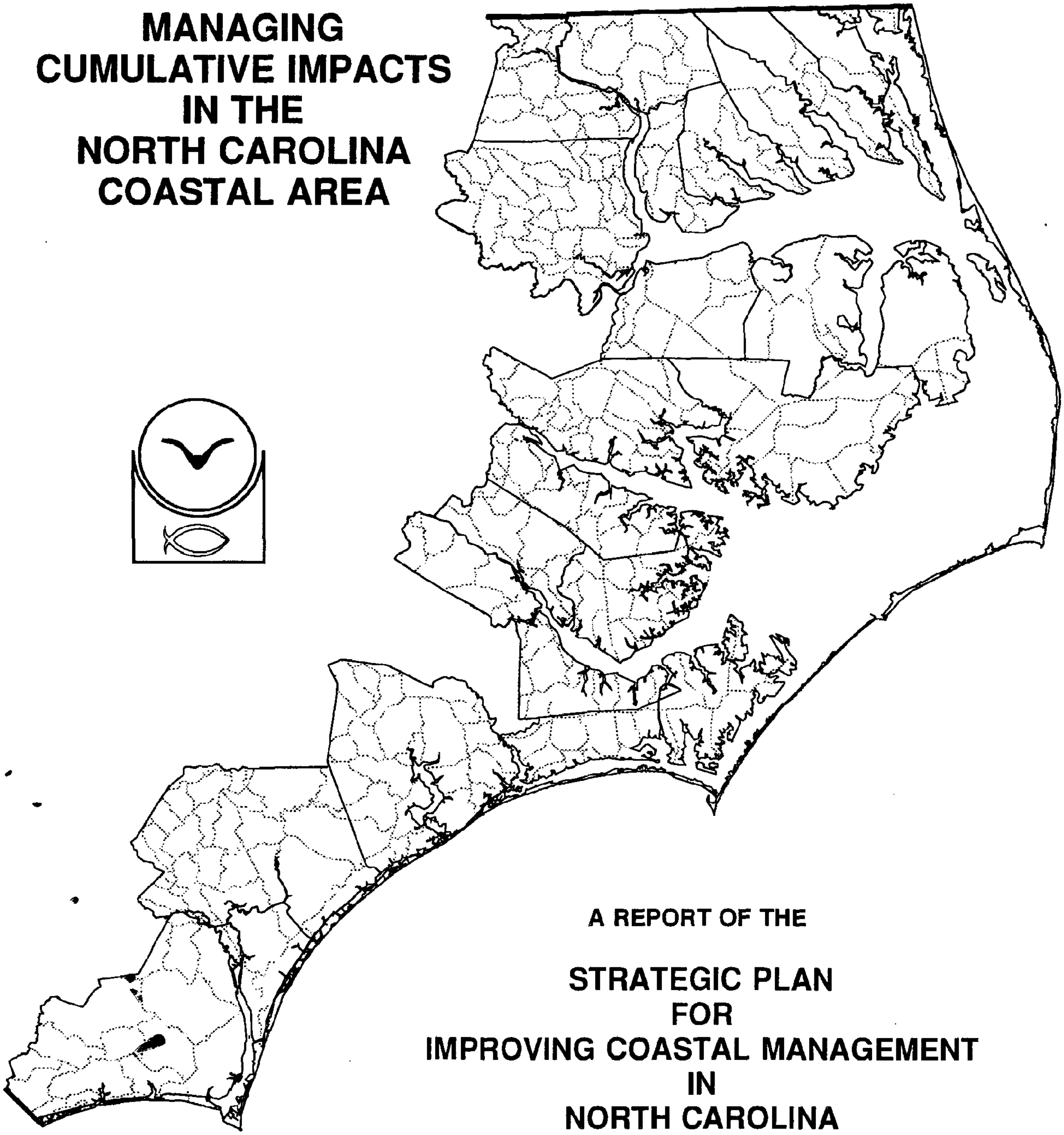
MANAGING CUMULATIVE IMPACTS IN THE NORTH CAROLINA COASTAL AREA



A REPORT OF THE

STRATEGIC PLAN FOR IMPROVING COASTAL MANAGEMENT IN NORTH CAROLINA

Performed Under the Coastal Zone Enhancement Grants Program

Division of Coastal Management
North Carolina Department of Environment, Health and Natural Resources

COVER GRAPHIC: This GIS map of the North Carolina Coastal Area shows boundaries of counties and small watersheds, or hydrologic units. These hydrologic units are the focus of analytical and planning components of the Strategic Plan for Improving Coastal Management in North Carolina.

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June 15, 1994

The preparation of this report was financed by funds provided by the Office of Ocean and Coastal Resources Management, NOAA, under the Coastal Zone Enhancement Grants Program. The views expressed herein are those of the author and do not necessarily reflect the views of NOAA or any of its sub-agencies or those of the North Carolina Department of Environment, Health and Natural Resources.

A publication of the North Carolina Department of Environment, Health and Natural Resources pursuant to National Oceanic and Atmospheric Administration Award No. NA270Z0332-01.

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INTRODUCTION

Section 1

The coastal area of North Carolina is being affected by the kind of rapid growth and development typical of the nation's coastal areas. As a whole, the coastal area is the fastest growing region in the state. During the 1980s, four of the five fastest growing counties in the state were located in the coastal area, and that trend has continued into the 1990s.

One of the primary purposes of the North Carolina Coastal Management Program (NC CMP) is "to guide growth and development and to minimize damage to the natural environment" (NCGS 113A-102) that makes the coastal area productive and attractive. It has been recognized since the passage of CAMA that commercial and residential development and the development of water dependent facilities such as piers and marinas may adversely impact biological resources and coastal water quality. Both the CAMA permitting program and local land use planning requirements, as well as other state and federal regulatory programs applicable to the coastal area, have been designed to minimize these adverse impacts while allowing coastal development to occur.

Most regulatory programs are designed to minimize the impacts of individual projects on the resources they directly affect. When development becomes concentrated, however, the cumulative and secondary, or indirect, impacts of the development may be significant, even though the direct effects of each individual project are minimal. Runoff from one specific development on the estuarine shoreline may not, in itself, result in a significant decline in water quality, but the cumulative runoff from many such developments may. The possibility of adverse cumulative impacts has been recognized since the development of the original CAMA use standards and land use planning guidelines, but the lack of specific statutory authority or straight-forward methods for assessing cumulative impacts made it difficult to address this possibility. Instead, the approach taken was to attempt to minimize individual impacts to such an extent that cumulative impacts would not be significant.

After nearly twenty years of experience with the CAMA regulatory and land use planning programs, the continued appropriateness of this approach is being questioned. Environmental degradation has occurred, in spite of CAMA and other state and federal environmental protection programs. Although the situation would be much worse without these programs, the public often perceives them as inadequate so long as any noticeable environmental degradation occurs. Seventy percent of public comments received in the CZMA §309 Assessment of the NC CMP performed in 1991 indicated that adverse cumulative impacts were a problem that should be addressed through program enhancements (DCM, 1992a). During a series of public meetings held in the spring of 1993, declines in coastal water quality and fisheries and closure of areas to shellfishing were the symptoms most often cited as evidence of adverse cumulative impacts of growth and development.

As part of its Four Year Strategic Plan for Enhancing Coastal Management, the North Carolina Division of Coastal Management (DCM) is developing methods for assessing and managing adverse cumulative impacts in a more holistic fashion than has been used in the past. This report is a technical introduction to the DCM approach. Section 1 summarizes the results of initial research on cumulative and secondary impacts, discussing their definition and considerations necessary for their assessment and management. Section 2 discusses the North Carolina context and assesses the strengths and weaknesses of the NC CMP in managing cumulative impacts. Section 3 describes the cumulative impacts management model being applied in the NC coastal area. Sections 4 and 5 discuss the types of high risk areas likely to be present in the coastal area and alternative cumulative impacts management strategies that may be applied to them.

Defining Cumulative and Secondary Impacts

While the existence of cumulative and secondary impacts has long been recognized, the difficulty of identifying and dealing with them has prevented specific action within planning and regulatory programs. It is easy to talk in general terms about cumulative impacts, but much more difficult to specifically identify them. The first critical step is to agree on a definition.

While there are a variety of ideas about cumulative impacts and what they include, the most widely accepted definition is that given by the Council on Environmental Quality (CEQ) in its guidelines for implementation of the National Environmental Policy Act (NEPA) of 1969. Those Guidelines define a cumulative impact as:

> ***"...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR Sect. 1508.7).***

This definition of cumulative impacts defines them as the "additive" result of all individual impacts of a series of actions occurring over time and space, including those of the past and the foreseeable future. The impacts of any single action may be negligible, but the cumulative effect of many actions may result in the gradual and incremental degradation of a resource over time.

There are other ways of considering cumulative impacts than as simply additive. In many cases environmental impacts are interactive or synergistic so that the total effect of an interaction between two or more impacts is greater than the sum of the individual effects (Beanlands, et al., 1986). The cumulative impact of synergistic actions is greater than the additive impact of each action. Considering the complexity of ecological systems, it is likely that synergistic cumulative impacts occur more frequently than additive impacts. The greater degree of complexity involved in synergistic impacts, however, make them even more difficult to assess or manage.

Still another approach toward cumulative impacts is to include all possible impacts of a given action, including not only its direct impacts but also those of additional actions which the first may stimulate. Examples include highway and bridge construction, in which the direct impacts of construction itself may not be as great as the impacts of additional growth and development that may result from the new highway or bridge. The cumulative impact of such a project may be considered as the total impact of the project itself plus the impacts of all resulting development.

To avoid further confusing an already difficult subject, however, it is preferable to consider this situation an example of secondary rather than cumulative impacts. In this case there is only one project or activity, and the potential impacts being considered include its indirect, or secondary, effects. Cumulative impacts, on the other hand, are the overall effects of multiple activities, whether these activities are related to one another or not. For the purposes of DCM's consideration of cumulative impacts, then, one activity at one place and occurring at one point in time can never be considered to have cumulative impacts. It is only when an activity is considered together with other activities affecting the same resources that cumulative impacts are relevant. This approach is consistent with the CEQ definition of cumulative impacts.

Secondary impacts, then, may be defined as the indirect effects of an activity resulting from the activity's role in influencing other systems. Other systems influenced may include the local economy, as in the highway or bridge example in which the improved access resulting from the highway or bridge creates new markets by eliminating previously existing constraints. Or the activity may influence natural systems, e.g., a development adjacent to a wetland may decrease certain of the wetland's functions, resulting in degraded water quality or declines in fish productivity. The development itself did not directly cause these ultimate impacts, but without the development's effect on other systems the secondary impacts would not have occurred. Secondary impacts occur whenever one activity results in far-reaching, indirect, and often unexpected, effects mediated by the operation of other systems.

Both natural ecosystems and human-generated systems such as the economy are extremely complex, transcending complete understanding or predictability. Due to this complexity, it is likely that every activity has at least some secondary impacts and that any time there are two or more activities, they have cumulative impacts. The question is not whether these impacts exist, but at what point they become sufficiently significant and adverse to warrant specific consideration and action.

Assessment vs. Management of Cumulative and Secondary Impacts

The CEQ definition of cumulative impacts was developed to provide guidance for implementing NEPA's requirement to assess cumulative impacts. Most of the subsequent literature on the subject deals with the topic of cumulative impacts assessment. There is a difference, however, between cumulative impacts assessment and cumulative impacts management (Institute for Environmental Negotiation, 1991). Since the two activities are often confused, it is helpful to distinguish them in planning an approach to cumulative impacts.

Ideally, cumulative impacts assessment includes an analysis of the complex relationships between multiple disturbances and valued environmental functions (Leibowitz, Abbbruzzese, et al., 1992). It seeks to identify, understand, and, if possible, quantify the actual cause and effect relationships among multiple human-induced activities and the functional characteristics of the ecosystems they effect. This requires a very complex analysis that is fraught with scientific difficulties and uncertainties. Trying to deal definitively with cause and effect relationships in a complex and inter-related web of causal pathways is extremely difficult, expensive and time-consuming. It stretches the current state of ecological understanding to its limits. Attempting to perform this type of analysis in a regulatory context probably exceeds those limits.

This does not mean that site or project-specific cumulative impacts analysis should not be attempted. It must be in those cases in which laws, such as NEPA, require that it be performed. It does mean, however, that it is an impractical approach upon which to base a government environmental management or regulatory program. While rudimentary techniques for cumulative impacts assessment exist, our current state of knowledge limits the results to either qualitative professional judgements or the output of complex mathematical models. This may not be an adequate basis upon which to justify why a landowner will not be allowed to do the same thing his neighbor has already done. Detailed, cause-and-effects cumulative impacts assessment is too complex, imprecise, and difficult to understand and explain to form an acceptable basis for public policy and regulatory decision-making.

Another approach is simply to accept the complexity of the cause-effect relationships and focus instead on the causes and effects themselves. Instead of attempting to understand and specify complex ecological relationships, this approach identifies the activities that result in impacts and the status of resources that are affected. Two implicit assumptions are involved.

(1) ***If a system is already exhibiting symptoms of degradation (i.e., adverse effects exist), the degradation is the result of the cumulative impacts of all the factors influencing the system.***

(2) ***If environment-impacting activities (causes of impacts) become intensive enough in a limited area, there will be adverse effects resulting from the cumulative impacts of the many causes.***

The first assumption is intuitively obvious and, therefore, not difficult to justify. The second assumption is more difficult, since it entails determining the point at which disturbance becomes "intense enough" to result in adverse cumulative impacts. This point is the limit of the local system's tolerance or buffering capacity for the particular disturbance or combination of disturbances involved. This limit is sometimes called the system's "carrying capacity," although that term and the well-documented phenomenon of limits to population densities upon which the carrying capacity concept is based do not really apply to multiple disturbances and cumulative impacts.

With engineered public facilities such as roads, water systems, and sewage treatment works, the determination of maximum capacity is straightforward (Dickert, et al., 1976). Similarly, if the available supply of a consumptive natural resource, such as groundwater or assimilative capacity, can be determined, the maximum human population it can support can be calculated. A 1983 study of the carrying capacity of part of Currituck County, NC, (Bell, et al.) concluded that its human population was limited by the amount of land suitable for septic tanks, since no wastewater treatment plant existed. Construction of a sewage treatment plant would effectively remove this limitation and, thus, change the area's carrying capacity and the limiting factor on which it depends. Any capacity determined by engineered facilities or by resources that can be substituted for, therefore, is not an absolute carrying capacity intrinsic to the area, since it can always be changed (Institute for Environmental Negotiation, 1991).

Determining natural limits or ecological thresholds is more difficult, since they are determined by complex and often poorly understood ecosystem dynamics. Definitive determination of ecological thresholds, even for one system, requires large amounts of research and data. Nevertheless, considerable progress is being made on identifying natural limits and applying them to management and regulatory decisions. Dickert and Tuttle (1985) used hydrologic and erosion models to establish land disturbance thresholds for the Elkhorn Slough watershed in California. These thresholds were incorporated into a land use planning framework. The whole basin approach to water quality management being implemented by the NC Division of Environmental Management (DEM, 1991) uses total maximum daily loads (TMDLs) derived from models based on assimilative capacity, existing loading, and other basin characteristics. These TMDLs are applied to both the NPDES regulatory program and to planning of voluntary BMPs for nonpoint sources to limit the total discharge of pollutants in the basin to a level below the threshold of water quality impairment.

Whether or not a natural threshold level can be reliably quantified, the concept is well accepted: when the cumulative effects of multiple human activities exceed a certain threshold, significant environmental damage becomes evident. Several useful general propositions can be derived from this concept.

(1) ***If environmental degradation is not evident, the threshold has presumably not been exceeded. (Although it may simply mean that we are not monitoring the appropriate parameters of degradation.)***

(2) ***Even though the exact threshold level may be unknown, the more pressure that exists in a given area, the closer the system is likely to be to its limits.***

(3) ***The more sensitive the resources of an area are to disturbance, the lower their threshold level is likely to be.***

Risk Assessment

Even though we cannot define ecological thresholds with certainty, these propositions provide a basis for what might be termed "cumulative impacts risk assessment." Ecological risk assessment has been applied for some time to analyses of the effects of specific environmental hazards (Barnthouse and Suter, 1986;) and has been more recently applied to cumulative impacts (Hunsaker, et al., 1990; Hunsaker, 1993). The objective of ecological risk assessment is to provide a quantitative basis for comparing risks and a systematic means of improving the estimation and understanding of those risks (Hunsaker, et al., 1990). It is not necessary to fully understand and quantify all the relevant parameters in order to compare the relative risks of different hazards or to compare different areas subject to different conditions. Relative risk assessment can be used to determine which risks are greater or which areas are at higher risk (Leibowitz, Preston, et al., 1992; Leibowitz, Abbruzzese, et al., 1992). While it may not provide precise answers, relative risk assessment does provide far better information than is currently available. This information can be used in making informed decisions and protecting or managing the environment at large geographic scales (Hunsaker, 1993).

A study by EPA's Science Advisory Board (1990) recommended that environmental management and protection efforts be focused on areas in which the greatest risk reduction could be achieved. Risk assessment is the necessary first step in identifying those areas of focus, whether they be specific environmental hazards or geographic areas. After high risk areas have been identified, risk management can be applied through the development and implementation of specific management strategies to control and manage the most serious risks.

