. Due to the nature of EEP’s operations and priorities, it will be difficult to improve this score under Engler’s (2005) framework, as structured.

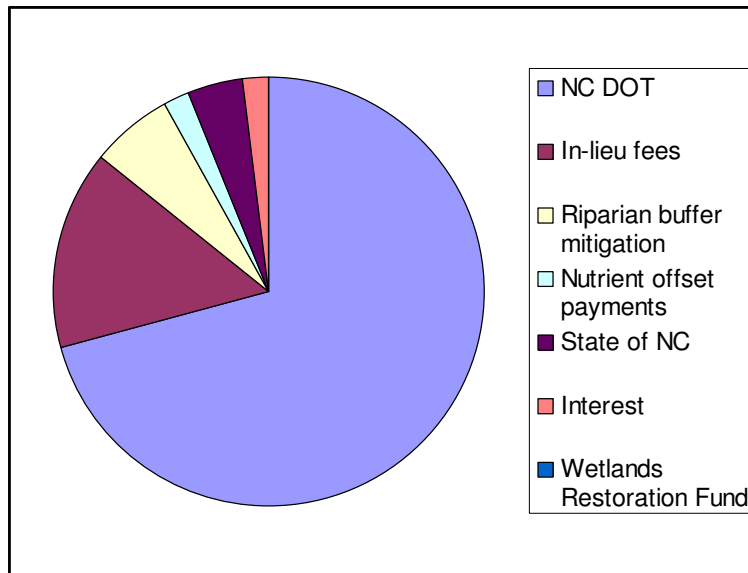


Figure 5: EEP FY2004 funding sources.

It may be useful to include a weighting structure in future analyses, based on the stability of each source of financing. For example, NCDOT's long-term planning horizon allows for a more stable governmental mechanism to ensure longevity. In contrast, in-lieu fees will generally be paid only at the outset of the mitigation process, not for long-term monitoring, and nutrient offset payment amounts have been changed repeatedly by the legislature, indicating less reliability in predicted revenues from these sources.

The National Research Council (2001) suggested that "to ensure the replacement of lost wetland functions, there should be effective legal and financial assurances for long-term site sustainability of all compensatory wetland projects" (p.139). The real concern behind this criterion is ensuring long-term monitoring capabilities. There may be endowment possibilities, such as an NCDOT trust fund, that could be established to guarantee funding for monitoring when road construction slows in the future.

Recommendation: *It is recommended that EEP develop funding mechanisms, such as the NCDENR-proposed Conservation Grant Fund Endowment (Gilmore, 2006), to guarantee long-term monitoring capabilities.*

Watershed Planning

Watershed Planning = Watershed planning is well – established → 1

Multi-level watershed planning is integral to EEP. Development projections, resource value, restoration need, partnering opportunities, water quality, and habitat issues are assessed through DWQ's Basinwide Water Quality Plans and EEP's Local Watershed Planning system to identify and prioritize potential mitigation sites at basin, cataloging unit (HUC-8), and local watershed (HUC-14) levels (EEP, 2006e). As Engler (2005, p.29) noted, "watershed planning is an expensive and time consuming undertaking," and one that is critical for effective mitigation planning and implementation. EEP has incorporated this programmatic component, and continues to achieve the highest possible score in this category. EEP updates Targeted Local Watershed Plans annually to guide placement of mitigation efforts. Directing mitigation based on a watershed planning perspective is a relatively new movement, but one that is gaining momentum within the field of wetland management. This movement will be explored later in the discussion.

Recommendation: Engler (2005) noted that DWQ and EEP watershed plans are not utilized in guiding placement of new development toward areas yielding the least environmental damage. This type of process would be complex, involving multiple land use issues, including property rights and economic impacts, and federal and state regulations, including NEPA and SEPA. At whatever level would be feasible, the concept of applying a watershed approach to infrastructure and development siting merits consideration for urban planning within North Carolina in order to reduce wetland impacts.

Long-term Monitoring

$$\text{Long – term Monitoring} = \frac{(\text{Years per program}) - (\text{Years per regulations})}{\text{Years per regulations}} = \frac{(5 - 5)}{5} = 0$$

At time of Engler's (2005) analysis, EEP met the federal requirements of five years of monitoring after project implementation. During FY2004, the five-year monitoring timeframe was still met. According to the MOA (NCDENR, *et al.*, 2003), monitoring is conducted at least annually, for a minimum of five years, until site performance criteria for functionality are met. Monitoring of preservation sites, already functional wetlands, is performed at least annually through contracts with land trusts and other groups (B. Satler, personal communication, June 8, 2006) to guard against infringement on the site or interference with nature.

Recommendations: *It is recommended that EEP allocate staff and funds, as necessary, to increase the frequency and duration of both monitoring and management of mitigation sites into perpetuity, or until long-term ecosystem stability warrants decreasing these activities. This recommendation is based on recognition that:*

- *Restored and created wetlands often take significantly longer than five years to develop full wetland functionality,*
- *There is a need for data contribution to the evolving field of optimizing wetland mitigation methods, and*
- *All mitigation sites, including preservation, may require ecosystem management to maintain wetland functions over time.*

Wetland Success

True mitigation success entails functional replacement of lost wetlands and streams. Evaluating this criterion would require a method for comparing the functionality of an impacted wetland with the functionality of the corresponding mitigation site. Potential methods for use in future analyses will be explored later in the discussion.

Since a functional assessment method has not yet been incorporated into EEP procedures, current success evaluation is based primarily on site geomorphic stability, hydrology, and vegetation density at a mitigation site after five years of monitoring

(EEP, 2005c). Hydrologic conditions are expected to meet or exceed the USACE wetland criteria of saturation or inundation during 12.5% of the growing season (Environmental Laboratory, 1987), and 260 trees per acre must have survived the five years since planting. Monitoring data from restored and created wetlands and streams are also compared with data collected at relatively undisturbed reference sites of the same type (Rummel, Klepper & Kahl, 2006). Additional intensive data collection at mitigation sites is currently underway to support development of a functional assessment method for future projects (EEP, 2005e).

