

IV. RESEARCH AND MONITORING PLAN

A. Research Program Overview

1. National Research Program

The Reserve System provides a mechanism for addressing scientific and technical aspects of coastal management problems through a comprehensive, interdisciplinary, and coordinated approach. Research and monitoring programs, including the development of baseline information, form the basis of this approach. Reserve research and monitoring activities are guided by the Reserve System research and monitoring plan (2006-2011) (Appendix O) which identifies goals, priorities, and implementation strategies. This approach, when used in combination with the education and outreach programs, will help ensure the availability of scientific information that has long-term, system-wide consistency and utility for managers and members of the public to use in protecting or improving natural processes in their estuaries. Research within the Reserves is designed to fulfill the Reserve System goals as defined in program regulations. These include:

- Address coastal management issues identified as significant through coordinated estuarine research within the System;
- Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
- Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

a. Reserve System Research Funding Priorities

To meet the Reserve System goals outlined above, federal regulations (15 Code of Federal Regulations Part 921.50 a) specify the purposes for which research funds are to be used:

- Support management-related research that will enhance scientific understanding of the Reserve ecosystem;
- Provide information needed by Reserve managers and coastal ecosystem policy-makers; and
- Improve public awareness and understanding of estuarine ecosystems and estuarine management issues.

The Reserve System has identified the following five priority research areas to complement the funding priorities outlined above:

1. Habitat and ecosystem processes
2. Anthropogenic influences on estuaries
3. Habitat conservation and restoration
4. Species management
5. Social science and economics

b. Reserve System Research Goals

The Reserve System research goals are embedded in Goal 2 of the Reserve System Strategic Plan 2005-2010, *'Increase the use of Reserve science and sites to address priority coastal management issues,'* and are outlined in the 2006-2011 Reserve System Research and Monitoring Plan (Appendix O). They include:

- Goal 1: Biological, chemical, physical, and ecological conditions of Reserves are characterized and monitored to describe reference conditions and to quantify change.
- Goal 2: Scientists conduct research at Reserves that is relevant to coastal management needs and increase basic understanding of estuarine processes.
- Goal 3: Scientists, educators, and coastal managers have access to National Estuarine Research Reserve System (NERRS) datasets, science products and results.
- Goal 4: The scientific, coastal management and education communities, as well as the general public, use data, products, tools, and techniques generated at the NERRS.

c. System-Wide Research Funding Opportunities

Currently, there are two Reserve system-wide efforts to fund estuarine research: the Graduate Research Fellowship (GRF) program and the National Coastal and Estuarine Research and Technology (NCERT) program. The GRF program supports students to produce high quality research in Reserves. The fellowship provides graduate students with funding for 1-3 years to conduct their research, as well as an opportunity to assist with the research and monitoring program at a Reserve. Projects must address coastal management issues identified as having regional or national significance; relate them to the Reserve System research focus areas; and be conducted at least partially within one or more designated Reserve sites. Proposals must focus on the following areas: 1) Eutrophication, effects of non-point source pollution and/or nutrient dynamics; 2) Habitat conservation and/or restoration; 3) Biodiversity and/or the effects of invasive species; 4) Mechanisms for sustaining resources within estuarine ecosystems; or 5) Economic, sociological, and/or anthropological research applicable to estuarine ecosystem management.

Students work with the Research Coordinator or Manager at the host Reserve to develop a plan to participate in the Reserve's research and/or monitoring program. Students are asked to provide up to 15 hours per week of research and/or monitoring assistance to the Reserve; this training may take place throughout the school year or may be concentrated during a specific season.

Secondly, research is funded through the National Coastal and Estuarine Research and Technology (NCERT) program. NCERT funds support collaborative research in the Research Reserves and transform the best available science into practical, innovative tools

that coastal managers can use to detect, prevent, and reverse the impacts of coastal pollution and habitat degradation. NCERT provides funding opportunities for site-based, hypothesis-driven research with broad-scale application. These projects are conducted both by Reserve staff as well as external researchers. Topics include global climate change, sea level rise, invasive species, and estuarine ecology to name just a few. These projects provide the baseline science needed to develop sound management decisions and quality educational material. This program links directly to North Carolina National Estuarine Research Reserve (NCNERR) Objective 2.1 by providing the opportunity to apply for funding for research in N.C. that will be used directly by the coastal management community.

d. System-wide Monitoring Program

It is the policy of the NCNERR to implement each component of the System-wide Monitoring Plan (SWMP) initiated by the Estuarine Reserves Division (ERD) in 1989, and as outlined in the Reserve System regulations and strategic plan:

- Component I: Environmental characterization, including studies necessary for inventory and comprehensive site descriptions;
- Component II: Site profile, to include a synthesis of data and information; and
- Component III: Implementation of the System-wide Monitoring Program.