This approach shifts the focus of attention from cumulative impacts assessment to cumulative impacts management. The emphasis changes from analyzing complex cause-effect relationships to assessing relative risks and developing management approaches to risk control. There is also a shift in spatial and temporal horizons. Cumulative impacts assessment of individual activities is carried out on the scale of a particular development project or discharge; cumulative impacts management is performed on the landscape-level scale at which cumulative impacts occur (Gosselink, et al., 1990). Cumulative impacts assessment focuses on the time horizon from the past to the present, while cumulative impacts management focuses on the time horizon from the present to the future (Williamson, 1992).

The cumulative impacts management approach also allows the application of standard planning and management techniques of problem-solving. The classical rational planning approach replaces the complexities of ecological analysis. Risk management decisions can be made through the consideration of priority problems in light of available management options, resources, administrative and legal structures, etc. This results in an approach more amenable to and more acceptable in public policy-making.

Gosselink and Lee (1989) proposed an approach to cumulative impacts management that can be generalized from the specific instance in which they applied it to a generally applicable management model. Their model has three components, summarized below with Gosselink and Lee's definitions of each component.

Assessment* - *The characterization of cumulative effects on both the ecological structure and the functional ecological processes in a designated landscape unit.

Goal-Setting* - *Agreement by public consensus on environmental goals for the assessment area, based on the assessment and consistent with statutes and regulations.

Implementation* - *The development of specific plans to implement the goals, based on the landscape structure and function of the area.

The assessment component in this model consists of an analysis of the current status of the landscape unit in comparison to its historic condition to determine the degree of degradation resulting from the cumulative impacts of past actions. Rather than attempting to analyze the cumulative impacts of specific projects on specific ecological parameters, this assessment approach uses a limited number of landscape indices, or relatively simple, measurable properties that reflect ecological structure and important functions. While Gosselink and Lee (1989) used wetland-related indices, the specific indices could vary, depending upon assessment objectives, and could include socio-economic as well as ecological parameters.

Applying a risk assessment approach to the Gosselink and Lee model results in an assessment that uses the same type of landscape indices to compare the status of different landscape units. Instead of a comparison of past with present conditions to determine ecological degradation, a comparison of current conditions and stressors in different spatial units can be used to determine the relative risks of significant adverse cumulative impacts among these areas. The areas at highest risk then become the focus of risk reduction management in the goal-setting and implementation phases.

This method has been called a "synoptic" approach (Leibowtiz, Abbruzzese, et al., 1992), since it provides a broad overview of environmental conditions. It's objective is not to provide a precise, quantitative assessment of cumulative impacts within an area nor to assess the cumulative impacts of specific projects, but to provide a relative rating of the significance of cumulative impacts among areas. The critical choices to be made in designing the risk assessment are the environmental indices to be used and the identification of appropriate landscape units and time scales for analysis.

Landscape Indicators and Indices

Landscape indicators are actual data or measurements that reflect some aspect of landscape condition. A landscape index is a calculated value derived from the values of landscape indicators and used as a basis for comparing landscape units (Leibowitz, Abbruzzese, et al., 1992). In a risk analysis of nonpoint source pollution, for example, acreage of agricultural cropland might be used as a landscape indicator. Nitrogen and phosphorus loadings calculated from average agricultural runoff figures might be a derived landscape index. The landscape indicator is a relatively easy to obtain data set for the landscape units. The landscape index translates the indicator value into an approximation of its functional significance.

The parameters used as landscape indicators and indices should adequately reflect both the pertinent environmental stressors and the pertinent measures of environmental quality that indicate the effects of stress. The specific parameters chosen will depend largely on the availability of data, as well as on the objectives and intended use of the assessment. It is rarely feasible to engage in extensive raw data acquisition for areas as large as those appropriate for cumulative impacts management (Leibowitz, Abruzzese, et al., 1992). Given limitations in time, resources, and information, it is necessary to use landscape indicators that are readily available and to calculate from them first order landscape indices that are as meaningful as possible in the context of the particular assessment.

In their assessment of the ecological status of the Tensas River Basin in Louisiana, Gosselink, Shaffer, et al. (1990) emphasized wildlife habitat, hydrology, and water quality. Landscape indicators included forest area and distribution, breeding bird surveys, Christmas bird counts, stream stage and discharge records, and water quality records. Landscape indices were the changes in values of the indicators over time. They found these data sets, supplemented with land-cover data and maps, to be sufficient to identify the major structural and functional changes related to the cumulative impacts of human activities. This information was used to formulate specific management goals and implementation strategies.

Leibowitz, Abbruzzese, et al., (1992) applied the synoptic approach to assessment of cumulative impacts on wetlands in Louisiana, Washington, and Illinois. Their objectives were to identify those areas where either wetland protection (Washington) or wetland restoration efforts (Louisiana and Illinois) should be focused. Landscape indicators included data on wetland area, measures of stream water quality, land use and human population. From these indicators, a series of landscape indices were calculated, based on the management objectives for each case. Indices of wetland hydrologic, water quality, and habitat functions, wetland values, replacement potential, and future risk of wetland loss were used to assess relative risks and significance of various landscape units for management efforts.

Since the goal of risk-based cumulative impacts assessment is the assignment of relative risk or priority for management action, not precise measurement or prediction, relatively simple landscape indicators and indices are sufficient. It is not necessary to mathematically describe exactly how conversion of forest land or wetlands to agricultural or urban uses leads to declines in habitat or water quality in order to assess the relative risk of such impacts among different landscape units. Thus, a risk-based approach to cumulative impacts assessment can greatly simplify data-gathering and analysis and still provide accurate guidance to management decision-making.

Spatial and Temporal Boundaries

Cumulative impacts, by definition, are landscape-level, long-term phenomena that occur as the consequences of numerous activities over time. Focusing on individual sites or projects necessarily misses these larger scale and longerterm patterns (Bedford, 1990). Each individual project has its site-specific effects, but cumulative impacts affect natural processes that occur within interacting ecosystems across the landscape. The water quality or productivity of a local portion of a larger waterbody is the result not only of what occurs at or adjacent to that portion, but also of what has occurred throughout the drainage basin.

The appropriate spatial scale for managing cumulative impacts, then, must be large enough to include all individual impacts that significantly influence the natural resource or process of interest. From a water quality perspective, entire drainage basins form an appropriate scale. From a wildlife management perspective, the management area must be large enough to satisfy the home range and habitat requirements of the farthest-ranging animal species of interest (Gosselink, et al., 1990). If habitat of wide-ranging migratory species is of interest, a very broad landscape boundary may be necessary. Ideally, space and time scales for cumulative impact management should be developed for each resource being managed. From the viewpoint of overall environmental management, however, a single scale that best fits most of the resources and impacts is more practical.

The choice of landscape units for cumulative impacts management must be based not only on ecological considerations, but also on management objectives and data availability. The unit boundaries should correspond as closely as possible to natural process boundaries, but may also be influenced by pragmatic considerations such as political jurisdictions, map scales, and analytical methods (Leibowitz, Abbruzzese, et al., 1992). Since water quality is an important environmental management consideration and watershed boundaries are relatively easy to delineate, watershed units of various sizes have been used most often as the basis for cumulative impacts analysis and management (Bedford, 1990; Johnston, et al., 1988; Gosselink, et al., 1990; Leibowitz, Abbruzzese, et al., 1992). Watersheds may also be divided into smaller sub-basins for more detailed analyses or aggregated into regional basins for broad-scale management considerations.

Appropriate temporal boundaries for cumulative impacts management are more difficult to identify. The CEQ definition refers to "past" and "reasonably foreseeable future actions," but leaves these terms undefined. Relevant past disturbances might include all those from which the system in question has not entirely recovered, no matter how long ago the disturbance occurred (Clark, 1986). What future activities are "foreseeable" may be more a question for the courts to define than a question amenable to objective analysis.

Since cumulative impacts management is more oriented toward future than past impacts, identifying a discrete historical time boundary is probably not necessary. The current ecological status of a spatial management unit is an adequate measure of the cumulative impacts of historic actions. Some historic analysis may be useful, however, to provide an accurate assessment of present ecological "health." Comparing current with past conditions can provide a measure of the extent to which historic degradation has occurred.

Future projections are limited by our level of understanding of many long-term natural processes such as sea level rise and the response of ecosystems to disturbances over time. The level and type of future impacts is subject to unpredictable economic and market conditions determined by forces often far distant from the management unit. While ideal cumulative impacts management would include a time scale at least one to two human generations into the future (Bedford, 1990), practicality often limits the horizon of reliable projections to much shorter periods.

Establishing Cumulative Impact Management Goals

An essential, but often difficult, component of cumulative impacts management is establishing goals for the resources of interest (Lee and Gosselink, 1988; Bedford and Preston, 1988). Specific goals or objectives are necessary to provide direction to any type of management. For cumulative impacts management, goals provide the link between the regional scale and site specific plans and regulatory decisions. Rather than trying to assess the impacts of a specific action at the landscape level or focusing merely on local impacts because they are more readily predictable, regulatory consideration of cumulative impacts can be made in light of the goals for the landscape unit potentially affected. The effects of the proposed action in relation to established cumulative impacts management goals can provide an objective basis for regulatory consideration of cumulative impacts.

While goals should be based on scientific information, they are often more dependent on values than on facts and, thus, are policy decisions to be made within the context of the specific cumulative impacts management program. Cumulative impacts management goals will normally be based on compliance with existing statutes and a balance between a healthy environment and economic development.

Assuming, however, that the over-riding goal is the maintenance of some acceptable level of environmental "health," goals for a specific management unit should be based on the "patient's" current condition. If the current environment is considered "healthy" according to some objective measure of relative well-being, then goal setting should focus on protecting a sufficient level of existing resources to maintain that health. *Impact minimization*, while still allowing some decline from current conditions, may be an acceptable strategy. Where the current condition is about equal to acceptable standards, a strategy of *impact avoidance* to prevent further deterioration is appropriate. If, on the other hand, the patient is already in bad health, that is, significant environmental impairment is present, appropriate goals might include prevention of any further significant impacts, amelioration of existing impacts, and *environmental restoration* (Gosselink, et al., 1990; Williamson, 1992).

Implementation of Cumulative Impact Management Goals

Dealing with cumulative impacts has been constrained by reluctance to accept responsibility for cumulative impacts assessment and management planning, the first two steps of the cumulative impacts management model (Williamson, 1992). These are large tasks, requiring a holistic approach that is often considered beyond the mandate of individual environmental agencies.

An even greater constraint to cumulative impacts management may be lack of an adequate management structure for goal implementation. Fragmentation of regulatory and resource management efforts into single-purpose agencies with responsibility for only parts of the environment (water, air, wetlands, etc.) or narrow segments of human activity (agriculture, forestry, industrial development, etc.) limits the extent to which any one agency can address cumulative impacts and their causes. Similarly, multiple over-lapping jurisdictions of federal, state, and local governments can complicate goal implementation. Cumulative impacts are regional phenomena that can be addressed only through regional planning and cooperation. Even the most well-developed efforts to manage cumulative impacts within a series of jurisdictions can be hampered by inaction by a single governmental entity within the region (Contant and Wiggins, 1991).

Goal implementation, that is, the actual management of cumulative impacts, requires as holistic an approach as the assessment and analysis components. This step includes development of specific plans to implement the goals for each landscape unit and enforceable policies to carry out the plans. The specific nature of plans and policies depends upon the resources or environmental characteristics of concern, the nature of the situation within each landscape unit, and the statutory context of the regulatory and management programs involved.

If the goal is to manage cumulative impacts on one particular resource (water, air, wildlife, wetlands, forest resources, etc.), then goal implementation may be within the purview of a single-purpose agency. Cumulative impacts, however, are more often than not cross or multimedia phenomena (Institute for Environmental Negotiation, 1991). That is, one class of activities may impact air and water quality, or wetlands, wildlife, and forest productivity. Managing cumulative impacts on one resource while ignoring others is contrary to the whole purpose of cumulative impacts management. If the goal is to manage cumulative impacts to the environment as a whole, or even to more than one environmental medium, then goal implementation is beyond the capabilities of any single-purpose agency or program and requires extensive inter-agency and inter-governmental coordination and cooperation.

Landscape units may be found to be at high risk of adverse cumulative impacts for various reasons. The appropriate means of goal implementation will depend upon the specific causative factors and environmental effects present. For example, degraded water quality may be the cumulative result of a few industrial activities or of widely dispersed residential development. In the former case, regulatory programs dealing with industrial practices may be sufficient for goal implementation. In the latter case, land use controls by local governments may be necessary. In the more common situation in which both industry and residential development are involved, inter-agency and inter-governmental coordination is, once again, the key to successful goal implementation.

Throughout this discussion, cumulative impacts management goal implementation is assumed to be a function of government. Since cumulative impacts are a classic example of the "tragedy of the commons" (Hardin, 1968), governmental action is probably the only feasible approach. But government is constrained in cumulative impacts management by its statutory basis and its organizational structure. Structural deficiencies can be compensated for by inter-agency and inter-government coordination and cooperation as discussed above, but all involved agencies must act within their mandates and statutory authorities. An appropriate combination of mandates and legal authorities, then, must exist or be constructed for the implementation of cumulative impacts management goals.

Successful cumulative impacts management, then, requires assessment techniques, holistic planning, and coordinated action of sorts that have not been used in the past. Minimum requirements include two specific elements: (1) a lead agency with the legal mandate, technical ability and willingness to assume the responsibility of on-going cumulative impacts assessment and management planning; and (2) a commitment and structure appropriate to coordination and cooperation in goal implementation by all the agencies and governmental levels involved. The ability of the North Carolina Coastal Management Program to meet these minimal requirements and assume the task of cumulative impacts management is the subject of the next section.

THE NORTH CAROLINA CONTEXT

Section 2

Statutory Mandates of the North Carolina Coastal Management Program

The NC CMP operates under the statutory authority and mandates of the North Carolina Coastal Area Management Act (CAMA - N.C.G.S. 113A, Article 7) and the Federal Coastal Zone Management Act (CZMA - 16 U.S.C. 1451 *et seq.*). Both of these acts set forth broad mandates for the overall management of coastal lands and resources. Several key provisions of these acts provide the capabilities for management of cumulative impacts.

In light of the discussion of cumulative impacts management in Section I, the statement of legislative findings in CAMA (G.S. 113A-102(a)) sounds as if it were written specifically to accomplish that end.

> *In recent years the coastal area has been subjected to increasing pressures which are the result of the often-conflicting needs of a society expanding in industrial development, in population, and in the recreational aspirations of its citizens. Unless these pressures are controlled by coordinated management, the very features of the coast which make it economically, aesthetically, and ecologically rich will be destroyed. The General Assembly therefore finds that an immediate and pressing need exists to establish a comprehensive plan for the protection, preservation, orderly development, and management of the coastal area of North Carolina.*

If the term "cumulative impacts" had been in as common use in 1974 as it is today, it surely would have been included in that statement of findings!

CAMA's statement of goals (G.S. 113A-102(b)) also sounds like the general goal statement of a cumulative impacts management program.

> *(1) To provide a management system capable of preserving and managing the natural ecological conditions of the estuarine system, the barrier dune system, and beaches, so as to safeguard and perpetuate their natural productivity and their biological, economic and aesthetic values;*
>
> *(2) To insure that the development or preservation of the land and water resources of*

the coastal area proceeds in a manner consistent with the capability of the land and water for development, use, or preservation based on ecological considerations;

(3) *To insure the orderly and balanced use and preservation of our coastal resources on behalf of the people of North Carolina and the nation;*

(4) *To establish policies, guidelines and standards for:*

(a) Protection, preservation, and conservation of natural resources including but not limited to water use, scenic vistas, and fish and wildlife; and management of transitional or intensely developed areas and areas especially suited to intensive use or development, as well as areas of significant natural value;

(b) The economic development of the coastal area, including but not limited to construction, location and design of industries, port facilities, commercial establishments and other developments;

(c) Recreation and tourist facilities and parklands;

(d) Transportation and circulation patterns for the coastal area including major thoroughfares, transportation routes, navigation channels and harbors, and other public utilities and facilities;

(e) Preservation and enhancement of the historic, cultural, and scientific aspects of the coastal area;

(f) Protection of present common-law and statutory public rights in the lands and waters of the coastal area:

(g) Any other purposes deemed necessary or appropriate to effectuate the policy of this Article.

It would be difficult to develop a more broad-based and complete statement of environmental management goals. Surely these goals incorporate a broad enough basis for cumulative impacts management. While this section of CAMA does not include specific reference to cumulative impacts, the mandate for their management seems clear. Three more specific provisions of CAMA establish the tools necessary for cumulative impacts management.

The first of these is the CAMA regulatory program. Part 3 of CAMA (G.S. 113A-113 *et seq.*) establishes Areas of Environmental Concern (AECs) as critical resource management areas in which the full regulatory authority of the State will be applied. The list of categories of areas that may be designated as AECs (G.S. 113A - 113(b)) is broad enough to include essentially all environmentally sensitive areas. Part 4 of CAMA (G.S. 113A-116 *et seq.*) establishes the CAMA regulatory program to require a permit for all development proposed within AECs. The list of grounds upon which permits shall be denied (G.S. 113A-120) includes the following:

> *...that the proposed development would contribute to cumulative effects that would be inconsistent with the guidelines set forth in subdivisions (1) through (9) of the subsection. Cumulative effects are impacts attributable to the collective effects of a number of projects and include the effects of additional projects similar to the requested permit in areas available for development in the vicinity.*

Subdivisions (1) through (9), referred to in regard to cumulative impacts, contain other grounds for permit denial, most of which relate to significant adverse environmental impacts. This part of CAMA provides clear statutory authority for a state-administered regulatory program to manage cumulative impacts.