An area of concern with the current hydrologic criteria is the lack of an upper limit on inundation. Due to the “wetter is better” philosophy, there is a tendency for mitigation wetlands to display longer periods of saturation than natural wetlands. Through permitted losses and mitigation, a shift is occurring towards greater numbers of ponds and fewer vegetated wetlands, which may indicate a change in overall wetland functionality (Cole and Brooks, 2000; Balcombe, *et al.*, 2005).

Recommendation: *A functional assessment method needs to be developed and standardized for use by USACE and NCDENR-DWQ in evaluating impacts and assigning mitigation requirements and by EEP in evaluating mitigation project success.*

Supplemental Data Analysis

Data queried from the NCDENR-DWQ BIMS database provided information about permitted losses for projects impacts under the threshold values of 150 linear feet of stream or 1 acre of wetland area (40 linear feet or 1/3 acre for classes of streams and wetlands, respectively, with high ecological value). Also included in the query were data regarding projects for which mitigation was not required at standard mitigation ratios, including requirements in excess of standard ratios. Cumulative losses are summarized in Table 4.

Table 4: Permitted losses in the Tar-Pamlico basin during FY2004.

<i>County</i>	<i>wetland (ac.)</i>	<i>stream (ft.)</i>	<i>open water (ac.)</i>
Edgecombe	2.037	145	0.404
Franklin	0.025	229	10.0338
Nash	0.34	30	0.022
Beaufort	4.768	462	0.3
Hyde	0.18	42.5	0.921
Pitt	0.79	19.5	0
Halifax*	-13.4984	132	0.403
Warren	0	227	0
Vance	0.01	235	0
Granville	0.666	339.5	0
Totals:	-4.6824	1861.5	12.0838

* Without the excess mitigation project, Halifax County would have lost 1.9846 wetland acres, bringing the total lost to 10.8006 acres.

It is difficult to quantify the cumulative functional impact of small wetland losses. Loss of a small area within a large, ecologically healthy wetland will likely not yield a significant change in wetland services within a river basin. However, destruction of a small geographically isolated wetland could be catastrophic to local wetland-dependent species of wildlife and vegetation if it is the only feature on the landscape providing wetland services (Leibowitz, 2003). Assessment of functions on a case-by-case basis is necessary to ensure that small permitted losses do not produce dramatic effects on basin-wide wetland functionality. USEPA (2001) highlights the importance of master planning and zoning ordinances in protecting wetlands from urban sprawl development, noting that “filling in one acre of wetlands may not seem significant, but the cumulative effect of filling in hundreds of one-acre wetlands affects entire watersheds – including the people, plants, and animals that live in them – and the quality and quantity of our water resources.”

Emerging Issues in Wetland Regulation

Preservation as mitigation

There is debate among the environmental community about the use of preservation as a mitigation tool. Opponents argue that it does not contribute to NNL objectives because it does not add stream linear feet or wetland acreage to the global total to compensate for corresponding permitted losses (D. McNaught, personal

communication, June 5, 2006). Proponents counter that preservation protects streams and wetlands from future impacts, especially when applied in areas threatened by development pressure. Preservation may be critical in the long term because natural systems generally function better than created streams and wetlands, and are important in maintaining ecological connectivity. The National Research Council (2001, drawn from Gardner, 2000) explains

“Preservation might not appear to offset the permitted loss to the wetland acreage base in the short-term. However, when the goal of a wetland program is viewed from a watershed perspective over a long period, the purpose is to secure a desired matrix of wetland types and locations to achieve the goals of the CWA in the watershed. If, in the future, certain wetlands deemed central to that goal might be compromised, purchase and protection of those wetlands as part of a compensation package might be warranted.”

Exclusive focus on preservation for mitigation will not meet federal and state goals of “no net loss” and increasing wetland area and functions. While preservation will prove valuable by protecting wetlands from development in the future, a combination of mitigation types is likely the best course of action for maintaining wetland functionality.

Watershed planning approach

Historically, there has been a preference among regulatory agencies for wetland mitigation to be completed on-site and in-kind, meaning that mitigation should take place as close as possible to, and yield the same wetland type as, the impact site.

Watershed approach recommendations and pros

In 1996, USEPA released guidance on using a watershed approach for “effectively protecting and restoring aquatic ecosystems and protecting human health” (USEPA, 2006e) and to “prevent pollution, achieve and sustain environmental improvements and meet other goals important to the community” (USEPA, 2006c) through the following framework (*Ibid.*, unless noted):

1. **Partnerships**

- Involvement of stakeholders is a key factor in ensuring that bureaucratic decision-making yields successful environmental results and meets local economic, social, and cultural goals.
- Partnering fosters communication and cooperation between all of the parties with an interest in the natural resources of the watershed, addresses environmental justice issues, and encourages adoption of pollution prevention techniques.

2. **Geographic Focus**

- The geographic scale of watershed planning can vary. Local governments may focus on small watersheds, while state-level planning may consider large river basins.
- The “nested” nature of watersheds within basins lends itself to multi-level watershed planning (USEPA, 2006d).

3. **Sound Management Techniques based on Strong Science and Data**

- Applying an iterative approach to environmental decision-making allows actions to be taken and progress to be made, even while data are being collected. The following steps should be utilized:
 - ♦ Assessing the natural resources and communities in the watershed
 - ♦ Setting environmental goals and objectives based on the condition and vulnerability of the natural ecosystem and the human community within the watershed
 - ♦ Identifying and prioritizing watershed problems to be addressed
 - ♦ Developing and implementing management options and plans
 - ♦ Evaluating the effectiveness of plan outcomes
 - ♦ Revising plans, as needed

Long-term, EPA envisions local watershed planning initiatives coordinating within comprehensive state structures to guide environmental decision-making related to aquatic ecosystems (USEPA, 2006d). It is predicted that the use of the watershed approach will organize and reduce duplication of effort for the many agencies interested in water quality issues, provide a better understanding of cumulative effects of human activities, highlight the most pressing problems and threats to aquatic systems, build a sense of community and responsibility among all citizens within the watershed, and yield higher quality environmental improvements at lower costs (USEPA, 2006f). In 2002, USEPA launched the competitive Targeted Watershed Grants program to fund community-driven water quality and wetland resource improvement programs that utilize a watershed approach (USEPA, 2006g; Engler, 2005).