The SWMP provides standardized data on national estuarine environmental trends while allowing the flexibility to assess coastal management issues of regional or local concern. The principal mission of the monitoring program is to develop quantitative measurements of short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purposes of contributing to effective coastal zone management. The program is designed to enhance the value and vision of the Reserves as a system of national references sites. The program also takes a phased approach and focuses on three different ecosystem characteristics.

1. **Abiotic Variables:** The monitoring program currently measures pH, conductivity, salinity, temperature, dissolved oxygen, turbidity, water level and atmospheric conditions. In addition, the program collects monthly nutrient and Chlorophyll *a* samples and monthly diel samples at one SWMP data logger station. Each Reserve uses a set of automated instruments and weather stations to collect these data for submission to a centralized data management office.
2. **Biotic Variables:** The Reserve System is focusing on monitoring biodiversity, habitat and population characteristics by monitoring organisms and habitats as funds are available.
3. **Watershed and Land use Classifications:** This component attempts to identify changes in coastal ecological conditions with the goal of tracking and evaluating changes in coastal habitats and watershed land use/cover. The main objective of this element is to examine the links between watershed land use activities and coastal habitat quality.

These data are compiled electronically at a central data management “hub”, the Centralized Data Management Office (CDMO) at the Belle W. Baruch Institute for Marine Biology and Coastal Research of the University of South Carolina. The CDMO provides additional

quality control for data and metadata and compiles and disseminates the data and summary statistics via the Web (<http://cdmo.baruch.sc.edu>) where researchers, coastal managers and educators readily access the information. The metadata meets the standards of the Federal Geographical Data Committee.

2. North Carolina NERR Research Plan Overview

These national programs provide an excellent framework for the research sector of the NCNERR. Yet, local issues and guidance are equally important. The NCNERR must be both nationally significant while at the same time maintaining local relevancy. To accomplish this, locally important issues are also utilized to guide the research sector of the NCNERR.

The NCNERR quantified the locally important issues through a market analysis and needs assessment. The Research and Monitoring program market analysis revealed that 94% of the 50 respondents (51% response rate) are familiar with the NCNERR; 49% of respondents are currently conducting research on Reserve sites or have in the past; and the highest ranked issues that these respondents are currently researching include fisheries, shellfish, coastal/watershed pollution, water quality, and stormwater issues. The needs assessment targeted local managers, scientists and citizens and asked them a series of questions designed to determine what scientific issues needed additional research. The needs assessment revealed that the highest ranked research topics that need more attention are water quality in relation to shellfish, impacts of development (*e.g.*, stormwater, shoreline stabilization, docks and piers, etc.), and effectiveness of beach stabilization methods. The results from this endeavor showed that research was needed in many areas. Additional sector guidance was derived from the research and monitoring needs identified by the Coastal Habitat Protection Plan (Appendix P). This document highlights the need for research in the following areas: strategic habitat areas, fish-habitat relationships, docks and marinas, estuarine erosion and shoreline stabilization, boating related impacts, beach nourishment, fishing gear impacts, managing non-native species, chemical effects, water supply, habitat status and trends, evaluating existing management measures, and comprehensive water quality monitoring.

All of these national and local needs were considered when developing the research objectives and activities outlined above and in Figure 1. The approach of combining national and local needs ensures the work conducted by NCNERR is broadly applicable while at the same time focused enough to assist local managers and policy makers in their endeavor to protect the coastal resources of North Carolina.

B. NCNERR Research Objectives

The NCNERR research activities address the following Reserve objectives (Figure 1):

- **Objective 1.1:** Education programs will deliver information on N.C. coastal resources to formal and informal educators, and K-12 and college students to foster environmental stewardship and informed decision-making.
- **Objective 2.1:** NCNERR research products will be used by the coastal management community.
- **Objective 2.2:** The NCNERR will enhance implementation of the System-Wide Monitoring Program.
- **Objective 3.1:** NCNERR habitat and watershed maps will inform management of the sites and improve understanding of watershed connections.
- **Objective 5.4:** The NCNERR will assess use of the sites by various education, research, and commercial entities.