The second cumulative impacts management tool provided by CAMA is its land use planning requirement (G.S. 113A-109 *et seq.*). Development and adoption of a land use plan is required for each county in the coastal area If a county fails to develop its own plan, the State must prepare a plan for it. All local land use plans must be consistent with guidelines established by the Coastal Resources Commission consisting of "statements of objectives, policies, and standards to be followed in public and private use of land and water areas within the coastal area" (G.S. 113A-107(a)). The land use planning provision of CAMA, together with the authority to establish state guidelines, establishes statutory authority for a coordinated state-local system of land use planning capable of including a strong cumulative impacts management program.

The third tool provided by CAMA for the implementation of cumulative impacts management addresses the need for inter-agency and inter-governmental coordination. This is the requirement for consistency between local and state governments and among all state agencies. Section 113A-111 requires that all CAMA permits be consistent with the applicable local land use plan, which, in turn, must be consistent with the State Guidelines. While seemingly circular, this important provision establishes the basis for a coordinated management system between state and local governments. Neither level of government can legally violate the policies established by the other.

Section 113A-125 provides the basis for coordination among state agencies. It requires that all regulatory permits issued by any state agency for activities within the coastal area be administered in coordination and consultation with the Coastal Resources Commission. Executive Order 15, issued by Governor Hunt in 1977, undergirds this requirement for inter-agency consistency by stating:

> ***All State agencies shall take account of and be consistent to the maximum extent possible with the coastal policies, guidelines and standards contained in the State guidelines, with the local land use plans developed under the mandate of the Coastal Area Management Act, and with the North Carolina Coastal Plan...in all regulatory programs, use and disposition of state-owned lands, financial assistance for public facilities, and encouragement and location of major public and private growth-inducing facilities.***

This is exactly the kind of inter-agency coordination required for implementation of a holistic cumulative impacts management program.

Statutory authority for inter-agency coordination is extended to federal agencies as well by the consistency provisions of the Federal CZMA. Section 307 of the CZMA requires that all federal activities, federally permitted activities, federally funded activities, and Outer Continental Shelf activities that affect any land or water use or natural resource of the coastal area must be consistent with the state coastal management program. Between CAMA and the CZMA, the inter-agency and inter-governmental coordination required for cumulative impacts management is statutorily mandated and does not have to depend entirely on voluntary cooperation.

The statutory authority of the NC CMP to develop and implement a complete cumulative impacts management program appears to be entirely adequate. While some aspects of implementation of these statutory provisions may need to be changed from the way they have been interpreted in the past, the necessary legal authorities are in place. The remaining question is whether the NC CMP and DCM have the necessary structure and the willingness to pursue this difficult task.

Organization and Capability

Cumulative impacts management requires a lead agency that will assume the responsibility of on-going assessment and management planning and that will perform the inter-agency and inter-governmental coordination necessary for goal implementation. The legal mandates and programs of the NC CMP put it in a unique position to perform this task. Some changes in emphasis will be necessary, however, to meaningfully implement a cumulative impacts management program in the North Carolina coastal area. All of the provisions of CAMA and the CZMA will need to be brought to bear in a coordinated fashion to achieve successful implementation.

CAMA Regulatory Program

The CAMA regulatory program is a strong tool that already possesses the authority to deny permits based on adverse cumulative impacts. It can be used as a mechanism for goal implementation in those areas in which activities in AECs play a significant role in causing cumulative impacts. Potential roles for the CAMA regulatory program in managing cumulative impacts are discussed in more detail later in this report. Cumulative impacts, however, are landscape-level phenomena that must be managed on a regional basis. A regulatory program that applies to less than 5 percent of the land area cannot be sufficient in itself to manage cumulative impacts.

Although the CAMA regulatory program applies to only a very small percentage of the coastal area, it has historically been the subject of a very high proportion of Coastal Resources Commission and Division of Coastal Management time and attention. Of the 215 pages of rules in Chapter 7 of the North Carolina Administrative Code (the Chapter dealing with coastal management), 150 pages deal specifically with the regulatory program. The demands and responsibilities of the regulatory program, both in specificity of rules required and staff time to conscientiously review permits, have necessarily resulted in a heavy emphasis on this aspect of the NC CMP. Both the CRC and DCM will need to take a broader approach to management of the entire coastal area in order to deal with cumulative impacts.

Although CAMA states that the State Guidelines for the coastal area "shall give particular attention to the nature of development which shall be appropriate within the various types of areas of environmental concern," the Guidelines are defined in a much broader sense as "objectives, policies, and standards to be followed in public and private use of land and water areas within the coastal area" (G.S. 113A-107(a)). The CRC clearly has the authority to develop policies that apply to lands and waters throughout the coastal area, although that authority has been used to only a very limited extent. Cumulative impacts management will require policies applicable to all of the coastal area that can be implemented through local land use planning and state and federal consistency.

Land Use Planning

While cumulative impacts assessment and management planning are best addressed at the regional scale, control of impacts is often best achieved at the local scale (Hunsaker, 1993). The state-local partnership basis of the NC CMP and the land use planning program provide a strong basis for managing cumulative impacts at the local level. Current land use planning guidelines (15A NCAC 7B) call for some degree of cumulative impacts assessment by local governments in preparing plan updates. There is no guidance on how this is to be done, however, and, to date, no adequate cumulative impacts analysis has been included in any CAMA land use plan. There will need to be some changes in the guidelines and in the way land use plans are reviewed and certified by the CRC in order to make the land use planning program an effective part of a cumulative impacts management program.

Consistency Provisions

As quoted in the previous section, CAMA and Executive Order 15 require that permits granted and actions carried out by all state agencies be consistent with the policies of the Coastal Management Program, including those stated in local land use plans. Full implementation of this requirement is absolutely essential for successful cumulative impacts management. All involved agencies, as well as the local government, must act in concert to implement cumulative impacts management goals. If they do not, even the most well-developed efforts to control cumulative impacts will be thwarted (Contant and Wiggins, 1991).

Federal agencies must also act in full cooperation and consistency with cumulative impact management goals and policies. The federal consistency requirements of the CZMA are meant to accomplish this, and the federal consistency program of the NC CMP is well-developed and fully operational. It will be necessary, however, to develop enforceable policies for cumulative impacts management and to have them incorporated into the federally-approved NC CMP in order for federal consistency to apply.

The NC CMP has the necessary legal authorities to develop a comprehensive cumulative impacts management program and, with some changes to increase their effectiveness, the necessary tools for goal implementation. The next section describes what a cumulative impacts management program in the NC CMP might consist of and the actions DCM is taking to develop the necessary capabilities.

A CUMULATIVE IMPACTS MANAGEMENT MODEL

Section 3

The following model is proposed as the basis for development of cumulative impacts management in the North Carolina coastal area. It is a modification of the Gosselink and Lee (1989) approach described in Section 1, incorporating risk assessment as the first step and the mandates and management tools of the NC CMP into the implementation phases.

Relative Risk Assessment

Comparing conditions in relatively small landscape units to identify specific areas at highest risk of adverse cumulative impacts.

Classification of Risks

Identifying specific classes of high risk areas based on current conditions and causative factors present in each landscape unit and categorizing the landscape units based on each area's particular class of risk.

Goal Setting

Establishing specific management goals for each high risk class based on the nature of the risks and conditions present.

Identification of Appropriate Implementation Mechanisms

Choosing from among the management tools available in the NC CMP the most applicable alternative or combination of alternatives for each high risk class.

Implementation

Development of specific policies, rules, etc., applicable to each class of high risk area that will serve as implementation mechanisms for cumulative impacts management.

The remainder of this Section discusses each step of the cumulative impacts management model in more detail and describes specific actions to be taken to apply the model to the North Carolina coastal area.

Relative Risk Assessment

Comparing conditions in relatively small landscape units to identify specific areas at high risk of adverse cumulative impacts.

The concept of relative risk assessment has been discussed in Section 1. The method has been fairly well developed and applied in pilot studies to several areas by the EPA (Leibowitz, Abbruzzese, et al., 1992), although the EPA pilot studies were more narrowly focused on specific types of cumulative impacts or on specific management purposes than the North Carolina application. The relative risk assessment approach being applied to the North Carolina coastal area is an adaptation of the synoptic approach developed by the EPA Environmental Research Laboratory, although the general approach was proposed by DCM prior to its knowledge of the EPA methodology (DCM, 1992b).

In the North Carolina model, the relative risk assessment consists of four steps: (1) dividing the assessment region into discrete landscape units that can be compared with one another; (2) gathering data for each landscape unit that will serve as indicators of environmental quality and of the risk of adverse cumulative impacts; (3) developing a series of indices based on the indicator data to quantify relative risk; and (4) applying the indices to identify landscape units at high risk compared with other units.

Landscape Units

CAMA defines the coastal area of North Carolina as consisting of the twenty counties "adjacent to, adjoining, intersected by or bounded by the Atlantic Ocean or any coastal sound" (G.S. 113A-103(2)). Together with a specific definition of coastal sound, this defines an area with clear boundaries that includes all coastal shorelands and those areas directly linked to coastal water quality. Although the definition is based on political boundaries, it generally coincides with accepted geological and biological boundaries. The coastal area includes that region of the state designated as the tidewater region on physiographic and geologic maps and that was inundated by the last Pleistocene sea level rise. The counties included are those where elevations are generally less than 30 to 40 feet above sea level, where drainage is poor, and where there are discernible effects of salt water (NOAA, 1978).

Although cumulative impacts on coastal resources include the effects of activities outside of these twenty counties, direct management by the NC CMP is limited to this region. A cumulative impacts management program must, similarly, be limited to the statutorily defined coastal area if it is to follow the legal mandate of CAMA and utilize the management tools discussed in the previous section. Any cumulative impacts management goals that include areas outside of the twenty coastal counties would have to be implemented through cooperative agreements with other agencies.

The coastal area defined by CAMA is certainly large enough and homogeneous enough in its links to the ocean and sounds to form a logical region for cumulative impacts assessment. The total land area of the twenty coastal counties is 5,984,853 acres, or about 19 percent of the total land area of the state. Total water area of the twenty counties is 2,236,912 acres, or about 87.5 percent of the total open water area of the state. The relative risk assessment approach requires that this large region be divided into smaller units for risk assessment.

Historically, subdivisions of the coastal area have been based on political jurisdictions: the twenty counties and their constituent municipalities. These are the geographic units of local government operation and land use planning as established by CAMA. Using these same subdivisions as the landscape units for cumulative impacts risk assessment would have the advantages of familiarity, historical precedent, data availability, and congruence of analytical units with government management units. There would, however, be significant disadvantages as well. Using county boundaries would divide the area into only twenty units, a scale too coarse for adequate analysis. Several of the coastal counties are quite large, and conditions vary widely within them. Most of the municipalities in the coastal area, on the other hand, are small, and much of the land area is not included within any municipal boundary. Perhaps the most significant disadvantage is that political boundaries do not coincide with the natural processes and functions that are affected by cumulative impacts.

Watersheds are ecological landscape units that correspond to the operation of water-based natural processes. Since water quality and fisheries are major concerns of the NC CMP and both are dependent on water-based processes, watershed units are congruent with existing management objectives. DEM's basinwide planning is based on watersheds, and analyses have been performed in the APES program for several coastal sub-basins (Dodd, McMahon, & Stichter, 1992; Dodd, Cunningham, et al., 1992). Using watersheds as landscape units would provide congruence with existing state management programs and would take advantage of data that have already been collected. Water quality is an integrating indicator of the cumulative impacts of all activities in a watershed. A watershed-based approach to data gathering and analysis provides an ecologically sound framework for many aspects of coastal management.

Watershed units have been used in several cumulative impacts assessments (Bedford, 1990; Johnston, et al., 1988; Gosselink, et al., 1990; Leibowitz, Abbruzzese, et al., 1992). These have varied in size from river basins of several hundred square miles to small creek watersheds of a few thousand acres. If watersheds are to be the basic landscape units for cumulative impacts assessment in the coastal area, several possible breakdowns exist. There are seventeen major river basins in North Carolina, seven of which include portions of the coastal area (DEM, 1991). River basins are divided by the U.S.Geological Survey (USGS) into cataloging units, identified by an eight-digit code. There are sixteen cataloging units included in whole or in part in the twenty coastal counties. River basins were divided more finely into sub-basins by DEM in the 1970s for tracking point source discharge information. For the APES portion of the coastal area, these sub-basins have been divided into still smaller sub-basins (Dodd, McMahon, and Stichter, 1992). The Soil Conservation Service (SCS) also divided USGS cataloging units into smaller watersheds for its watershed management programs, designating each of these watersheds by an eleven digit code.

All of these existing watershed breakdowns were considered staff as possible landscape units for cumulative impacts analysis, and even the smallest units, the SCS eleven-digit watersheds, were determined to be too large to be adequate. During 1992, coincident with DCM's initial planning for cumulative impacts analysis, SCS began a statewide project to map still smaller watersheds, or hydrologic units of 5,000 to 50,000 acres designated by a fourteen-digit code (SCS, 1992). Since this scale seemed appropriate for cumulative impacts risk assessment, DCM participated in this project and provided funds to the NC Center for Geographic Information and Analysis (CGIA) for digitization of hydrologic unit (HU) boundaries for the coastal area.

Digitization was completed in early 1993, resulting in division of the twenty coastal counties into 348 hydrologic units which will be the basic landscape units for cumulative impacts assessment and management. As the boundaries of these HUs were being delineated, representatives of DEM, SCS, and CGIA met regularly to review the boundaries and ensure that they were consistent with DEM sub-basin boundaries and USGS cataloging unit boundaries. The fourteen-digit HUs are subsets of eleven-digit HUs, which are subsets of USGS cataloging units. Data pertinent to cumulative impacts will be gathered and analyzed for each fourteen-digit HU, but can be aggregated into larger watershed units as needed for analytical or management purposes.

Landscape Indicators and Indices

Landscape indicators are estimable values that reflect some aspect of landscape condition or status. In cumulative impacts risk assessment, indicators are needed for both causes and effects of cumulative impacts, as well as for the relative sensitivity of landscape units to disturbance. Causes include all forms of human-induced disturbance to natural processes, and effects include all forms of response of natural processes to the imposed disturbances. Landscape indicators are not necessarily measurements of the actual causes and effects themselves, but of some parameter that indicates the intensity of causes and effects.

For example, the water quality of some coastal streams is degraded by agricultural runoff. Actual causes of the degradation are specific quantities of nutrients, toxins, and sediment that enter the water in runoff. Useful indicators of these causes may include the relative area of agricultural land in the watershed, the proportions of this land under various agricultural management practices, annual fertilizer purchases, numbers of different types of livestock, etc. The actual direct effects of the causes are specific concentrations of the various substances in the water. Useful indicators may include such things as the relative length of the stream classified as non-supporting of designated uses, numbers of algal blooms or fish kills, area or time of shellfish closures, etc.

The causes of cumulative impacts include all human disturbances in the landscape unit. In an area as large as the North Carolina coastal area, many different human activities occur that have the potential for disturbing natural processes. It would be impossible to specify and develop indicators for every possible activity. It is necessary, instead, to use broad indicators of the intensity of major land uses and human-induced pressures. Such indicators as population size and growth rate, percentage of total area in various land uses, intensity of management of land areas, numbers of specific impact-inducing activities present, etc., can be used to compare the intensity of human-induced pressures among landscape units.

Likewise, the effects of cumulative impacts include all changes in environmental conditions, species populations, and ecosystem dynamics that have occurred as a result of human actions. It is not possible to develop an indicator for every effect. Broad indicators of environmental quality, such as water and air quality measurements, proportion of the landscape in a disturbed vs. natural state, and condition of wildlife populations, must be used to reflect the many specific effects that may exist.

The extent to which a landscape unit is at risk of degradation by human activities depends upon the sensitivity, or buffering capacity, of the landscape to disturbance. Sensitivity depends upon such factors as the types of ecosystems present and their distributions, soil types, slope, water source, primary and secondary productivity, etc. Once again, it is impractical to develop indicators for every factor contributing to landscape sensitivity. The presence and relative concentrations of resources known to be sensitive to disturbance, such as endangered species habitat and submerged aquatic vegetation, or of resources recognized as being of particular importance, such as nursery areas, important wetlands, high quality waters, etc., can be used as indicators of relative sensitivity. The presence of characteristics known to buffer the effects of human disturbance, such as vegetated streamside buffers, can also indicate relative landscape sensitivity.

Based on these considerations, data availability, and potential usefulness, a list of indicators has been developed for the North Carolina coastal area. Indicators are summarized in Table I, and a complete list of indicators is included in Appendix A. These parameters are included in a database containing indicator values for each Hydrologic Unit and each coastal county. This database, the Population/Development/Resources Information System (PDRIS), was developed by DCM in cooperation with Research Triangle Institute. The PDRIS was developed primarily for the purpose of tracking, analyzing and reporting trends in population growth, development, and environmental quality in the coastal area. The database is interfaced with a GIS so that information can be viewed and analyzed spatially. The database is designed to allow periodic updating so that it can be kept current and used for trends analysis over time.