The National Research Council (NRC) report (2001) recommended institution of a watershed approach for analyzing impacts and guiding mitigation as a primary wetlands regulatory reform mechanism. The report suggested that, while some impacts may best be mitigated by traditional on-site and/or in-kind compensation, the greatest ecological benefit to a watershed may sometimes come from out-of-kind practices, such as enhancement of local wetland types that have been severely degraded. NRC proposed that, after assessing the functions that would be lost due to a permitted impact, the following considerations should be included in determining compensatory response on a case-by-case basis:

- The goal of restoring localized functions, including water quality improvements, wildlife habitat, and the food web base,
- Likely watershed functional improvements from in-kind vs. out-of-kind mitigation options, and
- Long-term watershed health, including wetland-upland connectivity.

Current movement toward watershed planning

Federal guidance released in November, 2005 (Federal Register 60:58605-58614) identified a mitigation banking goal of full compensation of wetland and aquatic losses, including projected losses, that enhances long-term ecological functioning of the local watershed. Very recent regulatory changes proposed jointly by USEPA and USACE (28 March 2006, Federal Register 71:15519) involve a shift away from the on-site, in-kind mitigation preference in site selection for compensatory wetland mitigation. Instead, the proposal recommends that, "in general, compensatory mitigation should be located within the same watershed as the impact site, and should be located where it is most likely to successfully replace lost functions, services, and values, taking into account such watershed scale features as aquatic habitat diversity, habitat connectivity, relationships to hydrologic sources (including the availability of water rights), and compatibility with adjacent land uses." Once implemented, these changes will require mitigation banks and in-lieu fee programs to incorporate a watershed planning approach in order to "improve the quality and success of compensatory mitigation projects in replacing losses of aquatic resource functions, services, and values resulting from activities authorized by Department of the Army permits." The proposed watershed approach, similar to the framework outlined by USEPA (2006c), involves a collaborative effort between stakeholders, and incorporates:

1. A regional or landscape perspective,
2. Consideration of Federal, Tribal, state, community, and private interests, and
3. The requirements of other programs and objectives, such as
 - Habitat conservation and connectivity,
 - Storm water management,
 - Flood control,
 - Pollution prevention, and
 - Economic development.

This current federal proposal (Federal Register, 71:15519) indicates a preference for “a formal watershed plan, developed by federal, state, and/or local environmental managers in consultation with affected stakeholders,” but acknowledges that many areas have not yet developed this type of comprehensive watershed plan. In the absence of a formal plan, a watershed approach can still be utilized in wetland mitigation through “structured consideration of watershed needs and how wetland types in specific locations can fulfill those needs” by taking into account:

- Current trends in habitat loss or conversion,
- Cumulative impacts of past development activities,
- Current development trends and sources of pollution,
- Presence and needs of sensitive species,
- Site conditions that favor or hinder the success of mitigation projects,
- Compatibility with adjacent land uses and watershed management plans,
- Chronic environmental problems such as flooding or poor water quality, and
- Local watershed goals and priorities (Federal Register 71:15519).

Through the processes of basing mitigation on NCDOT’s seven-year planning horizon and prioritizing mitigation targets in local watersheds, EEP has essentially become this type of mitigation bank for North Carolina.

Watershed approach cons

Potential drawbacks to a watershed approach have been suggested, and these should be noted in order to anticipate pitfalls in implementation:

- Planning on broad geographic scale with a long timeframe could weaken the regulatory commitment to protect individual wetlands (National Research Council, 2001).
- The watershed approach requires the involvement of multiple stakeholders, regulatory and non-regulatory agencies, and funding sources within a region. Coordination may be difficult or impractical for some municipalities (*Ibid.*).

- Successful mitigation is easier to implement in rural areas due to larger available tracts of land, lower population density, and greater connectivity with natural environments than those factors in urban centers. Conversely, more wetland impacts occur in more developed regions. The shift from on-site to in-watershed mitigation could facilitate a movement of wetlands from urban and developing coastal communities to rural locations, leaving cities more dependent on engineered solutions to water quality and flooding issues (Christen, 2006; Engler, 2005; Federal Register 71:15519; Ruhl and Salzman, 2006).
- The disconnect between wetland impact and associated mitigation complicates mitigation reporting and tracking procedures, as seen in the process of gathering data on EEP projects.
- Site-specific evaluation of impacted wetland functions is time-intensive, which can place a burden on regulatory agencies with limited resources. Due to a lack of dedicated staff for this purpose, some municipalities may simply be unable to develop a formal watershed management plan, and will instead need to rely on expertise from the stakeholders and regulatory agencies involved with local watershed decision-making (National Research Council, 2001).