C. Activities in Support of NCNERR Research Objectives

Research objectives are presented in bold, italic text with the objective number that refers to Figure 1 in parentheses. Objective activities are presented beneath each objective.

1. Education programs will deliver information on N.C. coastal resources to formal and informal educators, and K-12 and college students to foster environmental stewardship and informed decision-making (1.1)

Design field-based K-12 and college student site management projects with stewardship and research sectors

Research staff will work with education and stewardship staff to integrate field-based site management projects into K-12 student education programs. Field-based projects provide students with hands-on experience in the field and a heightened sense of appreciation of estuarine resources, while enhancing site management of the NCNERR sites. Projects may include trash clean ups, invasive species management (*e.g.*, Tamarisk tree mapping and removal), bird surveys, and osprey nest platform construction. Initially these efforts will take place on the Rachel Carson site, due to its proximity to the Reserve education staff, yet may expand to the other Reserve components pending success, need, and resources.

2. NCNERR research products are used by the coastal management community (2.1)

Develop research priorities with the coastal management community that address high priority coastal management issues

Research staff will continue to identify high priority coastal management science needs with the research and coastal management communities in North Carolina. To best accomplish this, a Division of Coastal Management (DCM) research and monitoring plan is under development that identifies high priority research topics. This plan is being developed through the coordinated efforts of NCNERR and the other sections of the DCM. This plan will be revisited every two years so that as the coastal management needs change, the focus of NCNERR's research efforts can change with them. An analogous education plan has been developed.

Conduct and promote site-based and watershed research that informs management of coastal ecosystems, including the Reserve sites

The NCNERR is perfectly suited to both generate and distribute the needed data upon which to base management decisions. The NCNERR contains undeveloped properties where natural processes occur with minimal anthropogenic impacts. Results from studies conducted at the Reserve components serve as reference sites providing baseline data representative of natural conditions. These can then be compared to those from developed areas of the same watershed allowing impacts to be quantified.

In addition to serving as reference sites, the Reserve properties are ideal locations for demonstration projects. The Reserves are very much in the public eye. This, combined with the capabilities of the education and outreach sector, provide an excellent opportunity to show alternatives to generally accepted coastal development and/or management practices. One such demonstration project will be constructed on the east end of the Rachel Carson Reserve which has been experiencing severe erosion. The Reserve will install an erosion control structure at this location as part of a larger project examining estuarine shoreline stabilization. This structure will demonstrate an alternative shoreline stabilization technique to the generally accepted practice of installing a vertical bulkhead. Another demonstration project in place at the Rachel Carson Reserve is the use of recycled building products in the construction of the public boardwalk.

The NCNERR conducts and facilitates original, high-quality research within the components and their associated watersheds as part of the national site research program. The NCNERR supports and recognizes the need for conducting the research program using a watershed management approach. This management approach is widely recognized as necessary for effective coastal management and is utilized by the National Oceanic and Atmospheric Administration (NOAA), U.S. Environmental Protection Agency, and Department of Environment and Natural Resources (DENR). The facilitated work is conducted by outside researchers from academic and other government and non-government agencies. This research focuses on understanding coastal processes, resulting in improved management of the coastal resources in North Carolina. The NCNERR facilitates research through various methods depending on project needs and internal resources. Activities successfully used to facilitate and promote external research projects include providing: access to the Reserve sites; staff time to assist with field sampling; expertise

to guide sample site selection and project design; and an excellent reference site for outside projects. The NCNERR education sector also helps facilitate research by providing an extremely valuable outreach component that many external researchers and institutions do not possess.

Research priorities will be addressed by the NCNERR as expertise and resources allow. External funding and partnership opportunities will be explored to enhance NCNERR capabilities. The research priorities will be communicated to the research community and potential GRFs (see below) through the NCNERR website, newsletter, and seminars. The NCNERR research priorities, current projects and results are also promoted through research staff members participating in local workgroups and advisory panels (see coordination and partnerships section below). This provides a direct link for NCNERR to influence North Carolina coastal policy.

Promote Graduate Research Fellowships

As part of the NERRS GRF program, two graduate student stipends are provided for work conducted within NCNERR. These stipends provide \$20,000 per year and are renewable for up to three years. The current focus areas provided by NERRS for the GRF program are: eutrophication, effects of non-point source pollution and/or nutrient dynamics; habitat conservation and/or restoration; biodiversity and/or the effects of invasive species; mechanisms for sustaining resources within estuarine ecosystems; or economic, sociological, and/or anthropological research applicable to estuarine ecosystem management. All of these correlate directly with the overarching threats faced by the NCNERR properties and research priorities fit within these foci.