This database will contain detailed information about conditions and trends in each HU. Since the PDRIS is meant to serve several purposes, not necessarily all of the parameters will be used as indicators for cumulative impacts risk assessment. A subset will be chosen for their value in adequately reflecting conditions and trends in each HU in regard to land use, natural resources, environmental quality, and population growth and development pressure.

In raw form, the indicators would be difficult to compare in a straight-forward fashion to identify HUs at highest risk of significant cumulative impacts of development. A series of indices will be developed to summarize the significance of the indicators and to facilitate relative risk assessment. These risk indices will be used as the basis for a quantitative assessment of each HU to determine the relative risks and nature of the risks present. High risk HUs identified by this method will then be classified into different categories based on the nature of the risk that resulted in their high risk status.

Classification of Risks

Identifying specific categories of high risk areas based on conditions and causative factors present in each landscape unit and classifying the landscape units based on each area's particular type of risk.

Many combinations of natural environmental conditions and human activities may result in environmental degradation. Thus, different areas may be at high risk of experiencing significant adverse cumulative impacts for different reasons. Choice of an appropriate cumulative impacts management strategy will depend upon the specific conditions in a given

TABLE I. SUMMARY OF HYDROLOGIC UNIT INDICATORS		
Class of Information	**Type of Indicators**	**Update**
Constant Values	HU identification, size, land & water areas, stream and waterbody names, historical census data	None
Surface Water Quality	Water classifications of streams & waterbodies, use support classes, number & extent of degradation incidents	Periodic
Groundwater Quality & Use	Groundwater classification, capacity use designations, contamination incidents	Periodic
Shellfish Waters	Shellfish water areas, closures	Annual
Land Use & Resources	Land cover and land use, extent of sensitive resources such as anadromous fish areas, nursery areas, endangered species, etc., land and water areas in public ownership and private preservation	Periodic
Population & Housing	Census-derived population and housing information	Periodic
Municipalities	Number & names of municipalities in seven size classes	Periodic
Development	Highway and railroad mileage, building permits	Annual
Economic Activity	Number, employment, and revenues of businesses in various classes	Annual
Agricultural Practices	Extent & importance of various crops and livestock, BMPs	Annual
Permits Issued	CAMA, NPDES, non-discharge, septic tank, air emission, 404/10, landfill, sedimentation control plans	Annual

HU, including the environmental characteristics of the HU, the degree and type of human disturbance present, and the effects the particular disturbances may have on the environment. The Risk Assessment step of the Cumulative Impacts Management Model consists of characterizing these conditions. The Risk Classification step consists of grouping high risk areas into categories based on those conditions so that the most appropriate management strategy can be determined.

Certain general principles about cumulative impacts risk give a useful starting point for risk classification. An area may be at high risk of adverse cumulative impacts due to either the nature of its natural environment or the nature and extent of human-induced disturbances. An area may already be experiencing environmental degradation or it may have a high potential for future degradation if certain human activities occur. High rates of population growth and development in an area are likely to result in significant cumulative impacts even if current measures of degradation do not identify them.

Based on consideration of these general principles and the specific conditions of coastal North Carolina, several potential classes of Cumulative Impact High Risk Areas can be identified.

High Risk Area Categories

(1) HUs with impaired water quality

(2) HUs with high potential for water quality impairment

(3) HUs with present or potential air quality impairment

(4) HUs with historic high growth in population/development

(5) HUs with anticipated high population/development growth

(6) HUs with concentrations of sensitive, high-value resources

(7) HUs with concentrations of productive/aesthetic resources

These potential categories of Cumulative Impact High Risk Areas are discussed in more detail in Section 4 of this report. This list is preliminary and based on professional judgement before the actual risk assessment is performed. Some of these categories may not actually exist in the NC coastal area, and other as yet unidentified categories may. But this *a priori* list is indicative of the type of classification that will be performed.

Goal Setting

Establishing specific management goals, consistent with the goals of CAMA and the NC CMP, for each high risk class based on the nature of the risks and conditions present.

The primary goals of cumulative impacts management in the North Carolina coastal area must coincide with the overall goals of the NC Coastal Management Program. The following excerpts from CAMA's statement of goals (G.S. 113A-102(b)) are the guiding principles upon which more specific management goals are to be based.

> *To provide a management system capable of preserving and managing the natural ecological conditions of the estuarine system, the barrier dune system, and beaches, so as to safeguard and perpetuate their natural productivity and their biological, economic and aesthetic values...*
>
> *To insure that the development or preservation of the land and water resources of the coastal area proceeds in a manner consistent with the capability of the land and water for development, use, or preservation based on ecological considerations...*
>
> *To insure the orderly and balanced use and preservation of our coastal resources...*
>
> *Protection, preservation, and conservation of natural resources...*
>
> *Management of transitional or intensely developed areas and areas especially suited to intensive use or development, as well as areas of significant natural value...*
>
> *The economic development of the coastal area...*

The first goal setting step consists of applying these basic principles to each category of high risk area to develop more specific goals based on the nature of the risks present. For example, the following goals for the potential high risk area categories listed above follow directly from the general goals of CAMA.

HUs With Present or Potential Water Quality Impairment

To improve water quality so as to preserve the ecological conditions, natural productivity, and biological and economic value of the estuarine system.

To maintain traditional water uses.

To insure that land development and water use occurs in a manner consistent with the ecological capability of the aquatic system to sustain its potential uses.

HUs With Present or Potential Air Quality Impairment

To improve air quality so as to safeguard and perpetuate the biological, economic and aesthetic values of the area.

To protect and preserve high air quality.

To guide economic development so as to minimize significant atmospheric emissions.

HUs With Historic or Anticipated High Population/Development Growth

To emphasize guiding development so as to insure that it occurs in a manner consistent with land and water capability for development, use or preservation.

To guide development toward those areas well suited for intensive use and away from areas of significant natural value.

To insure the orderly and balanced use of resources.

To protect and preserve natural resources in the face of continued growth and development.

To recognize and plan for needed increases in local services and infrastructure required to provide for a growing population.

HUs With Concentrations of Sensitive, High-Value Resources

To protect and preserve the biological and economic values of sensitive natural systems.

To guide development away from areas of significant natural value.

HUs With Concentrations of Productive or Aesthetic Resources

To encourage the management of lands for their most biologically and economically productive uses.

To protect scenic vistas and the aesthetic quality of the area.

To guide land development toward areas well suited for development and away from areas better suited for agriculture, forestry, or other natural resource-related use.

The final step of the goal-setting process is translating these general goals into specific management-oriented objectives. Since these specific objectives normally include or imply an implementation mechanism, development of specific objectives is also the first stage of implementation of cumulative impacts management. Each general goal is likely to involve several objectives that will be specific to the conditions in the high risk area. For example, in a high risk area with impaired water quality, the first general goal is to improve water quality. Specific objectives under this goal might include the following.

Protect estuarine waters from silt and nutrient runoff by requiring a vegetated buffer in all CAMA permits in the Estuarine Shoreline AEC.

Require vegetated buffers along all tributary streams in local land use plans and zoning and subdivision ordinances.

Target the HU for agricultural BMP installation under the Agricultural Cost Share program.

Designate the HU as a Critical Area under the Coastal Nonpoint Pollution Control Program and require application of additional NPS control measures.

Assist the local government in acquiring funds to expand the extent of sewer lines in the HU and to upgrade sewage treatment facilities.

Decrease allowable discharges from upstream dischargers.

Discourage the use of septic tanks by limiting their use to highly suitable soils and requiring a setback from all open water.

Increase protection and restoration of wetlands particularly effective in improving water quality.

These are just examples of the types of specific objectives that may be applicable to a given high risk area. The appropriate objectives for a specific HU would depend upon the sources of water quality degradation and the particular mix of land uses, discharges, and development patterns present in the HU. This list of examples illustrates the fact that several different implementation mechanisms may be useful or necessary in order to achieve the objectives. Analysis of alternative implementation mechanisms is the next step in the Cumulative Impacts Management Model.

Identification of Appropriate Implementation Mechanisms

Choosing from among the management tools available in the NC Coastal Management Program the most applicable alternative or combination of alternatives for each high risk class.

The risk classification and goal-setting steps characterize the nature of the situation in each high risk area and set forth specific goals for cumulative impacts management. These point toward the identification of appropriate implementation mechanisms, since goals are stated in terms of achievable management strategies. The most appropriate set of implementation mechanisms will vary for different classes of high risk areas and, to some extent, among individual HUs within a risk class.

The CAMA Regulatory Program

The CAMA regulatory program clearly has the statutory authority to deny permits for projects that would contribute to adverse cumulative impacts. The purpose of AEC designation is to apply state-level control over development in areas identified as critical resource management areas of greater than local concern (NOAA, 1978). In so far as adverse cumulative impacts can be considered to be of greater than local concern, the CAMA regulatory program is directly applicable to their management. There are at least three approaches toward using the CAMA regulatory program as an implementation mechanism for cumulative impacts management: (1) development of specific standards for cumulative impacts assessment in CAMA permit considerations; (2) development of AEC use standards specifically applicable to high risk areas; and (3) designation of additional AECs in high risk areas. These mechanisms would apply to high risk HUs in which the risk is associated with actions occurring in areas within present or statutorily-authorized AECs.

Land Use Planning

Managing the cumulative impacts of development is largely a matter of managing the development itself. Outside of AECs, land use planning and control will be a primary component of cumulative impacts management. The CAMA land use planning program provides several potential implementation mechanisms whereby local government determination of development types, patterns, and intensities can be used to minimize cumulative impacts. These mechanisms will be identified and applied through improvements to the land use planning process, particularly as it applies to high risk areas.

Interagency Coordination

Many of the specific objectives for cumulative impacts management will require implementation through programs of other state agencies. The above illustrative list of possible objectives for an HU with impaired water quality would involve the cooperation of at least four distinct agencies for implementation. Interagency cooperation and coordination is an essential component of cumulative impacts management in all high risk areas, but particularly in those involving water and air quality concerns.

The necessary coordination for water quality management can be achieved through including DEM's Basinwide Planning Program and the Coastal Nonpoint Pollution Control Program in the cumulative impacts management strategy. State consistency can also be used in implementation of cumulative impacts management in any situation in which implementation through the regulatory or management programs of other state agencies is necessary to achieve specific objectives.

Federal Consistency

Implementation of cumulative impacts management through programs of federal agencies is possible through the federal consistency requirements of the CZMA. DCM plays an active role in influencing federal actions and permit and funding decisions through its federal consistency program. In high risk HUs in which the federal government owns substantial amounts of property or in which federal activities or permit decisions are critical in implementing cumulative impacts management, federal consistency can be an effective implementation mechanism.

Special Area Management Planning

Special Area Management Planning (SAMP) is a specialized process which may be used to address complex multi-jurisdictional environmental problems through cooperative regional management. In a sense, DCM's entire cumulative impacts management effort, and even the entire Coastal Management Program, are forms of SAMP. Normally, however, the term is applied to localized, more narrowly-focused planning and management programs to address highly complex situations that are beyond the scope of other management mechanisms. As such, it may be an implementation mechanism for cumulative impacts management in high risk areas with problems so complex and involving so many multi-jurisdictional issues that a coordinated approach through other implementation mechanisms is impossible. Whether there are any such high risk areas in the NC coastal area is yet to be determined.

Implementation

Development of specific policies, rules, etc., applicable to each class of high risk area that will serve as implementation mechanisms for cumulative impacts management.

Implementation means taking action, and government action requires enforceable policies and rules. Application of the implementation mechanisms identified in the previous step to management of specific cumulative impacts situations will require some changes in existing rules and policies of the NC CMP. It would be premature to attempt to discuss the specific rule changes that might be needed, since this will require detailed analysis of the current rules in light of the management needs that become apparent as a result of risk analysis and goal setting. It is possible, however, to identify some general areas of change that will be necessary to apply the Cumulative Impacts Management Model successfully.

The Model is based on an approach of identifying specific geographic areas at high risk of adverse cumulative impacts and applying specific management strategies to those high risk areas. This approach necessarily entails applying different strategies, and thus different rules, to high risk areas than are applied to other areas. Historically, the NC CMP has applied one set of rules uniformly throughout the coastal area. Although different rules apply to AECs than to non-AEC areas, use standards within a given AEC category are the same where ever the AEC occurs. As the above examples indicate, application of the Cumulative Impacts Management Model would involve different use standards for AECs in high risk areas than for those in other areas.

Similar differences will likely be necessary for other implementation mechanisms, as well. Land use planning, for example, should logically be more comprehensive in areas undergoing intensive development than in rural areas where little growth and development are occurring. An activity requiring another state or federal permit (and thus subject to state or federal consistency requirements) that may be perfectly acceptable in some areas may not be desirable in a high risk area. Implementation of these different management strategies will necessitate the application of different rules and policies. If Special Area Management Planning is used as an implementation mechanism, the special area under jurisdiction of the plan would have its own unique set of rules and policies.

The concept of applying different policies to areas that differ in their characteristics or management needs is not foreign to the NC CMP, even though its use has been limited. Different rules apply to AECs than to non-AECs, and somewhat different rules apply to the estuarine shoreline AEC around Outstanding Resource Waters than to the same AEC bordering other estuarine waters. The underlying principle is the same: that some areas need to be managed differently from others because of their intrinsic qualities, the hazards associated with their uncontrolled use, the nature and intensity of development occurring in them, or because they have been recognized as of greater than local concern. The possibility of applying different rules to different areas has been recently discussed by CRC committees in relation to marina siting and land use planning requirements. Use of the approach in cumulative impacts management is a similar context.

Application of specific rules to high risk areas will necessitate some means of formal designation of these areas by the CRC. Identification of high risk areas through the risk assessment process will not, in itself, provide the necessary authority to apply different rules to these areas. Some form of ratification by a policy-making body is necessary. This designation could be performed on an area-by-area basis, analogous to the designation of natural and cultural resource area AECs, or it could be performed on a regional basis analogous to the way in which other AEC categories were established.

It must be stressed, however, that high risk areas are not envisioned to be a type of AEC. No permits would be required for activities in high risk areas other than those already required by existing regulatory programs; the standards for those permits would simply be different. Activities not currently requiring a permit would not require a permit in a high risk area; they may simply be subject to more stringent local land use considerations. Designation of an HU as a high risk area is meant to identify it as an area in need of additional management attention by whatever implementation mechanism is most appropriate for its particular situation, not as an area needing a new regulatory program.

Since high risk areas will not, in themselves, be AECs, cumulative impacts management will require renewed attention to coastal area wide policies applicable to areas outside of AECs. Some cumulative impacts problems may be amenable to management entirely through AEC use standards, but many are likely to require other implementation mechanisms. Management through land use planning and state and federal consistency requires policies that are applicable outside of AECs. These may be parts of the land use planning guidelines governing the ways local governments perform the planning process, policies applicable to permits granted or actions taken by other state or federal agencies, or policies specifically applicable to an area for which a special area management plan has been prepared. Policies will need to be incorporated into 15A NCAC 7B or 7M, must be specific enough to be enforceable, and must receive OCRM approval as part of the NC CMP. Without policies to allow implementation of cumulative impacts management outside of AECs, the management effort will be severely limited.

Implementation through local land use planning and control may also require recognition of the fact that some land use decisions are of greater than local concern. Since cumulative impacts management is regional in scope, such decisions cannot be made on the basis of purely parochial considerations. Certain policies for high risk areas may need to be required in local land use plans, whether the local government recognizes the need for them or not. Local implementation of those policies through zoning, subdivision ordinances, and other land use controls will be needed to supplement state-level implementation through permit decisions. To fully achieve local implementation, CAMA may need to be amended to require consistency of local ordinances and decisions with land use plans.

POSSIBLE TYPES OF HIGH RISK AREAS

Section 4

The Risk Classification step of the Cumulative Impacts Management Model consists of identifying different categories of high risk areas and classifying each high risk unit into one of the categories. Since assignment to a risk category is based on conditions, causative factors, and measurable impacts present in the landscape unit, the category classification forms the basis for choice of appropriate management strategies. In the discussion of risk classification in Section 3, seven potential categories of high risk area were identified. Although this list of categories is preliminary and may change after the risk assessment is completed, a more detailed discussion of these categories is useful in explaining and illustrating the Management Model. This section examines each of the seven *a priori* high risk categories in terms of conditions that may exist in an area included in the category, the types of risks that may be present, potential indicators of those risks, and potential management strategies.

Areas with Impaired Water Quality

Areas with evident environmental degradation are already experiencing recognizable adverse cumulative impacts. Water quality is the best available indicator of the cumulative impacts of all activities in a watershed. A Hydrologic Unit with degraded water quality, then, is clearly a high risk area. It is likely that enough HUs with existing water quality degradation will exist in the coastal area that such a risk category will be needed.

If there were water quality monitoring stations on each stream in each HU, it would be easy to identify HUs with impaired water quality. Indicators could be developed by establishing thresholds for various water quality measurements beyond which the water would be considered to be impaired. Without specific measurements for each stream, however, other parameters need to be used as indicators of water quality degradation. Several potential indicators exist.