Best monitoring practices

Wetland functional development

There is a movement within the field of wetland management that acknowledges the complexity of wetland systems and that functional development of restored or created wetlands can take much longer than 5 years. It also acknowledges that functionality is dependent on far more than the presence or absence of wetland vegetation. Mitigation, especially creation and restoration, projects often take years to develop full wetland functionality, and may or may not ever achieve functional equivalency with the wetlands they are meant to replace. Zampella and Laidig (2003) compared 50-year-old created ponds with natural coastal plain ponds in New Jersey. They found that hydrologic functions of the ponds were equivalent, but vegetation communities and water quality impacts differed, in part due to differences in settings and influences from the

surrounding landscape. This again highlights the importance of watershed planning in determining placement of mitigation sites. Simenstad and Thom (1996) compared sixteen ecosystem functions in a 7-year-old restored Washington estuary with functions in comparable natural wetlands, and found that bird usage and fish species diversity and density met reference conditions within three to five years. However, several other functional indicators, including soil development, vegetation diversity and density, and benthic community composition, did not exhibit movement toward maturing into functional equivalency. It is suggested that longer-term (10-year or more) studies will be needed to better understand the functional development of created and restored wetlands, and the likelihood of various mitigation methods to result in functional replacement of lost wetlands and streams (Simenstad and Thom, 1996).

Long-term stewardship

In recognition of this, and in response to a recommendation from the PACG, NCDENR is in the process of creating a Stewardship Program, separate from EEP, to coordinate funding and stewardship activities for perpetual monitoring and management of mitigation sites in North Carolina (NCDENR, et al., 2006; B. Satler, personal communication, June 8, 2006). Utilization of this group would significantly improve EEP's monitoring rating, provide opportunities for long-term data collection, and better ensure long-term functional replacement of wetland losses in NC. Simenstad and Thom (1996) noted that "given the typically short (3-5 yr) life-span of monitoring programs instituted to assess performance of restored or created wetlands, we need relevant predictors of system development and a better understanding of the time required to achieve functional equivalency with natural reference wetlands." EEP and NCDENR have an opportunity to contribute needed data to this objective of mitigation success optimization through the development of the Stewardship Program and partnering with wetland researchers.

Mitigation success determination

A recent USEPA/USACE proposal (Federal Register 71:15519) suggested development of success criteria for all aquatic mitigation related to federally permitted activities. The goals of the proposed regulation were stated as:

- To “enhance regulatory efficiency and improve protection of the aquatic environment,” and
- To “provide the regulated public with clear national standards and requirements for all aquatic resource compensatory mitigation required by Department of the Army permits, while
 - Allowing district engineers flexibility to address permit-specific situations.”

There is a problem with trying to provide clear national standards and flexibility at the same time. The regulators note that “ecological performance standards usually vary by aquatic type and geographic region” (Federal Register 71:15519), so the proposal outlines only general guidance on considerations for developing ecological success criteria to evaluate whether or not mitigation projects are meeting their goals. According to USEPA and USACE (*Ibid.*), performance standards may be based on:

- Variables or measures of functional capacity described in functional assessment methodologies,
- Measurements of hydrology or other aquatic resource characteristics, taking into account the hydrologic variability exhibited by reference aquatic resources, or
- Comparisons to reference aquatic resources of similar type and landscape position.

Additionally, these criteria should:

- Be based on attributes that are objective, verifiable, and can be measured with a reasonable amount of effort, and
- “Take into account the expected stages of the aquatic resource development process, in order to allow early identification of potential problems and appropriate adaptive management” (*Ibid.*).

Wetland functional assessment

Mitigation ratios vs. functional replacement

Mitigation ratios and wetland delineation have provided proxies for the much more in-depth process of functional assessment in determining wetland impacts and assigning and evaluating mitigation. Site-specific functional assessment is complex, resource intensive, and difficult to develop or implement for wide-scale use. However, in recognition of the wide range of wetland functionality, it is clear that one set of mitigation ratios will not guarantee equivalent replacement of lost ecological services, and there is a movement in the field toward development and incorporation of functional assessment methodologies.

Functional assessment methods

USEPA (2001) notes, "Although large-scale benefits of functions can be valued, determining the value of individual wetlands is difficult because they vary widely and do not all perform the same functions or perform functions equally well." This makes the determination of appropriate mitigation for a given wetland impact very challenging for regulators, and highlights the need for practical functional assessment methods.

"Wetland assessment procedures are tools in the trade of wetland science that provide a definitive procedure for identifying, characterizing, or measuring wetland functions and/or social benefits" (Bartoldus, 1999). They are necessary in the wetland mitigation field because "wetland function and area do not have a one-to-one correspondence" (Brinson, 1995). Departing from the current mitigation ratio approach, functional assessment methods may determine needs of greater or lesser acreage than impacts, depending on the type and watershed location of the mitigation wetland. Examples provided by the National Research Council (2001, pp.142-144) include:

- Mitigation through enhancement of an existing degraded wetland may result in increased wetland functionality in spite of a loss in wetland area, while
- Creation of buffers along rivers in upland areas may require significantly greater acreage to accomplish the same level of water quality and habitat functionality as a natural wetland.

USEPA and USACE (Federal Register 71:15519) have indicated a preference for functional assessment of impacted wetlands as a basis to determine compensatory mitigation. Only when a functional assessment method is not “available, appropriate, and practical to use” should a minimum one-to-one wetland acreage or stream linear foot ratio be applied as a “surrogate for functional replacement.” To achieve true functional replacement, the assessment method used must “apply equally to detecting gains in function due to mitigation and losses of function due to impacts” (Brinson, 1995).

There is general agreement that better evaluation procedures, based on assessment of wetland functions, need to be developed. However, there is debate about the best way to accomplish this. Many methods have been developed and utilized since the 1980’s – so many, in fact, that selecting a method can be confusing (Bartoldus, 1999). Most methods were developed independently for a specific agency, purpose, or geographic region, and results are generally not comparable across methods. Extremely thorough methods, such as the Hydrogeomorphic (HGM) Approach, have been proposed and even instituted by USACE for periods of time (Brinson, 1993). HGM models for quantifying hydrologic, biogeochemical, and habitat functions for specific wetland types in various US regions were developed during the late-1990’s by interdisciplinary teams of experts from the Natural Resources Conservation Service (NRCS), USEPA, USACE, USFWS, and the states and regions of interest. Application of the models involved measurement of observable field indicators for each type of function, such as using lichen patterns on tree trunks or silt on leaf litter to assess absence or presence and degree of flooding (Smith, *et al.*, 1995). Each indicator earned a rating from an associated index; when all ratings were input into the regional HGM models, an output value of functional capacity was produced, which took into consideration (Bartoldus, 1999):

- Characteristics and special features of the wetland, surrounding landscape, and interaction between the two,

- The rate or magnitude at which the wetland performed a given function, relative to highly-functioning reference wetlands of the same regional type, and
- The size of the wetland.