The NCNERR promotes and fosters this program through three main processes: advertising the funding opportunity, conducting the application review process, and by overseeing graduate students while funded by this fellowship. Advertising the funding opportunity is done by the Reserve through email postings to student list-serves, directed phone calls to Principal Investigators, and advertisement at regional scientific conferences. This effort is designed to increase the competition level for the fellowships by increasing the number of applicants. This should enhance the quality of work proposed and conducted within the NCNERR properties by fellowship recipients. This effort is already yielding successful results. Application rates over the past three years have increased from 1.5 applicants per opening to five applicants per opening. As part of the review process, the research sector forms review panels, secures and compiles all reviews, and ranks candidates for ERD. This activity helps to advertise the NCNERR in general by enhancing the Reserve's visibility to the various experts contacted across the country to participate in the review process. The Research Coordinator is also tasked with overseeing the graduate research fellows. The graduate students that receive the fellowship are required to work within the research and monitoring program of the Reserve. This provides an excellent opportunity for the Reserve to foster their research projects and assist in their training to become estuarine scientists. This program provides an ideal mechanism to address the overarching issues facing N.C. listed in section I, C, 4 and to educate and train graduate level students.

Collaborate with education sector to interpret and distribute research results

The research sector will work to ensure accurate and timely transfer of research results from all three aspects (site research, SWMP, and GRF) of the NCNERR research program to the education office assisting in the implementation of goals 1.1.4 and 1.3.4. The recently completed NCNERR site profile is an excellent example of this process. The site profile provides an overview of the NCNERR components and identifies important issues and knowledge gaps that need to be addressed in the future. This is an excellent tool that can be used by the education sector to inform their audiences. Research staff will work with education staff to incorporate high quality data, tools, techniques, and research results into education materials and programs, providing a direct link to the NCNERR customers. The Research and Education Coordinators are currently analyzing the Reserve's 13 years of SWMP and nutrient data to identify water quality trends and to observe how past events have affected local estuaries. Based on the data analysis new educational products will be developed for teachers, students, researchers, coastal decision-makers and the general public. Opportunities for distribution through the education program include incorporation of products into K-12 curricula, CTP technical bulletins, community outreach display boards, newsletters, and presentations at education sector workshops. The research sector will also work to publicize its products through annual reports, seminars, peer-reviewed journal publications, and presentations at conferences and coastal management meetings such as the Coastal Resources Commission meetings. NCNERR staff will encourage outside researchers conducting work on the components to disseminate results and products through these channels as well.

3. NCNERR will enhance implementation of the System-Wide Monitoring Program (2.2)

Monitor water quality at Rachel Carson, Masonboro Island and Zeke's Island

The four NERRS SWMP long-term water quality, Chlorophyll *a* and nutrient monitoring stations are located at the Masonboro Island and Zeke's Island components of the NCNERR. The NCNERR meteorological station is located on Masonboro Island. These sampling sites are maintained to fulfill the long-term monitoring of SWMP component I. These stations have been in place since 1994 and represent one of the best examples of long-term estuarine monitoring in North Carolina. Long-term monitoring is essential to evaluating slow, but continual changes in water quality typically associated with altered land use and eutrophication. Maintenance of these stations is paramount to continuing this valuable dataset. Given these important factors, these stations will be maintained above all else.

A partnership between the NCNERR and the National Park Service supports SWMP component I water quality monitoring at the Rachel Carson component. Through this partnership, codified with a Memorandum of Understanding, the Park Service provides the equipment and necessary consumables and NCNERR provides the manpower to maintain two water quality monitoring locations (Appendix J). One station is located at the Shackleford Banks portion of the Cape Lookout National Seashore and the other is located in the Middle Marsh portion of the Rachel Carson component. The data from these monitoring stations are being used by graduate students and faculty from local marine labs, the Park Service as part of their Inventory and Monitoring

Program, and the NCNERR for comparison with a similar dataset collected at the Middle Marsh site from 1997-2003.