Surface waters in the state are classified by the EMC according to their best uses based on existing and attainable uses and water quality (15A NCAC 2B .0100-.0200). Each classification requires that certain water quality standards be met in order to support the assigned uses. If water quality falls below those standards, the stream is classified as partially-supporting or non-supporting of its designated uses or as support-threatened. DEM maintains records on the degree of use support of most streams in the state. These use support designations can be used as indicators of water quality in an HU. If the percent of non-supporting or partially-supporting waters in an HU exceeds a certain level, then the HU can be classified as having impaired water quality.

Other indicators, while less direct, may also be useful in identifying areas with degraded water quality. Classification of shellfish growing waters by the Division of Environmental Health is based on point sources of contamination, fecal, pathogenic or toxic contamination, and fecal coliform counts (10 NCAC 10B .1400). If any of these conditions reaches a level in the water at which consumption of shellfish taken from the water may be deleterious to human health, the water is classified as restricted or prohibited (closed) for shellfish harvest. The percentage of shellfishing waters in an HU that are closed to shellfishing can be used as an indicator of impaired water quality. Similarly, the number of events in an HU indicating possible contamination, such as algal blooms and fish kills, can be used as indicators of short-term water quality impairment.

The causes of water quality impairment reflected by these indicators include high levels of toxins, pathogenic organisms or nutrients, or low levels of dissolved oxygen in the water. These conditions may result from identifiable point sources of pollution, from storm water runoff from agricultural or developed lands, or from other unidentified sources of contamination. Pollutants may enter an HU in flowing water from upstream sources or may originate in the HU itself. Analysis of permitted point source discharges, non-discharge permits for on-site wastewater disposal, and types and intensities of land use in the HU can be used to develop indicators of the sources of water quality impairment.

Appropriate management strategies for HUs with impaired water quality will depend upon the nature, extent, and sources of the impairment. Possible management objectives for an HU with impaired water quality were illustrated in Section 3 (see page 20). Achievement of those objectives would necessitate management strategies including several implementation mechanisms.

If the HU contains estuarine waters subject to impairment from stormwater runoff, use standards for the Estuarine Shoreline AEC could be used to provide protection. Requirements for an undisturbed vegetated buffer along the estuarine shoreline and/or engineered stormwater control structures could be included as CAMA permit conditions for all development in the AEC within the high risk HU. The amount of impervious surface could be limited to less than the 30 percent general limitation, or the total percentage of built-upon area could be limited as in the ORW Estuarine Shoreline rules. The width of the Estuarine Shoreline AEC could be increased in water-quality high risk areas to increase the effectiveness of these protective measures.

Vegetated buffers to filter runoff water may also be needed along tributary streams and non-estuarine waters. This could be implemented by means of additional AEC designations. CAMA authorizes designation of AECs along the shoreline of public trust waters and in floodways and floodplains (G.S. 113A-113(b)(6)). Such AECs could be established in water quality high risk areas for the sole purpose of protecting water quality through vegetated buffers or density limitations.

Vegetated buffers along waterways could also be required in local zoning, subdivision, and sedimentation and erosion control ordinances. The CAMA land use planning guidelines could be amended to require that buffer areas be included in the conservation land use class with appropriate limitations on their use. Except for actions in which state or federal permits are involved, however, enforcement of use limitations in buffers would be by the local government. Unless CAMA were amended to require consistency between land use plans and local ordinances, implementation of buffer protection would not be ensured.

Nonpoint source pollution could also be addressed through the use of Best Management Practices (BMPs) in agriculture, forestry, and land development. Such BMPs currently exist and are currently implemented voluntarily or through economic incentives or disincentives. Targeting water quality high risk areas for additional agricultural cost-share funding could be used to encourage the use of agricultural BMPs in areas where agriculture is the predominant source of runoff-borne pollutants. Similar targeting for strict enforcement of forestry BMPs or additional sedimentation control measures under the state Sedimentation Pollution Control Act (G.S. 113A-50 *et seq.*) could provide additional means of implementation. Since these programs are administered by other state agencies, interagency coordination, either voluntary or through state consistency requirements, would be necessary to accomplish this targeting.

The Coastal Nonpoint Pollution Control Program (CNPCP) requires enforceability of general NPS management measures such as BMPs and the application of additional management measures in identified critical areas (NOAA and EPA, 1993). Since one of the primary criteria for identification of critical areas is the presence of impaired or threatened waters, all or parts of water quality high risk areas could be designated as CNPCP critical areas. Management measures specific to the nature of the NPS problem could then be applied. Such additional management measures might include stricter enforcement of or more stringent standards for some of the implementation mechanisms discussed above or they might include more specific requirements for local actions such as low density zoning or cluster development ordinances.

In rural parts of the coastal area, septic tanks and package treatment plants are the primary means of sewage disposal. Improperly installed or malfunctioning onsite sewage disposal systems can discharge to the ground surface or a shallow water table, resulting in eventual entry of pollutants into surface waters. The proportion of houses in an HU with septic tanks rather than central sewage treatment systems can indicate the potential significance of this pollution source. If onsite sewage disposal is a significant source of water quality degradation in a high risk HU, several management strategies might be applied. Stringent soil requirements, setbacks from surface waters, and management and maintenance requirements could be applied to septic tank installations. Large onsite disposal systems require a state nondischarge permit, but individual small septic tanks are subject to regulation at the local level following state guidelines. Implementation of stricter requirements would necessitate interagency coordination and cooperation of local governments. In situations where installation or expansion of a centralized sewage treatment system is feasible, the appropriate management strategy might consist of assisting the local government in obtaining funds for such purposes.

Point source discharges into surface waters require an NPDES permit. Numbers of existing permits and their discharges can be used as indicators of the significance of point source pollutants in the HU. If they are determined to be a significant problem, this information can be used to limit discharges from existing and future permitted sources. If water entering an HU from upstream is already degraded due to upstream discharges, implementation would require limitation of those discharges as well as those occurring within the HU. This type of holistic water quality planning can be accomplished through DEM's Basinwide Planning Program, and illustrates another situation in which interagency coordination is necessary for cumulative impacts management.

Protection and restoration of wetlands that perform significant water quality functions could also be an appropriate management strategy for water quality high risk areas. DCM's wetland functional assessment procedure could be used to identify the specific wetlands with the highest water quality functions, and these could be afforded higher levels of protection through land use plan policies and by agreements with the Army Corps of Engineers and/or DEM. Since federal consistency requirements apply to 404 permits, any enforceable state or local policy in the NC CMP that specifies high levels of protection for these wetlands could be used to implement this strategy. DCM's Wetland Restoration Plan will identify possible restoration sites with high potential for performing significant water quality functions. These sites could be targeted for restoration through a local, state, or federal wetland restoration program.

The overall management strategy for a specific water quality high risk area might consist of various combinations of these, or other, action components, carefully coordinated to achieve the desired objective of improving water quality and preventing further degradation. In areas with severe water quality problems, such a strategy might approach being a type of special area management plan addressing diverse problems through the coordinated efforts of several agencies at different levels of government. In areas with less severe water quality degradation a less comprehensive approach targeting only the largest pollutant sources may be adequate. It is likely that a minimum set of management approaches and policies can be developed for application to all high risk areas in this category, with more specific management plans needed only for special cases.

Areas with High Potential for Water Quality Impairment

Another category of high risk area might include areas with presently acceptable water quality but in which high rates of population growth or new or substantially expanding land uses pose an imminent threat of water quality impairment. Environmental degradation is not yet evident in such areas, but the risk is high.

Indicators of this type of risk would include current water quality indicators in combination with indicators of growth and/or land use changes. If an HU contains Outstanding Resource Waters or High Quality Waters, the management objective is to prevent any degradation. If the area contains stressed waters, such as Nutrient Sensitive Waters or support-threatened waters, any additional stress may result in significant water quality impairment. In either case, such an area would be identified as at high risk if other factors indicate a high potential for increased pollutant loadings. A combination of conditions is necessary for the risk of future water quality impairment to be high.

Several indicators could be used to identify areas in which growth or land use changes are occurring at such rates that future water quality impairment is a high risk. Rapid rates of population growth, a large number of recently granted NPDES or CAMA permits, large numbers of building permits or sedimentation pollution control plans, increases or dramatic changes in the extent of intensive agricultural practices, etc., would indicate the likelihood of increased pollutant loadings. Increased loading, together with the presence of waters highly sensitive to even relatively small additional pollutant inputs, indicate a high potential risk for water quality impairment.

Potential management strategies for this category of high risk area would be similar to those for an area with already impaired water quality, except that more stress would be put on preventive rather than ameliorative actions. Planning-related strategies would be more appropriate than regulatory strategies.

For areas experiencing rapid population growth, growth management tools could be used by local governments to influence continued growth so as to minimize its potential effects on water quality. More sophisticated land classifications in the land use plan could be used to identify areas in which growth management would need to be applied to protect water quality. Planning expansion of central sewer systems and limiting intensive development to areas serviced by sewer lines may be an appropriate first step in growth management. Again, revisions to the land use planning guidelines, and possibly an amendment to CAMA to require local consistency with the land use plan, are likely to be necessary to ensure implementation of local management strategies.

For areas in which future water quality is threatened by land use changes not related to growth and development, such as expansion of concentrated livestock farming, state-level action may be needed. Designation of the area as a CNPCP critical area would require use of additional management measures to control nonpoint pollution. This may be a particularly appropriate strategy in areas with high potential risk for water quality impairment, since the CNPCP criteria for critical areas coincide with the conditions that would result in inclusion in this high risk category (NOAA and EPA, 1993). The additional measures that might be applied would depend upon the specific land use change that poses the risk.

Areas with Present or Potential Air Quality Impairment

While air quality problems are not widespread in the coastal area, there may be limited areas at high risk of air quality impairment, particularly around urban or industrial areas. If urbanization increases in the coastal area or if industries with significant atmospheric discharges locate there, air quality protection will become a more pressing concern. By analyzing potential air quality problems in advance, it will be possible to pay particular attention to increasing urbanization and industrialization in potential high risk areas.

Impaired air quality may result from the cumulative effects of many relatively minor diffuse sources, such as large numbers of automobiles, or from one or a few large concentrated emission sources, such as certain industries. Number and density of diffuse sources exist in proportion to population size and density, which can be used as indicators. Concentrated emissions sources require an air quality permit from DEM (15A NCAC 2H .0600), and their locations are know. Complex sources, such as large parking facilities and subdivisions, also require permits (15A NCAC 2D .0800). Emission sources that do not require a permit may be required to register with DEM (15A NCAC 2D .0202), and the locations of these registered sources are also known. The DEM Air Quality Branch maintains a database of all known emissions sources. Through the use of these various data sources, the locations of air pollutant emitters can be pinpointed.

Whether emissions result in air quality problems depends upon their magnitude and density and on atmospheric dispersal. Actual ambient air quality monitoring is a more realistic assessment of the degree of air quality impairment than is simply the presence of sources. DEM maintains ambient air quality monitoring stations in strategic locations across the state. Standards for allowable concentrations of various pollutants are set in regulation (15A NCAC 2D .0400). The relationship of ambient concentrations to the allowable maximum can be used as an indicator of how close an area is to exceeding the standards.

Management strategies within the scope of the NC CMP that may apply to areas with high risk of air quality impairment are probably limited to land use planning. Direct air quality regulation is performed by DEM through its permitting and emission control program, but the locations of sources are the result of land use decisions. If HUs with high potential for development of air quality problems can be identified and made known, local governments can take actions to steer pollutant emitting development away from those areas and into others.

Areas with Historic Rapid Growth

In parts of the coastal area, population has increased dramatically over the past two decades. Between 1980 and 1990 the populations of Brunswick, Carteret, Dare, and Onslow counties increased by over 25 percent. Most of this growth is concentrated within a few HUs. Rapid growth leads to rapid increases in demands for resources and services and in stresses on the environment. Existing water supplies, waste disposal systems, roads, schools, and other infrastructure can be outstripped more rapidly than local governments can respond. Development that necessarily accompanies high population growth results in land conversion, increases in impervious surfaces, and increases in waste production that result in rapidly increasing stresses on water quality, wildlife and fish populations, and other environmental resources.

Indicators of areas of high population growth are relatively straightforward. Simply the presence of population growth above a certain rate can be used to identify high risk areas. The threshold rate might be determined through the use of growth impact coefficients that relate population growth to resulting effects and stresses. DCM has a contract with Research Triangle Institute to develop a first approximation of such coefficients by the end of 1994. Other parameters, such as rate and extent of land conversion and increases in population-related businesses such as retail trade, may also be used as corroborating risk indicators.

In this risk category, the most significant consideration for any indicator is rate of increase rather than absolute numbers. An already densely populated area might absorb an additional thousand people with little noticeable effects, while a sparsely populated rural area might be entirely changed by the same influx. Rapid growth rates indicate rapidly changing conditions and potential instability in both human and natural systems. Instability is a primary determinant of risk.

Choice of appropriate management strategies for high population growth areas will depend upon whether the area also falls into another high risk category. For example, if the stresses of population growth have resulted in impaired water quality, the area will also be classified as a water quality high risk and appropriate management strategies for that risk category will be applicable. If the area has high concentrations of sensitive resources, those resources may already be under stress. Measures to ameliorate existing stress as well as to prevent additional stress may be warranted.

There are significant differences between ameliorative, or corrective, actions and preventive actions. While stress can be prevented by guiding growth and development, correction of existing stresses requires changes to already existing facilities or practices. Prevention of problems is the traditional emphasis of planning and regulatory programs, while correction is more likely to require costly engineering solutions. For example, preventing dense residential development on soils unsuitable for septic tanks unless a satisfactory sewer system is in place imposes little direct costs. Providing a sewer system to an already existing residential development can involve substantial costs to both the local government and property owners. For this reason, corrective actions are usually more difficult to accomplish than preventive actions.

Nevertheless, management strategies most appropriate for historic high growth areas may need to emphasize corrective as well as preventive actions. Improvement or expansion of water supply systems, sewage and solid waste disposal systems, and other aspects of local infrastructure may be necessary simply to correct already existing problems. Collection and treatment of stormwater runoff, installation of detention ponds, and other stormwater runoff control measures may be necessary to correct situations that could have been prevented by maintaining riparian buffers.

Appropriate roles for the NC CMP in such engineering-based corrective actions might include identifying problem areas in need of action, analyzing alternatives, and facilitating funding for them. DCM has no authority to require such actions or to fund them. It could perform a useful role, however, in expediting coordination between local governments and the agencies with appropriate authorities.

Preventive actions will also be needed in high growth areas to avert continued and intensified problems. Comprehensive planning and stringent land use controls will need to be applied by the local government. Sensitive areas that would either be destroyed themselves by intensive development or the development of which would result in degradation of other resources will need to be identified and protected. Infrastructure and community services will need to be improved and expanded.

All of the management strategies available to the NC CMP will need to be applied to implement these corrective and preventive actions in high growth areas. Comprehensive planning and land use controls above and beyond that currently required in the CAMA planning guidelines will need to be encouraged by DCM or required by amendments to the rules. Consistency between the land use plan and local government actions will be essential.

If local governments fail to adequately protect sensitive areas that are of more than local significance, these areas may need to be designated as AECs so that state-level protection can be applied. Use standards in existing AECs may need to be strengthened in high-growth areas to prevent further deterioration of water quality, fisheries, etc.

The full authority of both state and federal consistency requirements will need to be applied to ensure that the actions of other government agencies are in accord with the growth-directing policies of local governments and with any state-imposed protective efforts. If problems are severe enough, and particularly if they involve conflicts in the policies or actions of different government agencies or levels, Special Area Management Planning may be necessary to adequately address the situation.

Anticipated High-Growth Areas

Most areas with high population growth rates over the past ten to twenty years are likely to continue to grow rapidly, at least until all available land is developed. There are other areas, however, that are just beginning to experience rapid population growth or that will begin to grow in the near future. These areas present the best opportunities for implementation of meaningful cumulative impacts management, since they have not yet experienced major adverse impacts. It is in these areas that appropriate preventive actions, if implemented in advance of anticipated growth, will be most beneficial.

Identifying potential future high growth areas, however, is more difficult than identifying areas that are already growing. Neither historic population growth rates nor growth projections based on historic trends can be used as reliable indicators of future growth. Indicators of future growth potential will have to be based on HU location in relation to historic high growth areas and on indicators of increasing economic activity that may signal impending growth.

Since areas that have been growing are likely to continue to grow, HUs adjacent to historic high growth areas are potential sites of future growth. The paths that development in high growth areas has been following may point toward the areas in which future growth may be expected. For example, the recent rapid pace of development of the Currituck County outer banks could have been predicted as the logical course of development spreading north from the Dare County banks to the south. Thus, the presence of rapid growth in one HU may be used as an indicator of potential growth in adjacent HUs, particularly those in the path of expanding development and those with environments similar to the area of historic growth.

Planned growth-inducing activities or developments are also indicators of future population growth. Examples include the Global Transpark (which is not in the coastal area, but close enough to induce growth in Craven and adjacent counties), military base expansions (expansion of MCAS Cherry Point in Craven County is underway), new highways, new bridges, development of industrial parks, major new residential developments, etc. Tracking plans and permit applications for such activities can provide a means of predicting where future growth is likely to occur. HUs in the area of such growth-inducing activities can be identified as high risk areas and appropriate management strategies applied before the growth takes place.