This type of assessment yielded in-depth descriptions of wetland functionality, but required intensive training to perform correctly. It demanded time for model development (months) and for field analysis and assessment calculations (hours to days per evaluation) that was considered excessive, given the budgets of regulatory agencies. Additionally, functional capacity values were comparable only between wetlands of the same regional subclass, not across different wetland types or geographic areas, and therefore could not be easily used in a watershed approach to mitigation optimization. Due to these drawbacks, wetland evaluation reverted to the 1987 Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987; USEPA, 2006h). This method provides a simple, fast means of delineating wetland boundaries based on the presence or absence of wetland hydrology, hydric soils, and hydrophytic vegetation, but does not quantify the functions performed by the wetland.

In theory, the procedure developed by Smith et al. (1995, Figure 6) could be utilized by regulatory agencies to guarantee the best possible mitigation strategy for unavoidable wetland impacts. The challenge is condensing this procedure into a timeframe that can keep up with permit applications and fit into staffing budgets without compromising the quality of the resulting mitigation. While HGM-type analyses may provide a good base for functional assessment, a new method needs to be developed and standardized across agencies in order for:

- Mitigation agencies to be able to design projects that will restore lost wetland functions on a watershed scale by considering the functionality of both in-kind and out-of-kind mitigation options, and
- Regulatory agencies to be able to make wise permitting decisions and perform oversight of the projects under their jurisdiction in a thorough yet timely manner.

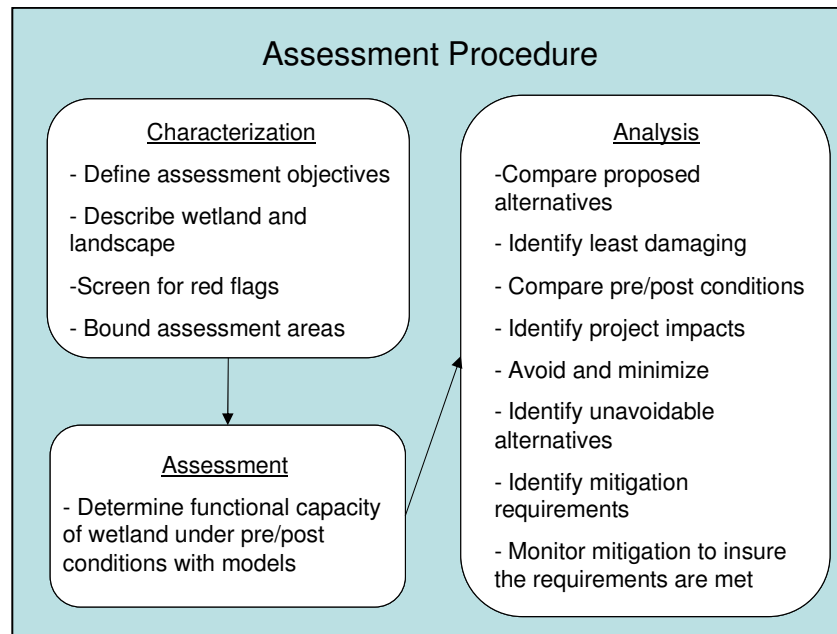


Figure 6: Proposed steps in wetland functional assessment, from Smith et al. (1995).

The ideal functional assessment method should:

- Be easily learned
- Be simple to perform
- Be completed quickly under varying field conditions
- Yield dependable estimates of different functions (flood control, habitat, and water quality) that are consistent and repeatable from one assessor to another
- Be applicable to both actual and proposed wetlands, so that mitigation can be appropriately assigned to impacts
- Be applicable over a reasonably wide geographic area, or customizable to a local geographic area
 - To support a watershed approach, it is imperative that the method apply at a watershed scale.
- Yield results that are comparable across geographic areas and wetland types
 - To support broad-scale tracking of wetland changes, results should at be comparable at a state or national level. This does not suggest that mitigation should be allowed outside of the watershed of impact.

It will be challenging to create a method that is simple, yet complicated, enough to meet all of these objectives! North Carolina has been ground-breaking, and possibly trend-setting, with the establishment of EEP. NCDENR is now poised to incorporate a new functional assessment method into the processes of impact evaluation, compensatory mitigation assignment, and wetland evaluation. The North Carolina Wetland Assessment Method (NCWAM) and Stream Assessment Method (NCSAM) are under development with input from DWQ, DCM, USACE, and USEPA in order to enhance replacement of wetland and stream functions lost in North Carolina. As EEP has drawn national attention as a possible model for wetland mitigation programs, NCWAM and NCSAM are sure to generate considerable interest as one of the first state-level regulatory uses of functional assessment in assigning and evaluating mitigation. Standardization of assessment methods will vastly simplify communication between regulatory agencies, mitigation providers, and those creating the impacts; thereby allowing more focus to rest where it should – on maintaining wetland and stream functionality in North Carolina and maximizing the environmental benefits realized through the state’s wetland policies and programs.

Mitigation tracking and reporting

Difficulties in data collection for this study highlighted a central problem with environmental management programs. Agencies such as EEP, NCDENR, and USACE generally have to concentrate efforts on task completion related to regulatory responsibilities, rather than on follow-up, monitoring, and compilation and dissemination of data. Data availability regarding compensatory mitigation is lacking due to:

- Agency limitations on time and budgets for data collection,
- “Public records” that are actually almost inaccessible to the public due to privacy laws and the cost and paperwork involved in gaining access,
- Agency desire to protect internal databases from tampering, and
- Minimal staff time for responding to public requests for customized report preparation.