Participate in regional ocean observing and NERRS Integrated Ocean Observing Systems efforts

Integrating the NCNERR SWMP component I into the Integrated Ocean Observing Systems (IOOS) backbone will provide NCNERR data in near real-time nationwide. To facilitate involvement, the research staff will participate in regional ocean observing activities and advertise the near real-time capabilities of the NCNERR to regional IOOS partners, federal and state agencies, and universities. Staff will also seek outside funding to equip additional sampling sites with telemetry hardware. This activity supports SWMP component I. Initial success in this activity has already been achieved. The SWMP station located in Zeke's Basin has been equipped with telemetry hardware via external funding through a partnership with the Carolina Regional Coastal Ocean Observing System. Discussions are currently occurring with this organization to equip an additional NCNERR water quality monitoring station with telemetry hardware at the Rachel Carson component. Providing the SWMP data in near real-time makes the data available to a wider audience. Results from the research needs assessment clearly showed respondents are interested in having the SWMP data telemetered (74% of respondents answered yes).

Evaluate equipping SWMP sondes with Chlorophyll *a* probes

Currently NCNERR quantifies Chlorophyll *a* once per month as part of the nutrient sampling program. Upgrading the sondes with Chlorophyll *a* probes would allow estimates of Chlorophyll *a* to be obtained every 15 minutes. The State of North Carolina, as well as many other research entities, use Chlorophyll *a* as an indicator of water quality. Having Chlorophyll *a* data every 15 minutes as opposed to once per month will greatly increase the quality and usefulness of the SWMP data. Additional end users of the SWMP data are expected as a result of this additional capacity. The main constraint on this activity is the cost of the Chlorophyll *a* probes. Partnership opportunities are one potential way to alleviate this constraint. Efforts will be made by the research staff to seek collaborators that may be willing to provide external funding to support this activity. This activity supports SWMP components I and II.

Explore reinstallation of SWMP water quality monitoring at the Currituck Banks component

Traditionally, research and monitoring efforts have been focused in the southern components (Masonboro and Zeke's Islands). However, water quality monitoring was recently expanded to the Rachel Carson component (September 2007) and it is desirable to have monitoring at the Currituck Banks component as well because each component is geographically disparate and has very different physical and biological environments. Conclusions reached based on the water quality data from Masonboro and Zeke's are unlikely to be applicable to the Rachel Carson and Currituck Banks components. The only way to assess the water quality at these components is to equip them with instrumentation. Results from the research needs assessment showed that three-quarters of the respondents fully supported this activity. Water quality data from all four Reserve

components will help NCNERR directly assess the threat to water quality associated with increased coastal populations.

Initial successes regarding this activity include a two-year externally funded study that supported SWMP component I monitoring within Currituck Banks from 2005 to October 2007. This effort helped expand the NCNERR research partners to include the United States Geological Survey (USGS), U.S. Army Corps of Engineers, N.C. Division of Water Resources, the University of North Carolina (UNC)- Coastal Studies Institute and Elizabeth City State University. Additionally, this project increased the number of individuals asking for data. Requests have come from the Albemarle-Pamlico National Estuary Program (APNEP) and from graduate students working on harmful algal blooms within Currituck Sound. Currently this instrumentation is not deployed but funding sources and partnerships to support redeployment are being sought.

Conduct additional components of SWMP as appropriate

The SWMP component I represents only one aspect of the required dataset envisioned by the NERRS. The component II or biomonitoring contains several components including: submerged aquatic vegetation (SAV) and emergent marsh spatial and temporal distribution; nekton biodiversity; phytoplankton abundance and community composition; and benthic infauna biodiversity. This activity supports SWMP component II monitoring within NCNERR. The goal of this component of SWMP is to understand how the biological components of the Reserve respond over short- and long-term cycles. Some of these are captured in Objective 3.1 below; however, others like the nekton, phytoplankton and benthic infauna portions are not. NCNERR does not have the capacity to accomplish all of these biomonitoring aspects. Thus, the research sector has focused efforts on the emergent marsh portion. Working with partners from the CCFHR in Beaufort, N.C. the Reserve has initiated marsh monitoring at four locations near the Rachel Carson Reserve. This effort, partially funded by NOAA's Restoration Center is examining how closely restored marshes mimic the function of natural marshes. This work will also allow NCNERR to track the ability of marshes within the Reserve properties to maintain themselves against the threat of sea level rise. Additional marsh monitoring is planned by the stewardship sector for the Wilmington area (see Stewardship Plan). This emergent marsh monitoring is the first step toward implementing this activity. The other portions of SWMP component II will be implemented as funding and staff resources allow. SWMP component III is the mapping of land use and cover in the Reserve properties and associated watersheds (described in section IV, C, 4 below).