Upturns in the general pace of economic activity can also be used as indicators of potential future growth. New business openings, increases in the number of state or local permits being applied for, increases in demand for building materials, increases in real estate transactions, and increases in retail sales could all be used as indicators that an area is poised for rapid population growth. All of these parameters can be tracked with DCM's Population/Development/ Resources Information System.

Management strategies for future growth areas will involve an intensification of both state and local activities to prepare for the increasing pressures of development. A logical first step would be to carefully inventory the resources that will be impacted by future growth to determine their present status, their regional significance, and their sensitivity to disturbance. The objective of this inventory would be to identify the specific resources and areas that may warrant protective measures above and beyond any that are already in place. All sensitive resources should be identified, and at least those of greater than local significance targeted for specific protective measures.

Comprehensive land use planning should be applied by the local governments to identify areas into which growth would best be guided and to formulate protective mechanisms for sensitive areas. Planning will have to be coupled with growth management strategies and implemented through appropriate land use control ordinances. Comprehensive plans should include provisions for providing additional infrastructure and services needed for the expected growth.

For areas identified as sensitive resources of greater than local significance, AEC designation or stricter use standards for areas already in AECs should be considered. This step should be taken either in coordination with local government actions or to fill any gaps remaining after the local government has taken whatever actions it is willing to implement. Purchase of any outstanding resource areas that cannot be protected by other means should be considered by both the state and local governments.

Specific protective and growth management strategies chosen will depend upon the nature of the resources in the area and the types of threats likely to result from growth. If growth is likely to threaten water quality, for example, some of the strategies discussed under water quality high risk areas may be appropriate. If there are no outstanding resources or significant threats to environmental quality from the anticipated growth, simply good planning and growth management by the local governments may be sufficient to ensure that growth occurs in ways that will enhance the quality of life in the area.

High Value Resource Areas

Some parts of the coastal area may be identified as high risk areas simply because of a concentration of sensitive, high value resources within them, whether or not those resources are currently threatened or impaired. These might be HUs in which so much of the land or water area is made up of high value resources or resources of such sensitivity to disturbance that very little growth and development could occur without significant resource impairment. Or they might include HUs with only limited areas of sensitive resources but in which the resources are of such significance and sensitivity that development around them should be carefully planned and monitored. In either case, the high-value resources are at risk of degradation from any substantial growth and development.

The PDRIS database contains the area and percentage of each HU composed of several high-value and sensitive resources. The specific resources included are listed in Table II.

Table II. High Value Resource Areas in PDRIS
Anadromous Fish Habitat
Coastal Reserve Waters
Coastal Reserve Lands
Natural Heritage Inventory Areas
Primary Nursery Areas
Secondary Nursery Areas
Submerged Aquatic Vegetation
Threatened/Endangered Species Habitat
Highly Significant Wetlands
Shellfish Waters
High Quality Waters
Outstanding Resource Waters
Water Supply Watersheds

All of these resources are recognized as of sufficiently high value to warrant special protection in state or federal statutes and/or regulations. They are high value resources by law, not by arbitrary designation. There are several different situations in which an HU containing these resources may merit designation as a high risk area.

If the extent of these resources within an HU is so great that any substantial development would pose a threat to them, the risk of their impairment is high. Indicators of this situation would consist of high total percentages of the area of an HU being occupied by these resources.

If existing development in an area is of sufficient magnitude or intensity that high-value resources are already threatened, then the simple presence of these resources in an HU may be used as a high risk indicator. An area with that intensity of existing development, however, would also be identified as an area of high historic population growth. The presence of indicators of two categories of high risk would emphasize and help to explain the significance of the risk.

The presence of even relatively small areas of high value resources within an HU could indicate high risk if those resources are of sufficiently high value. An example of this category would be an HU containing threatened or endangered species habitat. Such habitat is protected by federal law even if it occupies a relatively small area. Another example might be HUs bordering Outstanding Resource Waters. Any substantial development in such areas may result in water quality impairment unless it is carefully planned and executed.

The appropriate management strategies for high-value resource areas will depend upon the extent and value of the resources and the degree of already existing development. The primary management concern should be protection of the specific high-value areas. If they occupy a large proportion of an HU, then growth may need to be restricted in the whole HU. If, as is more commonly the case, high-value resources occupy only a small portion of an HU, only that portion and immediately surrounding areas may need to be protected.

Some high-value resource areas are already included in AECs. Coastal wetlands, while they are only one type of high-value wetland, are included in a separate AEC category. Primary Nursery Areas (PNAs) and Outstanding Resource Waters (ORWs) are included in the Estuarine Waters AEC but are afforded higher levels of protection than other estuarine waters. These existing mechanisms may be sufficient to protect these high-value resources. The 1989 amendments to CAMA, however, authorized inclusion of contiguous lands in the Coastal Wetlands AEC and separate AEC categories including adjacent lands for PNAs and ORWs. This authority could be used to improve protection of these areas as part of a cumulative impacts management strategy.

In many cases, local land use planning and corresponding land use regulation could provide adequate protection for high-value resource areas. Most current land use plans, however, don't afford significant protection to any resources other than those in AECs. Land use control through zoning, protective overlay districts, etc., are lacking in most of the coastal area. Local land use planning and control will need to be improved and stringently implemented if it is to play a major role in protecting high-value resources.

In cases in which specific land areas are of particularly high resource value, public acquisition may be the best means of providing protection. While a cumulative impacts management strategy cannot mandate public acquisition, it can be used to identify those areas that should be considered for acquisition under other programs.

Productive and Aesthetic Resource Areas

Agriculture, forestry, and fishing are economic mainstays in much of the coastal area. The scenic beauty of the coastal regions is one of the primary reasons for their popularity for tourism, another important component of the coastal economy. Protection of the productive and aesthetic resources of the coastal area is essential to maintaining its economic well-being.

The information on land use, soils, and economic activity in the PDRIS will provide adequate indicators of the presence and importance of productive resources in each HU. Identification of aesthetic resources, however, is less straight-forward. Presence of public recreation lands and shoreline areas may provide some indication of aesthetic resources. The relative importance of the tourist economy in an HU may serve as an indicator of the economic importance of protecting its aesthetic resources.

CAMA clearly includes the protection of highly productive and scenic areas within the authorized mandates of the NC CMP. Protection of recreational opportunities and scenic vistas is specifically included in the Legislative Findings and Goals (NCGS 113A-102). The list of authorized AECs includes "renewable resource areas where uncontrolled or incompatible development which results in the loss or reduction of continued long-range productivity could jeopardize future water, food or fiber requirements," (NCGS 113A-113 (b)(3)) and lists "prime forestry land" as a specific AEC category (NCGS 113A-113(b)(3)(c)). With the exception of fisheries productivity, however, little emphasis has been given to the protection of productive or aesthetic resources in the implementation of the NC CMP.

While several management mechanisms exist for the protection of productive farm and forest lands, they have not been used for this purpose in the NC coastal area. Property value assessment based on the economic return from agricultural or forest crops is one of the primary means used in other areas to protect farm and forest land. Local tax structures that base property values on an area's potential for development instead of its current use often result in the loss, rather than the protection, of productive lands. So long as this approach to property evaluation is used and the economic demand for development continues, productive lands will continue to be converted to other uses.

Whether productive lands are maintained in productivity or converted to other uses is, and should remain, a local decision unless the significance of the crops being produced is of national or regional concern. If the benefits of land conversion are perceived to be greater than the costs of losing productivity and the results of that loss on the local economy and culture, government cannot be justified in trying to prevent it. Unless the state or federal governments overtly choose to protect productive lands, it would not be appropriate for the NC CMP to become involved. In this sense, then, the identification of highly productive lands at high risk of loss will be performed primarily to identify them to local governments which can choose the course of action they feel is appropriate.

The protection of resources that are perceived to belong to the public, however, is a different matter. The overall protection of environmental quality falls into this category, as do the more specific protection of recreational fisheries and aesthetic resources. Protection of fisheries is already strongly emphasized in the NC CMP, and the factors related to fisheries, such as water quality and nursery areas, will be addressed in identifying and managing other categories of high risk areas. The only specific resources included in this risk category that are reasonably subject to management by the NC CMP, then, are aesthetic resources.

Protection of scenic areas could be accomplished by several mechanisms. Local land use planning could give priority to protection of scenic beauty by identifying particularly significant areas and either preventing their development or limiting development so as to maintain scenic values. More emphasis on protecting scenic beauty could be included in AEC use standards. Although the general management objective for Estuarine System AECs includes safeguarding and protecting aesthetic values (15A NCAC 7H.0203), nothing specific as to how this is to be done is included in the Use Standards. Without any standards, it would be difficult to deny a permit on the grounds that the resulting project would be too ugly!

Whether any specific aesthetic standards are practical or advisable is open to question. The old cliche about beauty being in the eye of the beholder has enough truth to it to make absolute aesthetic standards difficult to formulate. Whether an ocean beach is more beautiful with or without adjacent high rise hotels, for example, probably depends more on whether the person making the judgement is staying in one of the hotels than on any universal standard. It is likely that high risk of loss of aesthetic quality will also be a risk category that will be identified to provide information rather than one to be directly addressed by the NC CMP.

ALTERNATIVE MANAGEMENT STRATEGIES

Section 5

North Carolina's approach to coastal area cumulative impacts management is based on identifying high risk areas and applying a combination of management strategies appropriate to the specific situations within them. The proposition that certain parts of the coastal area need to be treated differently from others is clearly implicit in this area-based cumulative impacts management strategy. Some areas, due to their particular characteristics or the intensity of development in them, are subject to adverse cumulative impacts, and others, at least presently, are not. The focus of management attention must be placed on those areas in which adverse cumulative impacts are, or have a high potential for becoming, serious problems. That means that those areas need to be treated differently from areas where adverse impacts are minor.

While this idea is not foreign to the NC CMP, since AECs are treated differently from other areas, it has not been widely applied. All local governments are subject to the same Planning Guidelines, and all permitted activities in a given AEC category must adhere to the same use standards. This uniform application of regulations, while it seems equitable and avoids the complications of identifying which areas come under which regulations, has serious short-comings in managing cumulative impacts. If high risk areas are to be treated differently to address their special situations, then different regulations must apply to them.

In order to legally apply a different set of regulations to high risk areas, some mechanism of officially designating those areas will be necessary. Then the specific regulations applicable to them must be adopted. Both of these steps will require action by the CRC. The first two steps of the cumulative impacts management model, i.e., Relative Risk Assessment and Classification of Risks, are designed to perform the difficult task of identifying the areas that need special attention. The rest of the model is designed to identify and apply the specific special attention needed. While these are two distinct steps, they are part of one management strategy. Either one without the other would be largely meaningless. Similarly, the CRC cannot be expected to approve the designation of an area as a high risk area without being clearly aware of the implications of that designation. The entire process, then, must be completed before it is introduced to the CRC.

The specific mechanisms for high risk area designation and the specific regulations that may be proposed to apply to them must be developed as part of the cumulative impacts management strategy. This is the policy dimension of the strategy as opposed to the technical dimensions discussed above. The rest of this Section discusses some of the policy implications of using the alternative management mechanisms available to the NC CMP as effective tools for cumulative impacts management. The discussion of various possibilities is not meant to suggest that they will be proposed, but only to identify and explore as many alternatives as possible.

The CAMA Regulatory Program

The CAMA regulatory program, consisting of AEC designation and direct state regulation of development, is the strongest management tool available to the NC CMP. As such, it is a primary potential implementation mechanism for cumulative impacts management.

Cumulative Impact Considerations In CAMA Permit Decisions

Since contribution to adverse cumulative effects is a statutorily authorized basis for permit denial, it would appear that individual review of each permit application for its contribution to adverse cumulative impacts would be the obvious way to apply the CAMA regulatory program to cumulative impacts management. This approach, however, requires an objective and legally defensible means of assessing the cumulative impacts of a single proposed project in the context of everything else that already has, or will in the foreseeable future, impact the same resources. The scientific and practical difficulties of this kind of cumulative impacts assessment have been discussed above (p. 3), and are so overwhelming as to make this approach infeasible at the present time.

NEPA, with its requirement for cumulative impacts assessment, has been in effect since 1970. Over the ensuing 24 years, many cumulative impact assessments have been attempted for individual projects, and environmental managers and scientist have expended great effort in trying to develop adequate assessment methodologies. In spite of the time and effort invested in these attempts, an objective, scientifically sound, and understandable method of cumulative impact assessment for individual projects is not available. The potential for application of such an approach exists within the CAMA regulatory program, and alternative methodologies will be examined in the development of DCM's cumulative impacts management strategy. It is not likely, however, that objective cumulative impacts assessment methods will be incorporated into CAMA permit application review in the near future.

Cumulative impacts are landscape scale, rather than site-specific, phenomena. The Cumulative Impacts Management Model described in this report follows a landscape-scale approach toward identifying high risk areas. In order to apply the site and project specific CAMA regulatory program to cumulative impacts management in the context of this model, it must be applied differently in high risk areas than in the rest of the coastal area. This would entail changing the regulatory structure in high risk HUs by designating new AECs, increasing the geographic extent of present AECs, changing AEC use standards, or some combination of these approaches.

New AECs

While high risk areas, in their entirety, are not envisioned to be a type of AEC, cumulative impacts management in high risk areas could entail designation of parts of them as new AECs. The CRC has the option of designating new AECs so long as the AECs fit within one of the general categories authorized by CAMA. Several of the AEC categories established by CAMA could be particularly amenable to use in managing cumulative and secondary impacts.

In 1989, the General Assembly amended CAMA by adding two new categories of AECs: Outstanding Resource Waters (ORWs) and Primary Nursery Areas (PNAs). The statutory definition of these AEC categories authorizes the CRC to include within the area designated as AECs "such contiguous land as the CRC reasonably deems necessary" for the protection of the resource values involved. (NCGS §113A-113(b)(8)(9)). This "contiguous area" authorization reflects the realization that activities outside the precise boundaries of the resources themselves may have substantial cumulative and secondary impacts on them.

While ORWs and PNAs are already included in the Estuarine System AEC category, their designation as distinct AECs including the land around them would have significant advantages for cumulative impacts management. Both of these resources are included in the list of high value resource areas (Table II). At least some of the HUs containing ORWs and PNAs are likely to be identified as high risk areas; perhaps all of them should be. If these resource areas were distinct AECs in themselves, and if their presence were a primary determinant of high risk, there would be no need for different AEC use standards in high risk areas. The presence of the resources themselves would determine the use standards.

The inclusion of contiguous lands within these AEC categories would have particular advantages in managing secondary impacts resulting from activities on surrounding lands. The use standards for the AEC itself, rather than those for the Estuarine Shoreline AEC, would apply to contiguous lands. This would make the application of use standards specifically tailored to protect these sensitive resources from secondary impacts more straight-forward.

The CAMA definition of the Coastal Wetlands AEC also includes the "contiguous areas" clause that applies to ORWs and PNAs (NCGS 113A-113(b)(1)). While use standards for coastal wetlands are highly protective, coastal wetlands are still subject to secondary impacts from development of adjacent lands. The ability to treat lands and non-tidal wetlands adjacent to coastal wetlands differently from those in other estuarine shoreline areas would provide a valuable tool for cumulative and secondary impacts management.

CAMA also authorizes AEC designation for "renewable resource areas where uncontrolled or incompatible development which results in the loss or reduction of continued long-range productivity could jeopardize future water, food or fiber requirements of more than local concern" (NCGS §113A-113(b)(3)). This statutory provision would allow AEC designation for watersheds, aquifers, capacity use areas, prime forestry land, and similar areas likely to be included in some high risk areas.

The natural and cultural resource AEC category is defined in CAMA as including "fragile or historic areas, and other areas containing environmental or natural resources of more than local significance" (NCGS 113A-113(b)(4)). This definition is broad enough to include many significant coastal resource areas. Current rules include complex natural areas, areas that contain remnant species, unique geologic formations, and significant architectural and historical resources within this category (15A NCAC 7H.0504), but the examples given in CAMA are more inclusive than this. The definition would seem to allow AEC designation for any "environmental or natural resources of more than local significance."

The natural and cultural resource AEC category could be of great value in providing protection for sensitive resources in high risk areas. The fact that this AEC category has received little application in the past is not a comment on its usefulness so much as an artifact of its narrow interpretation in current rules and an arcane and difficult nomination and designation procedure. If the CRC should decide to make greater use of this AEC category and change the nomination and designation procedures, it could become a significant component of a cumulative impacts management strategy.

In addition to the Estuarine Shoreline, which has been an AEC since the initial approval of the NC CMP, CAMA authorizes AEC designation for shorelines of all public trust waters (NCGS 113A-113(b)(6)(b)) and for floodways and floodplains (NCGS 113A-113(b)(6)(c)). Designation of such areas as AECs could provide protection for riparian buffers and wetlands in areas upstream of estuarine waters. This could be a valuable management tool in high risk HUs with water quality degradation and in protecting estuarine resources from stresses caused by upstream development.

The rationale for AEC designation of estuarine shorelines is that "Development within estuarine shorelines influences the quality of estuarine life" (15A NCAC 7H.0209(c)). This relationship between shoreline development and aquatic life clearly applies not only to estuarine shorelines but also to the shorelines of all water bodies. It is also clear that the quality and quantity of water flowing into estuaries from upstream sources has a significant influence on estuarine life. In order to adequately address management of cumulative impacts on overall water quality and aquatic life, protection of upstream riparian areas is an indispensible management tool. The fact that this tool is available as part of the CAMA regulatory program speaks strongly in favor of its implementation through AEC designation of public trust shorelines and/or floodplains.