There is no central agency responsible for maintaining wetland-related data and providing convenient public access to it. Given the current rate of wetland loss, it could be argued that instituting and maintaining such a system is of lower priority than investing resources in preserving remaining wetlands and ensuring functional replacement of those that continue to be lost.

However, the density of the regulatory structure, and lack of associated information, leads to difficulty in evaluating how that structure is performing. Multiple agencies are involved, with decision triggers and thresholds that either overlap or diverge, depending upon the circumstance. While mitigation requirements are exceeding wetland impacts, it is unclear how much mitigation has been completed in North Carolina. EEP data that are now publicly available have been an improvement in this area, but it is still extremely challenging to piece together the chain of events from permitted activities and actual wetland impacts through mitigation project completion and long-term degree of success. USEPA has recently awarded funding to NCDENR-DWQ for two 3-year positions to perform tracking of stream and wetland mitigation in North Carolina. It is expected that these positions will result in:

- Enhanced data availability through BIMS, and
- Greater understanding of the status of compensatory mitigation in the state.

Ideally, these positions will become state-funded after the initial 3-year term and provide a permanent system for mitigation oversight in NC. In the long-term, state-level efforts such as this could be coordinated under USEPA or USACE to provide a national database of mitigation information.

CONCLUSIONS

Most reviews of wetland management in North Carolina are mixed, and therefore, realistic. They acknowledge that while its implementation may not be perfect, the EEP concept is a step in the right direction toward addressing the complexities of wetland

regulation in a manner that maximizes systemic watershed health. It is to be expected that a novel, ambitious, collaborative process would have growing pains, especially when it carries burdens from the past. What everyone is looking for is progress over time, which was seen in comparing FY2003 and FY2004 results. By the end of the initial 2-year transition period, EEP had improved performance in many of the criteria in the policy analysis framework (Engler, 2005). Significant improvement had been made in the areas of transparency and stream mitigation effectiveness, while wetland effectiveness, long-term monitoring, and financial stability continued to require attention.

Improving wetland management

The study revealed interrelated factors influencing the level of achievable wetland ecological health. Based on these, primary recommendations for enhancing North Carolina's environment through wetland management involve expanding the use of the watershed approach and incorporating functional assessment methodology.

- The degree to which NCDENR-DWQ and EEP are utilizing a watershed approach in mitigation planning deserves recognition. While already used in water supply planning, it would be exceptional to see this approach incorporated into the regulatory structure guiding allowable placement of new development.
- It is clear that a functional assessment method needs to be incorporated into both USACE and DWQ's determination of wetland impacts and mitigation requirements, and into EEP's watershed planning and mitigation success evaluation procedures. Future analyses will need to consider the efficacy of NCWAM and NCSAM application for these purposes.

Future analyses

It is recommended that PTRF or another NC environmental organization repeat this type of analysis annually over the next few years, incorporating spatial and functional assessment data, as they become available, in order to:

- Gauge the degree of success of wetland science and regulatory integration in North Carolina and the Tar-Pamlico River basin over time,
- Track impacts and mitigation within the Tar-Pamlico basin,
- Foster trust, transparency, and productive, targeted communication between the environmental advocacy and regulatory communities in NC, and
- Help PTRF to identify areas in which to focus efforts.

Recommendations for enhancing future analyses include:

- Incorporation of spatial data will provide a sense of where impacts and mitigation are happening, and whether or not wetland locations and types are shifting within the basin. EEP's spatial database (under development) and targeted local watershed reports may prove useful for this.
- EEP is continually improving reporting mechanisms, and greater clarity in documenting the chain of events from permit → impact → mitigation → monitoring for all projects in its charge will vastly simplify evaluation of program success. Additionally, the mitigation tracking database that will be developed by DWQ over the next few years may become a useful resource.

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Appendix A: Data Sources and Calculations

Efficiency

Data Sources:

Variable: Mitigation output

- An EEP ILF database query was performed by EEP staff (J. Stanfill, personal communication, July 26, 2006) to provide data about the ILF projects, and corresponding mitigation units, completed during FY2004.

Variable: Programmatic costs

- USACE and DWQ permit numbers and completion dates associated with identified ILF projects were cross-referenced with the EEP 2004-2005 Annual Report (EEP, 2005c), Appendix C: Compensatory Mitigation Payments and Requirements, to find data on the fees charged for each project.

Effectiveness-Stream and Wetland

Data Sources:

Variable: Annual mitigation completed

- EEP staff provided data on the status of all present EEP projects in the Tar-Pamlico basin (C. Kiley, personal communication, September 13, 2006).
- This list was cross-referenced with the EEP Annual Report 2004-2005 (EEP, 2005c), Appendix A: EEP Cumulative Property Inventory: Properties Closed to Date 06/30/2005, to determine the projects that were completed during FY2004.

- Data regarding the total amount of stream and wetland mitigation achieved at each site was then found in the third EEP quarterly report for FY2005 (EEP, 2006d):
 - Appendix A: EEP Gross Asset List of Tier 1 Restoration, Enhancement, Creation, and Preservation Sites Alphabetically; and
 - Appendix D1: EEP Gross High Quality Preservation Project List and Summary.