Promote use of SWMP data by partners

The SWMP data are used by many outside entities. In response to the needs assessment question "what ways could you use NCNERR SWMP data or what ways have you used NCNERR SWMP data in the past?" there were a multitude of responses. Some of the uses respondents indicated include: assist graduate student thesis preparation; manage shellfish and recreational waters; classroom demonstrations; and preliminary data to support proposal development. Results from the market analysis and needs assessment clearly showed that the SWMP data was extremely

valuable and 77% of respondents desired that all North Carolina Coastal Reserve sites including the NCNERR sites be outfitted with SWMP component I monitoring equipment.

Clearly the SWMP data is being used by outside partners and the NCNERR will continue promote the use of this dataset. Some of the previous activities work toward this goal such as telemetering more sites, and adding additional data parameters. SWMP capabilities and available data are advertised when research staff gives seminars and has one on one conversations with colleagues. An ongoing effort between the research and education sectors to examine and analyze the NCNERR SWMP dataset for long-term trends will also help promote this dataset. This report when completed will be distributed to all of the Reserve's partners and available for download from the NCNERR website. In 2009 a new SWMP brochure will be developed that describes SWMP and the available dataset. This brochure will be available for download from the website and handed out at appropriate venues.

4. NCNERR habitat and watershed maps will improve understanding of ecosystem connections (3.1)

Map upland and emergent wetlands within NCNERR boundaries

The research and stewardship sectors will conduct a joint effort with the Geographic Information System (GIS) Specialist to map the four NCNERR components using the NERRS Habitat Classification scheme. Field surveys and digital image analyses will be conducted to delineate habitats for the Masonboro Island, Zeke's Island, Rachel Carson and Currituck Banks sites, based on NERRS classification protocols and methods developed by the NCNERR. Baseline habitat maps and aerial statistics have been produced for the four NCNERR sites. Methods and results are presented in the NCNERR Site Profile. The habitat classifications will be updated every five to ten years, dependent on availability of appropriate aerial imagery and staff priorities. The updates will be used to evaluate changes in habitat distribution and condition for the four NCNERR components. This activity directly supports SWMP components II and III.

Map SAV distribution and condition within NCNERR boundaries

The North Carolina Coastal Habitat Protection Plan (CHPP) recognizes SAV as one of the six habitats that supports coastal fisheries. Given the pristine nature of the components and staff expertise, the NCNERR is well situated to develop and test mapping protocols within its boundaries. The research and stewardship sectors and the GIS Specialist will collect existing information on SAV distribution within the NCNERR sites, collaborate with researchers and partners (*e.g.*, the North Carolina SAV Monitoring Committee and NERRS Biomonitoring workgroup) to identify appropriate techniques for monitoring SAV, and map distribution and condition within the NCNERR. Field surveys have been completed for the Rachel Carson and Masonboro Island components. Significant SAV beds were mapped and conditions documented at Rachel Carson in the summers of 2006 and 2007. No SAV was found at Masonboro Island in the summer of 2007. Similar field surveys will be conducted for Currituck Banks and Zeke's Island. Significant SAV beds that are identified at any of the NCNERR sites will be periodically re-surveyed for extent and condition. The potential will be investigated for designating existing NCNERR beds as sentinel SAV sites as part of a long-term SAV monitoring program, if

established for the State of North Carolina. This activity also directly supports the SWMP components II and III and is one of the priorities for the CHPP's research and monitoring needs (Appendix P).

Assess NCNERR watershed land cover and change

The GIS Specialist will analyze NOAA Coastal Change Analysis Program (C-CAP) land cover and change data, producing maps and areal statistics of land cover and change in NCNERR component watersheds. Land cover maps and statistics were derived from C-CAP data for the four watersheds from 1991, 1997 and the difference between the two dates. Methods and results are reported in the NCNERR Site Profile. This effort will be repeated and results compared to the existing Land Cover products as future C-CAP data sets become available. This effort will also endeavor to characterize the relationships between NCNERR habitat condition and watershed land cover. This activity supports SWMP component III and addresses the altered land use threat to the Reserve properties. Research staff will assist the GIS Specialist with this project and will interpret the Land Cover information for inclusion in education products.