While designation of additional AECs would provide valuable tools for cumulative impacts management, the advisability and feasibility of emphasizing this approach is open to question. AEC designation should not be taken lightly nor considered a solution to all problems. The designation process in itself is long and administratively difficult and must be accompanied by the development of appropriate use standards. It would apply an additional regulatory burden on the public and additional demands on a limited DCM staff. Because of these considerations, the CRC has been hesitant to expand the scope of state regulation through designating new AECs.

Using new AEC designation as a tool for cumulative impacts management should be considered an option of last resort, not the first approach to be applied. It should be considered only in cases in which a resource area of recognized great significance is demonstrably threatened by development activities and in which no other management tool is adequate to provide the necessary protection. Whether such situations will be identified in the cumulative impacts risk assessment process remains to be seen.

AEC Boundary Modifications

Expanding the area encompassed in already existing AECs would provide a more moderate approach to using the CAMA regulatory program to address cumulative and secondary impacts. Precendent for this approach to providing higher levels of protection for sensitive areas already exists in the expansion of the Estuarine Shoreline AEC to 575 feet around ORWs. This same approach might be applicable to high risk HUs containing impaired or threatened waters in which water quality impairment is linked to shoreline activities. Indeed, this might prove to be the most feasible way in which modifications to the AEC structure can be incorporated into cumulative impacts management.

Including contiguous lands in the coastal wetlands AEC, as discussed above, might more accurately be considered a boundary modification than a new AEC designation. This modification would certainly make management of cumulative and secondary impacts on coastal wetlands more practical. The Estuarine Shoreline AEC around PNAs could also be widened without necessarily establishing a separate AEC category, but to be a meaningful change, this would have to be accompanied by different use standards for shorelines adjacent to PNAs. The Estuarine Shoreline AEC around ORWs has already been expanded, and different use standards apply.

It may also be appropriate to widen shoreline AECs in high risk areas where land-based, rather than water-based, resources are threatened. For example, many functionally significant fresh water wetlands lie adjacent to shorelines, especially in the Albemarle Sound area. While these wetlands are subject to the §404 wetland regulatory program, they are not afforded the same level of protection as are coastal wetlands, even though they are likely to be equally important to the estuarine system. Similar examples of land-based resources located near shorelines may be identified in the risk assessment. Widening the shoreline AEC to encompass the extent of these resources could be a useful tool in protecting both the resource areas themselves and adjacent estuarine waters from adverse cumulative and secondary impacts.

Changes in Use Standards

The least drastic approach to modifying the CAMA regulatory program for implementation of cumulative impacts management would be modification of AEC use standards in high risk areas. Some development activities that would be permissable under current use standards in most of the coastal area may not be appropriate in certain high risk areas. For example, in areas designated high risk because of water quality impairment, marina siting standards could be made more stringent, impervious surface limitations could be tightened, or development could be limited to areas served by municipal sewer systems.

These examples are merely hypothetical, but indicate the kinds of changes in use standards that might be considered to implement cumulative impacts management. Specific rule amendment proposals will be developed in the fourth step of the cumulative impacts management model when appropriate implementation mechanisms are identified to address specific situations in high risk areas.

Since rule amendments changing AEC use standards to address new situations has been an on-going process throughout the history of the NC CMP, it is a process that the CRC, DCM staff, and the public are comfortable with. Modification of AEC use standards applicable to AECs in high risk areas is, therefore, a feasible cumulative impacts management mechanism. While it does represent a somewhat different approach, in that the modified use standards would be applicable to only those portions of a given AEC category falling within certain high risk areas, it is not a radical departure from the way in which the CAMA regulatory program has always worked. If there are situations in which development in AECs is a substantive contributing factor to adverse cumulative impacts and in which modified use standards could be clearly shown to be of benefit in preventing those impacts, it is likely that the CRC would approve reasonable rule modifications.

Land Use Planning

The fact that the CAMA requirement for local land use planning applies to all of the coastal area, not just to AECs, makes it a potentially more useful tool for dealing with landscape level cumulative impacts than is the CAMA regulatory program. The local planning component of the NC CMP, therefore, is expected to play a major role in cumulative impacts management.

In order to make land use planning a powerful implementation tool for cumulative impacts management, however, several changes in current policies and procedures will be necessary. Revisions to the Land Use Planning Guidelines and modifications of planning procedures will likely be necessary to incorporate cumulative impacts management into local planning programs. Possible improvements to the planning process include the use of more comprehensive information in planning, basing local plans on the same hydrologic units used in regional cumulative impacts risk assessment, improved plan coordination and consistency, and more stringent local and state implementation of land use plans.

Improved Information for Planning

It is unrealistic, except, in a very limited sense, to expect local plans to include cumulative impacts assessments unless a regional assessment is available from which to tier to the local level (Hunsaker, 1993). The scope of local plans, while larger than that of site specific development projects, is still too limited to adequately address regional phenomena. The regional risk assessment and coastal-area-wide cumulative impacts management program being developed by DCM will, however, provide the regional context into which local planning can fit. The information bases developed for region-wide risk assessment and management can provide the link between state and local perspectives necessary to achieving an integrated approach to cumulative impacts management.

The Population/Development/Resources Information System (PDRIS) developed by DCM contains a wealth of information useful not only for regional management, but for local land use planning as well. A complete list of information included in the PDRIS is given in the Appendix. In addition, DCM's wetlands mapping and functional assessment efforts have produced detailed information on this significant component of the coastal area landscape. DCM is developing mechanisms for providing this information to local governments as part of the land use plan update process.

Providing this information to local governments will have several advantageous results: (1) accuracy and consistency of the information used for planning will be improved; (2) local governments will be relieved of many of the data gathering requirements of land use plan updates; (3) the use of information based on hydrologic units will enable better local understanding of the effects of growth and development on the natural environment than is possible with information collected by political jurisdiction; and (4) data transfer and the use of common information will improve communication and coordination between state and local governments. All of these results will increase the value of local planning as a tool for cumulative impacts management.

The only barriers to providing PDRIS and wetlands data to local governments are the logistical problems of media, formats, timing, etc. Information must be provided in forms in which local governments are able to access and use it. The wide size range of local governments in the coastal area results in a range of computer and GIS capabilities and ability to use and manipulate information. Mechanisms for transferring and using information that account for these differences must be developed. A Project of Special Merit grant awarded to DCM under the

CZMA §309 Program for federal fiscal year 1994-95 will provide funding to develop these mechanisms. File or map formats, minimum computer hardware and software configurations, transfer media, and delivery procedures will be determined to facilitate widespread dissemination of the state information database.

If this more sophisticated information is to be valuable in improving cumulative impacts management, it must be used meaningfully by local governments. Since much of the information will be new and in a format different from that historically used for local planning, local governments will need guidance and assistance in applying it to their situations. DCM has started working with some local governments in the use of state-provided information to develop methods for local applications. This effort will be expanded over the next two years to include working relationships with several coastal area governments to develop applications appropriate to a range of local situations.

The diversity of local governments in the coastal area also results in a range in sophistication and interest in improving land use planning. Some communities are likely to embrace improved information and techniques and immediately put them to use; others are likely to be hesitant. The availability of better information will not result in an immediate and universal improvement in local land use plans. Over a period of time, however, it will increase the sophistication of local planning and will increase the effectiveness of local planning in managing cumulative impacts.

Hydrologic Unit Based Planning

The most obvious framework for tiering from the regional risk assessment to local planning would be using the same hydrologic units for local planning as are being used in the regional assessment. The data collected and analyses performed for the regional assessment could be provided in the same form to local governments, which would use this information as the basis for sub-plans for each HU within their jurisdiction. This approach would provide a common framework for regional and local cumulative impacts management and for addressing the particular problems of high risk areas in local plans.

If local plans are to be effective in addressing the problems of high risk areas, their planning for these HUs must be different than for other areas. Requiring that planning for high risk areas specifically address the particular situations leading to the high risk designation is the only meaningful way in which local planning can serve as an implementation mechanism within the cumulative impacts management model. If local governments are required to plan differently for high risk HUs as distinct units within a larger planning jurisdiction, it is only a small additional step to base the entire plan on a series of hydrologic units.

Basing local planning on watershed units would also promote better understanding of relationships between land use and water quality and provide a basis for implementation of DEM basin-wide plans through local planning and land use management. It might also stimulate local governments to consider the implications of land use in a part of a watershed on the rest of the watershed and on those downstream.

There are obvious difficulties, however, in attempting to base local planning on hydrologic units. The most apparent difficulty is the disparity between boundaries of HUs and planning jurisdictions. Political jurisdictions do not conform to watershed boundaries, resulting in many HUs that overlap two or more planning jurisdictions. Small municipalities may occupy only a portion of a watershed and have no voice in what happens in the rest of it. Of necessity, plans for many HUs would be fragmented among different local planning bodies so that the advantages of coordinated planning for those HUs could be lost.

If approached realistically, however, this difficulty could be turned into a long term advantage. Planning by watershed units would require local governments to examine relationships between land use and water quality. It should become apparent that what happens in part of a watershed influences other parts, and what happens upstream certainly influences water quality downstream. Given enough time, this may result in a more coordinated approach to planning among different political jurisdictions that occupy portions of the same watershed. Improved coordination among plans would, in itself, increase the effectiveness of local planning in cumulative impacts management.

Another potential difficulty with watershed-based planning is the fact that population and economic data are collected and reported by political jurisdictions, not watersheds. This difficulty has been largely overcome, however, in the development of the PDRIS. DCM and RTI have developed methods for allocating and distributing data reported on other geographic bases to hydrologic units. This information will be maintained in the PDRIS and will be readily available to local governments.

Again, what at first appears to be a disadvantage of HU-based planning could become a distinct advantage in the long term. Agricultural agencies, such as SCS and ASCS, are moving toward collecting and reporting agricultural data on the basis of the same HUs used in the PDRIS. Both EPA and NOAA are actively promoting watersheds as logical data collection and environmental planning units. DEM's basin-wide approach to water quality planning and permitting uses river basins and sub-basins as analytical and planning units. If local governments began to plan by these HUs, they would begin to collect and analyze local information on the same basis. While there may be some difficulties in the short run, moving toward common, environmentally-based units for data collection, analysis, and planning by local, state, and federal agencies would be a distinct long-term advantage in cumulative impacts assessment and management.

Since planning by hydrologic units would necessitate closer coordination among political jurisdictions sharing common watersheds, the current disjointed timing of land use plan updates would present a short-run difficulty. There is already an effort underway, however, to improve coordination of plan update timing among adjacent and overlapping jurisdictions, such as counties and the municipalities within them. Changing the organization of this rescheduling effort from a county to a river basin basis would overcome this difficulty. Some lag time will elapse before all updates can be coordinated by river basins. But once again, this short term difficulty could result in long term improvements in dealing with cumulative impacts.

While watershed-based planning is clearly relevant to environmental and resource management, it may not be particularly relevant to other planning needs. Provision of community services, for example, bears little relationship to watershed boundaries. In order to meet the planning needs of local communities, a combination of watershed-based planning for resource protection and population center-based planning for community service needs would be most appropriate.

The feasibility of adopting and implementing a change to watershed-based planning in CAMA land use plans depends upon the degree to which the involved parties - DCM, local governments, and the CRC - choose to emphasize the difficulties and shortcomings or the long term advantages. There would be some transitional difficulties, and watershed-based planning is not a panacea. But the long term advantages of this approach in the context of a resource protection oriented planning program are great. Indeed, hydrologic unit based planning may be the only way to implement cumulative impacts management in the CAMA planning program.

Improved Coordination and Consistency

Cumulative impacts management cannot be successful if local actions are not coordinated and consistent with regional goals (Contant and Wiggins, 1991). After the regional assessment is performed and a cumulative impacts management program developed for the entire NC coastal area, it will be necessary for local plans to be consistent with and provide local implementation for regional cumulative impacts management goals. The basis for achieving this is found in CAMA, which, in reference to land use plans, states that "The plan shall be consistent with the goals of the coastal area management system...and with the State guidelines adopted by the Commission" (G.S. 113A-110(a)). The State Guidelines also state: "All policies adopted by the local government as a part of the land use plan shall be consistent with the overall coastal policy adopted by the Coastal Resources Commission" (15A NCAC 7B.0203(d)).

Achieving consistency between regional cumulative impacts management strategies and local plans will require some changes in the basis for CRC review and certification of land use plans. In addition to ensuring that the required procedures have been followed and the required topics addressed, the CRC must ensure that the policies in local plans are consistent with the basic goals of the NC CMP. In the context of cumulative impacts management, local policies must be consistent with policies developed in the regional strategy. The legal basis for this requirement is provided in the above quotations from CAMA and the State Guidelines.

It is also necessary that local plans be consistent and coordinated with others in the same subregion. The Guidelines require that "Meetings shall be held with the planning and governing boards of all adjoining planning jurisdictions to discuss planning concerns of mutual interest" (15A NCAC 7B.0203(c)). This approach has proven to be ineffective, since there is no explicit requirement that policies be consistent from one unit to another. This leads to uncoordinated and often conflicting policies in the plans of adjacent jurisdictions, a situation that is more likely to result in adverse cumulative impacts than to alleviate them.

This problem is exacerbated by the current timing of land use plan updates. Plans must be updated every five years beginning with the time of the first plan prepared by the local government. Since municipalities can decide at any time to prepare a land use plan for the first time, plan updates for municipalities often do not occur on the same schedule as updates for the county in which they are located or for other nearby municipalities. This disjointed timing works against coordinated planning and results in failure to consider common concerns and develop consistent policies.

A separate report is being prepared to suggest specific changes to the land use planning process to make it more effective in cumulative impacts management, so only a few general possibilities will be discussed here. The overriding concern must be putting plans in the context of their region through coordinated timing and consistency of policies. All plans for a subregion should be developed at the same time, and policies should be consistent among plans and with general policies for the subregion and the entire Coastal Management Program.

Perhaps the number of separate plans should be decreased, so that a county and all the municipalities in it produce one plan through concerted effort rather than many plans through separate efforts. Possibly going a further step and shifting the planning process from a purely local to a regional basis would be most effective. Regional plans could then pay particular attention to and contain more comprehensive planning for local landscape units with high cumulative impacts risk and be less comprehensive for low risk landscape units.

Adopting a hydrologic unit basis for planning, as discussed above, would be a less drastic change than shifting to regional planning and could overcome many of the problems of lack of consistency and coordination. If all of the plans within a river basin were updated simultaneously, and if local governments were required to coordinate plans for shared hydrologic units, the opportunity for improved coordination would at least be present. Perhaps over time it would become a reality.

Land Use Plan Implementation

Plans by themselves, however well coordinated and comprehensive, will not be effective in managing cumulative impacts unless they are implemented. Implementation at the local level could be improved by requiring that all local ordinances and actions be consistent with the plan. CAMA now explicitly requires such consistency only in AECs (G.S. 113A-111).

If CAMA were amended to require consistency between land use plans and local ordinances, and if land use plans were required to be consistent with cumulative impacts management policies adopted by the CRC, a structure would be in place whereby cumulative impacts management through local land use planning could become a reality. Short of that, the CAMA planning program will be, at best, an uneven implementation mechanism.

Inter-Agency Coordination

Whatever changes might be made to the CAMA regulatory and land use planning programs to improve their effectiveness in managing cumulative impacts, these management tools alone will be inadequate to the task. Although the management tools available to the NC CMP are broad in scope, they are limited by the statutory authorities of other agencies and the structure of North Carolina state government. While protection of water quality, for example, is a goal of the NC CMP, the regulatory authority for water quality protection lies with DEM. Many other state, federal, and local agencies also play significant roles in determining land use patterns and managing resources in the North Carolina coastal area. The decisions and actions of all involved agencies must be consistent with cumulative impacts management goals if those goals are to be achieved.

Other agencies, each focused on its own authorities and responsibilities, will not automatically act consistently. DCM, as the lead agency in cumulative impacts management, will have to take the initiative in coordinating agency activities to address the situations in high risk areas. Specific means of interagency coordination must be included in the cumulative impacts strategy.

The coordinating role of the NC CMP was set forth in the original coastal management plan (NOAA, 1978), which pictures the CMP as an "umbrella" program coordinating the activities of all agencies involved in activities related to coastal management. Implementation of this coordinating role, however, has not been achieved to the extent originally envisioned. Resource and environmental management remains fragmented among various agencies, and the role of DCM is seen as limited to implementation of the specific authorities of CAMA. Successful management of cumulative impacts, however, will require that a more holistic approach be achieved and that the NC CMP become a true umbrella program, not dictating the actions of other agencies, but coordinating them into a cohesive program of coastal management.

There are too many agencies and programs pertinent to coastal management to attempt to discuss them all here. The relevance of some of them may not become apparent until the assessment is completed and cumulative impacts management strategies are being devised. There are, however, some programs carried out by or involving other agencies that obviously relate to cumulative impacts management. These include DEM's Basinwide Planning Program, the Water Supply Planning Program of the Division of Water Resources, and the Coastal Nonpoint Pollution Control Program.