Variable: Annual mitigation incurred

- Projected NCDOT impacts, in linear feet of stream and acres of wetlands, for FY2004 were found in the EEP quarterly report for July 1 – September 30, 2004 (EEP, 2004), Table 1.
 - *[If this method is repeated for future analyses, it should be noted that the report format has changed and this information will be found in the first quarterly report for the fiscal year of interest, Appendix G: MOA Future Requirements - Remaining NCDOT Projected Impacts.]*
- Projected ILF required mitigation was not available for FY2004, so it was not included in this analysis.
 - *[If this method is repeated for future analyses, this information will be found in the first quarterly report for the fiscal year of interest, Appendix J: MOU ILF Present and Future Quarter Mitigation Requirements.]*

Adaptability (Inclusion of Current Science)

Data sources for individual sub-criteria:

A₁: *A means to observe accepted wetland resource mitigation practices whether this is an internal scientific advisory board or established relationships with respected professionals in the field.*

- Information on the role of the PACG was collected from the EEP MOA, section IV.E. (NCDENR *at al.*, 2003), the EEP website (EEP, 2005a), and

conversations with EEP staff (B. Satler, personal communication, June 8, 2006).

A₂: *Formal recommendations provided from internal scientific review groups on a regular basis (at least annually).*

- Regularly scheduled PACG meetings and reporting requirements are documented in the EEP MOA, sections VI.A.4, VII.A.2, and VII.B. (NCDENR, *et al.*, 2003) and on the EEP website (EEP, 2006c).

A₃: *Annual review of the scientific advisory team or professionals' recommendations by program staff for potential acceptance and program inclusion.*

- The EEP MOA (NCDENR, *et al.*, 2003)
- The PACG roster (EEP, 2005a)

A₄: *Contribution to local, regional, or national mitigation forums or conferences for peer feedback and response.*

- Information about EEP presentations and publications can be found on the EEP website at <http://www.nceep.net/news/eeppublications.htm>

A₅: *Other means to review mitigation practices on a regular basis.*

- Aside from the PACG, no other regularly scheduled means of reviewing current mitigation practices are mentioned in the EEP MOA (NCDENR, *et al.*, 2003). The Policy, Process, and Procedures Manual being developed with Research Triangle Institute (RTI) International is available on the EEP website at <http://www.nceep.net/abouteep/organization.html>.

Transparency

Data sources for individual sub-criteria:

T₁: Regular reporting (at least twice annually).

- Quarterly and annual reports on EEP activities that are provided to USACE, PACG, and are publicly available on the EEP website (EEP, 2006c).

T₂: Report format derived from public input and programmatic requirements.

- Interview with EEP staff; reporting requirements per the EEP MOA (NCDENR, 2003).

T₃: Public review and comment window after report release.

- Release of reports for public access (EEP, 2006c).

T₄: Report consistency.

- Examination of all EEP quarterly reports prior to time of analysis – formats have generally become standardized.

Stakeholder Acceptability

Positive views were expressed by:

- Tar River Land Conservancy (Johnson, 2005)
- Buck Engineering (Kenny, 2005)
- EBX (Kenny, 2005)
- Center for Transportation and the Environment (McDermott, 2005)
- Forest Hills resident (Masakadza, 2004)

Negative views or views expressing concern were provided by:

- Environmental Defense (D. McNaught, personal communication, June 5, 2006)
- PTRF (H. Jacobs, personal communication, May 2006)
- Forest Hills resident (Wise, 2005)

Inter-Group Coordination

The EEP MOA is a formal agreement between NCDENR, NCDOT, and USACE, but it is not an act of North Carolina legislature (NCDENR, 2003).

Financial Stability

Data Source:

FY2004 data were gleaned from the EEP 2004-2005 Annual Report, Section V. Revenues, Expenditures and Encumbrances (EEP, 2005c).

Table 5: EEP FY2004 funding sources and calculations for financial stability criterion.

<i>Funding sources</i>	<i>Contribution (\$)</i>	<i>Diff from largest contributor</i>
NC DOT	44120374.00	0.00
In-lieu fees (Fund 2981)	9452868.00	0.56
Riparian buffer mitigation (Fund 2982 Buffer Fund)	3851863.00	0.65
Nutrient offset payments (Fund 2981)	1190827.00	0.69
State of NC appropriations	2523031.00	0.67
Fund 2981 interest	1218077.00	0.69
Wetlands Restoration Fund (non-mitigation projects, Fund 2980)	52005.00	0.71
Totals:	62409045.00	3.95

Watershed Planning

Data Sources:

- The DWQ Tar-Pamlico River Basinwide Water Quality Plan can be found at <http://h2o.enr.state.nc.us/basinwide/tarpam2004.html>.
- The EEP Tar-Pamlico River Basin Watershed Restoration Plan can be found at <http://www.nceep.net/services/restplans/TarPamilicoPlan.pdf>.

- Information on EEP targeted local watersheds can be found at <http://www.nceep.net/pages/lwp.htm>.

Long-term Monitoring

Data Sources:

- A minimum five-year monitoring period is specified in the EEP MOA, section X.A. Additionally, section IV.A.1 specifies that EEP has a responsibility “to evaluate the site at least annually until success criteria have been met,” and to develop “a plan for the preservation and long-term management of the site” (NCDENR, *et al.*, 2003).
- Monitoring reports for EEP sites in the Tar-Pamlico basin (Rummel, Klepper & Kahl, LLP, 2006)
- EEP FY2004-2005 Annual Report (EEP, 2005c)

Appendix B: North Carolina Wetlands

Details provided below about range, location, vegetation, hydrology, and soils were primarily drawn from Schafale and Weakley's (1990) classification of North Carolina natural communities. Further information was derived from other sources, as noted.

Salt/brackish marsh

Located throughout coastal NC, salt and brackish marshes border tidal estuaries, which provide protected environments for aquatic nurseries that are critical to the sustainability of the state's seafood industry. The waters in coastal marshes are tidally-influenced and mixohaline to euhaline (at least somewhat salty), so the plant communities must be tolerant of these conditions. Dominant vegetation includes *Juncus spp.* (especially black needlerush, *Juncus roemerianus*) and *Spartina spp.* (especially salt marsh cordgrass, *Spartina alterniflora*). This is the only category involving salt water.