5. NCNERR will assess use of the sites by various education, research and commercial entities (5.4)

Maintain the research permit system

The NCNERR requires all researchers using the Reserve properties to fill out a research permit. Full details regarding this permit can be found in Appendix Q - Research Policies. In short, the permit system tracks Reserve use by researchers. This tracking is used by NCNERR to inform the performance measures to both NOAA and DENR. It also helps maintain project integrity by preventing project conflicts (*e.g.*, trying to utilize the same sampling location), and conflicts with other Reserve users. This tracking has become even more important as the populations of the coastal counties have increased leading to increased Reserve use. Requiring a permit also provides the Reserve with an excellent opportunity to meet and interact with external researchers. It provides one more way to initiate new partnerships and advertise the capabilities of the Reserve.

The permit system is in the process of being updated. The permit application up to this point had to be filled out in hardcopy format. A new web-based electronic format is being piloted in an effort to increase compliance with this permit requirement. Another part of the permit process that needs improving is the success NCNERR has at getting final reports submitted. As part of the permit, any final reports and or manuscripts that result from the work need to be submitted to NCNERR. Often the Reserve does not receive these final reports. Efforts to improve upon this will be undertaken by the research sector. One option is to use the NCNERR website as a location for researchers to advertise their work and submit electronic versions of their final reports and manuscripts.

D. Coordination and Partnerships

1. Coordination

a. NCNERR Components

To enhance the NCNERR's abilities through collaboration, the research staff seeks to foster communication and program consistency between Reserve sectors and sites to ensure cohesive and integrated Reserve research programs. The Reserve Manager will foster this enhanced integration among NCNERR sectors through regular staff meetings and encouraging participation of other sector staff in research programs. The research sector will notify other Reserve staff of ongoing and upcoming research projects conducted internally and by external partners for potential dissemination through education programs and coordination with stewardship staff. These activities will encourage the sectors to work together more efficiently as well as create a more integrated research program throughout all components of the NCNERR.

b. National and Regional NERRs

The NCNERR research and monitoring programs are consistently reported to NOAA's ERD through biannual progress reports and through performance monitoring data. Additionally, upcoming research activities are outlined in the annual NCNERR 315 grant application. The NERRS annual meeting and winter research sector meetings are attended by the appropriate research staff. The NCNERR SWMP adheres to national data collection and reporting protocols. The NCNERR research staff will continue to serve on NERRS workgroups and attend Southeast Coastal Ocean Observations Regional Association (SECOORA) meetings. SECOORA is one of eleven Regional Associations comprising the coastal component of the IOOS. SECOORA is a 501(c)3 membership non-profit which designs, implements, operates, and improves the provision of data, information, and products for marine and estuarine systems deemed necessary for common uses according to sound scientific practice. SECOORA serves the needs of users with measurements, telemetry, data management and communications, data analysis and modeling, and data visualization and publishing.

c. North Carolina Division of Coastal Management

This management plan outlines increased opportunities for collaboration between DCM and the research sector. The NCNERR research staff participation on panels, such as the DCM Ocean Policy Workgroup, the APNEP indicators workgroup, and attendance at Coastal Resource Commission meetings, will promote interaction between research and DCM staff. This interaction is critical for the success of many of the tasks outlined in this research plan. The research sector will continue to promote Reserve research activities and capabilities within DCM and DENR. This understanding is vital to fulfilling NCNERR Objective 5.2 to strengthen its relationship with DCM.

2. Partnerships

The topical and geographic diversity of the research program offers opportunities for new and expansion of existing partnerships throughout coastal North Carolina. The facilities of the research program are largely met through existing infrastructure at the Reserve's offices and through partnerships with the UNC-Coastal Studies Institute and the UNC-CH Institute of Marine Sciences. Research collaborations with universities and state agencies enhance the topical coverage of the research program and promote the research platform of the NCNERR. Examples of such collaboration include the NCNERR and National Park Service agreement for water quality monitoring at Rachel Carson, and an atmospheric deposition monitoring program with the U.S. Fish and Wildlife Service, the UNC-CH Institute of Marine Sciences, and North Carolina State University. The September 2005 312 Evaluation Findings suggest enhancing research partnerships to capitalize on the diversity and strength of coastal North Carolina's research community. The examples provided throughout the plan demonstrate the progress made since the evaluation and the activities outlined in this chapter will facilitate this. A full listing of existing research NCNERR partnerships is located in Appendix L.