Tidal and non-tidal freshwater marshes

Freshwater marshes border estuaries, lakes, and drowned rivers. Water levels may be influenced by tides, but salinity is 0.5 ppt or less. Vegetation needs to be adapted for life in flooded, but not salty, conditions, and is usually dense and herbaceous. Common plants includes sedges, millets, rushes, and grasses (NCDWM, 1999).

Riverine swamp forest

Wetlands in this category exist in the central and eastern parts of the state. Riverine swamp forests composed of flood-tolerant trees, such as cypress (*Taxodium spp.*), and herbaceous vegetation can develop in shallow depressions on large floodplains bordering rivers in North Carolina's piedmont region (Mitsch and Gosselink, 2000). Along freshwater sounds and the mouths of blackwater rivers in the coastal plain, tidal cypress-gum swamps may contain communities composed of cypress, sweetgum, red maple, loblolly pine (*Pinus taeda*), and shrubs. On the floodplains of blackwater and brownwater rivers, cypress-gum swamps can develop in sloughs and swales that

remain flooded for long periods of time, hosting communities of cypress and tupelo (*Nyssa spp.*).



Figure 7: Cypress swamp in the Tar-Pamlico River basin (photo credit: H. Jacobs).

Non-riverine swamp forest

These deciduous or mixed hardwood and pine forests occur primarily in the northeastern part of North Carolina in seasonally flooded peatlands with poor drainage. Dominant vegetation includes bald cypress (*Taxodium distichum*), swamp and water tupelo, red maple, green ash, and sweet gum (NCDWM, 1999). While vegetation is similar to that of riverine swamp forests, these wetlands do not occur along rivers and inundation is not as deep as it is in riverine swamps (Fleming, et al., 2006).

Bottomland hardwood forest

Bottomlands are lowland areas along rivers which are subject to periodic flooding, but high enough to avoid permanent standing water. Canopies are dominated by hardwood trees, especially oaks, or a mix of hardwoods and conifers. These settings are ideal settings for the growth of valuable hardwoods, so many have been logged. The range of bottomland hardwood forests covers the coastal plain, piedmont, and low mountains, but very few natural bottomland forests remain intact in North Carolina.

Headwater wetland

Wetlands around the sources of river systems may be only periodically saturated. Vegetation tends to be a dense mixture of shrubs and trees. There is debate about the level of wetland functionality provided by these systems, with arguments both for and against their importance for conservation. Certain headwater wetlands in the sandhills region provide the wet, acidic organic-peat soils needed for growth of rare atlantic white cedar (*Chamaecyparis thyoides*) and its related community of shrubs and spotted turtles (Woods Hole Research Center, 2005).

Floodplain pool

Small floodplain pools are found in depressions in abandoned dry river channels in the piedmont and upper coastal plain. They contain water nearly constantly. Depending on the depth of the pond, they may contain aquatic and/or wetland vegetation.

Mountain bog

Scattered in valley bottoms in the Appalachian mountains, these rare, very acidic, peat-accumulating ecosystems are fed by seepage water. Shrubs and herbaceous plants are underlain by mats of Sphagnum mosses.

Seep

Also known as springs, seeps can occur in any of NC's ecoregions when groundwater is forced to the surface by underlying layers of less permeable sediments, such as clays (MDEQ, 2001). Seeps tend to be small in area and saturated most of the time. Herbaceous wetland plants are shaded by trees in neighboring communities.



Figure 8: Seep wetland in the NC piedmont (photo credit: J. Mahagan).

Pine flat

Pine flatwoods are common in the outer to middle coastal plain, in non-riverine areas. Sandy soils are seasonally saturated, but may experience extended dry periods. Dominant vegetation consists of a canopy of mixed pines, especially loblolly, and sparse to dense low shrubs and herbaceous plants. Some hardwood trees may be present (NCDWM, 1999).

Pine savanna

Pine savannas are seasonally wet, flat areas in the lower coastal plain that are dependent upon fire to facilitate germination of new trees. Various pines, especially longleaf (*Pinus palustris*) make up a sparse canopy (Lazure, 2005), with a dense herbaceous understory. Pine savannas contain more rare plant species, such as Cooley's meadowrue at The Nature Conservancy's (2006) Myrtle Head Savannah preserve, than any other NC ecosystem. Much of the original pine savanna in the state has been converted to agriculture, so that these once extensive forests are now rare (Luczkovich, 2001).

Estuarine woody

Forested estuarine ecosystems may occur at the upper tidal reaches of coastal rivers, where tidal influence is occasional and salinity stays below 0.5 ppt. Along the Albemarle-Pamlico Sound, woody estuarine communities are dominated by pines and rushes. Shrub-scrub communities in this category are dominated by wax myrtle and eastern red cedar (Fleming, et al., 2006; NCDRCM, 1999).

Pocosin

Pocosins are acidic, peat-accumulating wetlands that are “isolated” on the landscape, which has led to disagreements about their protection under USACE jurisdiction over navigable waters of the US. Disconnected from rivers and streams, pocosins are mainly fed by precipitation. They are located primarily on the coastal plain, and vegetation consists of dense evergreen shrubs and varying densities of trees, including pond and loblolly pines (NCDRCM, 1999). The name is derived from an Algonquin word for “swamp on a hill” (Mitsch and Gosselink, 2000, p.779).

Hardwood flat

These non-riverine flat wetlands experience saturation due to seasonal high water tables or poorly drained soils, rather than input from rivers or estuaries. Sweet gum and red maple are frequently present, but community structure is extremely variable (NCDRCM, 1999).

Others

Maritime forests of live oak, red maple, and swamp tupelo are found so near to the ocean shoreline that the trees are stunted by exposure to salt spray (NCDRCM, 1999). In addition to the categories of most common wetlands, North Carolina contains several types of rare and special wetlands, including oxbow lakes, fens, vernal and upland pools, swamp forest – bog complexes, and wet marl forests (Shafale and Weakley, 1990).



Figure 9: Formation of an oxbow lake in the Tar-Pamlico River basin (photo credit: H. Jacobs).