Basinwide Planning

North Carolina's basinwide approach to water quality management, designed and implemented by DEM, is the closest approximation to cumulative impacts management presently in operation in the state. All water quality management activities, including permitting, monitoring, modeling, nonpoint source assessments, and planning, are coordinated and integrated by river basin. Water quality and aquatic resources are assessed simultaneously throughout an entire river basin, leading to the development of basinwide water quality management plans and strategies (DEM, 1991). This innovative program is considered a national model for management of cumulative impacts on water quality.

Close coordination between DCM's cumulative impacts management strategy and DEM's Basinwide Planning Program is a primary goal of the strategy (DCM, 1992b). Since both efforts are based on watershed units, and since water quality is a good indicator of cumulative impacts, the basis for coordination is obvious. The structure of how coordination will be implemented is being developed through frequent consultations between the two agencies. Several possibilities exist.

While basinwide plans are for entire river basins, they are broken down into sub-basins for analysis and implementation. Currently DEM uses it own sub-basin delineations, roughly equivalent to the eleven-digit SCS/USGS hydrologic units. Further reducing the level of detailed analysis and implementation to the fourteen-digit HU level used by DCM would make the analytical units of both agencies directly equivalent. The PDRIS could then be used by DEM to provide more detailed information on population, land use and water quality in each HU, increasing the level of precision of the basinwide plan.

DCM's analyses will provide identification of water quality high risk areas, which can be the focus areas within the basinwide plan. When the high risk is a result primarily of upstream activities, DCM can potentially influence treatment of those activities in the plan, extending the influence of the NC CMP over upstream activities that influence coastal water quality. When activities within a coastal HU significantly contribute to water quality impairment, the NC CMP can provide basinwide plan implementation through land use planning and the CAMA regulatory program.

Hydrologic unit-based planning with plan updates coordinated by river basin would provide an ideal implementation opportunity for land use related aspects of basinwide plans. Changing to this basis for CAMA land use planning would provide a clear basis for coordination with basinwide planning, in addition to the intrinsic advantages of HU-based planning discussed above. True interagency coordination requires adjustments on the part of all programs involved. The CMP cannot expect to influence the actions of DEM in regard to upstream activities unless it is prepared, in turn, to accomodate the implementation aspects of DEM's basinwide plans.

Water Supply Planning

The State Water Supply Plan Statute (NCGS 143-355(l-m)) requires local governments that provide public water supply service to analyze current water supply and demand, project future water needs, and plan for the continued provision of adequate water supplies. Water Supply Plans must also specify how much wastewater is generated by the system and where it is discharged. Plans are submitted to the Division of Water Resources (DWR) and must be updated at least every five years. Based on these local plans, DWR develops a state water supply plan to identify potential conflicts and areas for coordination.

Adequate water supply is a potential growth-limiting factor in some coastal communities, particularly those dependent upon limited groundwater aquifers. Water Supply Plans are meant to identify those areas, bring them to the attention of the local government, and ensure that appropriate adjustments are planned in advance and that state technical assistance is provided where needed. When water use conflicts or water shortages occur, DWR performs ground water studies and recommends alternatives, including Capacity Use Designation and other measures.

These water supply programs are an attempt to manage and plan for cumulative demands on a finite resource, and, as such, are a form of cumulative impacts management. Local Water Supply Plans are also closely related to land use planning, since amounts and patterns of growth and development determine future water demand. Water supply planning is another obvious area for coordination with the NC CMP's cumulative impacts management program.

DCM and DWR have begun discussing ways in which the efforts can be coordinated. One obvious possibility is to combine water supply plan updates with CAMA land use plan updates. Water supply planning is an important component of comprehensive planning, and both are updated on the same five-year cycle. In addition to increasing the scope and significance of CAMA land use plans in managing cumulative impacts, including water supply planning would decrease redundancy of effort by local governments.

Information from water supply plans could also be used to identify HUs with potential water supply problems, increasing the scope and usefulness of the PDRIS. At some point in the future, when local water supplies become limiting to growth and regional solutions are necessary, water supply planning may form a basis for a regional approach to growth planning and management.

Coastal Nonpoint Pollution Control Program

The Coastal Nonpoint Pollution Control Program (CNPCP), established by Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990, requires coastal states to develop coordinated programs for control of nonpoint source pollution of coastal waters. The program, currently under development, will be implemented through changes to the state Nonpoint Source Management Program in DEM and to the NC CMP. The central purpose of the CNPCP is to strengthen links between federal and state coastal management and water quality programs in order to enhance state and local efforts to manage land use activities that degrade coastal waters and habitats (NOAA and EPA, 1993). It, thus, provides excellent opportunities for improving inter-agency coordination in addressing the cumulative impacts of land uses.

The CNPCP must contain enforceable policies and mechanisms to implement nonpoint source management measures for a range of land use practices throughout the coastal area, and, in some instances, to a larger area. In areas with existing threatened or impaired waters or in which new or substantially expanding land uses may contribute to future impairment, additional more stringent management measures must be applied. These CNPCP management measures may provide a range of implementation mechanisms for cumulative impacts management, particularly in high risk areas with existing or potential water quality degradation.

The primary purpose of the CNPCP is to implement management measures for nonpoint source pollution by more fully integrating federal, state, and local authorities. It is being developed by DCM in close coordination with the Nonpoint Source Management Program (§319 Program in

DEM, and also involves coordination with several other agencies with management or regulatory authorities related to potential nonpoint source generating activities or nonpoint source controls. The other agencies involved, in addition to the §319 Program, include the stormwater, wetlands, groundwater, and basinwide planning programs in DEM and the divisions of Soil and Water Conservation, Land Resources, Environmental Health, Solid Waste Management, and Forest Resources. Seldom does any one effort attempt to coordinate the activities of so many agencies.

While the exact form of North Carolina's CNPCP is yet to be determined, it is federally-mandated and must follow guidelines developed by NOAA and EPA. Thus, its development and implementation in a form closely approximating federal requirements is virtually certain. The role of the CNPCP as an implementation mechanism for cumulative impacts management, however, will depend upon the degree to which the two efforts are integrated into an overall strategy.

To ensure this integration, DCM is developing North Carolina's CNPCP in close coordination with development of the cumulative impacts management strategy. Analyses of land use and water quality impairment performed in cumulative impacts assessment will be used to identify areas in need of additional NPS management measures in the CNPCP. Since these same areas are also likely to be identified as high risk areas, the CNPCP will play a primary role in addressing the cumulative impacts of land uses within them.

Special Area Management Planning

SAMP is a tool for cooperative multiagency management of areas of special importance with intense use and management conflicts. Its use is normally limited to situations in which highly valuable resources are overtly threatened and no appropriate management framework exists. The SAMP process brings together all involved agencies, governmental levels, and user groups in an attempt to resolve conflicts and develop a mutually agreeable management structure. Special administrative arrangements or new management forms are often created to increase regulatory coordination or to guide development (Brower and Carol, 1987).

SAMP is a difficult, time-consuming, and expensive process that requires the full commitment of all parties and often necessitates the development of new implementation mechanisms. It has been used with varying degrees of success in several states to address highly complex problems that could not be handled in any other fashion. In most cases, SAMP is considered an approach of last resort when all other management approaches have proven insufficient. The formal SAMP process should not be used if a simpler solution is available.

Due to its difficulties and the limitation of its use to unique situations in which alternative approaches are inadequate, SAMP is not a suitable implementation mechanism for wide-scale cumulative impacts management. Any policies or management structures developed through a SAMP would be limited to the specific geographic area to which it applies. If SAMP is used as a means of cumulative impacts management, its applicability will be limited to areas with particularly acute problems where other alternatives are inadequate.

SUMMARY AND CONCLUSIONS

Section 6

As population and development continue to increase in the North Carolina coastal area, managing the cumulative and secondary impacts of development has become a necessity. The primary mandate of the NC CMP is to guide growth and development so as to minimize environmental degradation. It is not possible to carry out this mandate successfully without assessing and managing the cumulative and indirect, as well as the individual and direct, impacts of development. This requires a more holistic management perspective and approach than have been used in the past.

It is extremely difficult to assess the cumulative impacts of incremental development on complex ecological systems. Linking individual causes with cumulative effects in an objective and legally defensible manner is impractical with current knowledge and methods. While it would be desirable to include cumulative impacts assessments in CAMA permit reviews, detailed, cause and effects assessment is too complex, imprecise, and difficult to comprehend to form an acceptable basis for regulatory decision-making.

Instead of cause and effect analysis, DCM is applying an area-based risk assessment approach emphasizing management, rather than assessment, of cumulative impacts. This approach identifies the activities that result in impacts and the status of resources that are affected. If either the level of impacting activities is intense or resources are already impaired, an area is at high risk of adverse cumulative impacts. Risk assessment can be applied without analysis or complete understanding of the complex details of cause and effect relationships and ecological thresholds. Risk assessment can identify which risks are greater or which areas are at higher risk so that time and attention can be focused on risk management rather than on ecological assessment.

This change in emphasis allows the use of standard planning and management techniques in cumulative impacts management. Risk management decisions can be made through the consideration of priority problems in light of available management options, resources, administrative and legal structures, etc. This approach is, therefore, more amenable to public policymaking. It's objective is not to provide a precise assessment of cumulative impacts within an area nor to assess the cumulative impacts of specific projects, but to identify areas at highest risk to which the conventional tools of environmental management can be applied.

Since the cumulative impacts of individual actions adversely affect public resources, cumlative impacts management is a legitimate function of government. Traditional government environmental programs, however, are designed to deal with individual actions and resources one at a time. The structure of single-purpose agencies often contrains their ability to take the holistic approach necessary for successful cumulative impacts management.

The NC CMP, however, is unusual in that its mandate includes a very broad and complete statement of environmental management goals. It is not limited to a specific class of resources or a single type of activity, but is to address the entire range of human activities as they influence the economic, aesthetic, and ecological well-being of the coastal area. The legislative findings and goal statements of CAMA provide a sound basis for a comprehensive cumulative impacts management program.

Similarly, the management mechanisms available to the NC CMP provide a broad spectrum of cumulative impacts management tools. The CAMA regulatory program, which specifically includes adverse cumulative impacts as grounds for permit denial, focuses full state authority on the most environmentally critical portions of the coastal area. The land use planning requirements of CAMA, together with the authority to establish state planning guidelines, provides a coordinated state-local system of land use planning capable of including a strong cumulative impacts management component. The interagency coordinating function of the NC CMP, backed up with legal requirements for state and federal consistency, provides the basis for implementation of the holistic, inter-agency approach needed for cumulative impacts management.

The North Carolina Model

Although the statutory authority and tools for cumulative impacts management have existed in the NC CMP since its inception, they have not been applied specifically for this purpose. Putting them together for the specific purpose of managing cumulative impacts requires a new analytical and structural model consisting of relative risk assessment, classification of risks, goal-setting, identification of the most appropriate implementation mechanisms, and implementation.

Relative Risk Assessment

The first step consists of comparing conditions in relatively small landscape units to identify areas at high risk of adverse cumulative impacts. The landscape units being used are 348 small watersheds, or hydrologic units, of 5,000 to 50,000 acres delineated by SCS. A large amount of information is being collected for each of these units to indicate the intensity of land use and development pressure and the concentration and condition of natural resources. A series of indices are being developed to summarize the indicator data and provide a basis for comparison among hydrologic units to identify those at highest risk of adverse cumulative impacts.

Classification of Risks

High risk areas will be classified into categories based on conditions and causative factors present in them. An area may be at high risk of adverse cumulative impacts due either to the nature or condition of its natural environment or to the type and magnitude of human-induced disturbances. Which management measures are most appropriate for a given area will depend upon its risk category.

Goal Setting

Specific management goals, consistent with the goals of CAMA, will be established for each high risk category. Appropriate management objectives for a given area will depend upon the nature of the risk and conditions present in the unit.

Identification of Implementation Mechanisms

For each high risk area category, the most applicable alternative or combination of alternatives will be chosen from among the management tools available in the NC CMP. Different situations and goals dictate the use of different management strategies. Various combinations of regulatory action, land use planning, and inter-agency coordination will be devised to address the situations of different high risk categories.

Implementation

Specific policies and rules applicable to each category of high risk area will be developed to apply the appropriate implementation mechanisms. Different management strategies, and thus different rules, will need to be applied to high risk areas than to other areas. This will require CRC action to designate high risk areas and adopt appropriate rules for their management. Implementation will also require close coordination with other agencies in the application of their regulatory and management authorities in high risk areas.

Management Strategies

The management tools available in the NC CMP provide a basis for managing cumulative impacts if they are applied effectively. The risk and area-based management strategy implies that certain parts of the coastal area, the high risk areas, need to be treated differently from others. This will entail some changes in the way that CAMA management mechanisms are applied.

The CAMA Regulatory Program

The difficulties in performing objective and legally defensible cumulative impact assessments for individually proposed projects are so great that this approach is presently an infeasible way to use the CAMA regulatory program for cumulative impacts management. A more feasible approach would be to modify the CAMA regulatory structure as it applies to designated high risk areas. This could be done through designating new AECs in high risk areas, increasing the geographic extent of AECs in high risk areas, or applying different use standards to existing AECs in high risk areas.

While several CAMA-authorized AEC categories could be useful in cumulative impacts management, designation of new AECs is not an appropriate approach for wide-scale use. In limited cases, however, it should be considered. The natural and cultural resource AEC category, in particular, could be of value in providing protection for sensitive resources of more than local significance in high risk areas. The high risk designation would indicate the presence of significant threats to those resources. The designation of public trust shoreline AECs, at least in high risk areas, could also be a valuable management tool for maintaining riparian areas in water quality threatened areas.

Several possibilities exist for applying AEC boundary modifications to cumulative impacts management. Including contiguous land areas around outstanding resource waters, primary nursery areas, and coastal wetlands within the designated AEC area would allow management of the resources and the lands most directly affecting them under one set of rules designed to protect the resources from cumulative and secondary impacts as well as direct impacts. Widening the estuarine shoreline AEC in water quality high risk areas could be valuable in protecting estuarine water quality from the impacts of shoreline acitivities.

Modifying AEC use standards in existing AECs within high risk areas is probably the most feasible way of applying the CAMA regulatory program to cumulative impacts management. Applying somewhat different rules in high risk areas would reflect the unique situations of these areas and the fact that activities that are appropriate elsewhere may not be appropriate in these areas.

Land Use Planning

The local land use planning component of the NC CMP can be a critical aspect of cumulative impacts management. Its use in this context, however, will require some changes in planning guidelines and procedures.

The regional risk assessment being used to identify high risk areas provides a regional context into which local cumulative impacts management can fit. Transfer to local governments of information gathered and analyzed in the regional assessment can provide the link between regional and local perspectives necessary to make this happen. Providing this information and assisting local governments in applying it to their local situations will improve the accuracy and consistency of information used for planning and help to focus attention on high risk areas and sensitive resources.

The most straight-forward way to apply regional information to local planning would be to use hydrologic units as planning units. Data and analyses from the regional assessment could be provided to local governments, which would use this information as the basis for sub-plans for each HU within their jurisdictions. While there are difficulties in changing to watershed-based planning, the long-term advantages in the context of a resource protection oriented planning program are compelling. Basing local plans on hydrologic units would improve the environmental soundness of local plans and would fit local planning into a nested system of watershed units that could integrate planning, cumulative impacts management, and information management at the local, state, and federal levels.

In order for local land use planning to specifically address the situations in high risk areas, planning for those areas must be different than for other areas. Somewhat different planning guidelines need to be developed for application to high risk areas. The particular conditions leading to the high risk must be addressed and dealt with in plans for high risk HUs. The type of special planning attention appropriate will depend upon the nature of conditions in the HU and the nature of the risk.

Cumulative impacts management will not be successful unless local plans are consistent with and provide local implementation for regional cumulative impacts management goals. This requirement needs to be added to review criteria for land use plan certification, and the regional goals need to be incorporated into the NC CMP. The goals should include specific objectives for local action in each category of high risk area.

Improving coordination among plans in the same subregion is perhaps the most pressing change needed to address cumulative impacts through local planning. This could best be achieved by timing land use plan updates on a river basin basis. Updating all plans within a river basin at the same time and requiring local governments to coordinate plans for shared hydrologic units would provide a sound basis for integrated watershed planning. This approach would also present the opportunity for implementing the DEM basinwide plan for the river basin.

Plans must be implemented to be effective. CAMA needs to be amended to require consistency between land use plans and local ordinances. If land use plans and local ordinances are consistent with cumulative impacts management goals and policies adopted by the CRC, and if the plans are implemented at both the local and state levels, cumulative impacts management through local land use planning could be highly effective.

Inter-Agency Coordination

Many local, state, and federal agencies play significant roles in determining land use patterns and managing resources in the coastal area. Cumulative impacts management requires that the actions of these agencies be coordinated toward achieving common goals. The NC CMP must play the key role in coordinating agency activities to address the situations in high risk areas, and specific means of inter-agency coordination must be included in a cumulative impacts management strategy.

The Division of Environmental Management's Basinwide Water Quality Planning Program, the Water Supply Planning Program implemented by the Division of Water Resources, and the Coastal Nonpoint Pollution Control Program being developed by the Division of Coastal Management provide excellent opportunities for interagency coordination in cumulative impacts management. All of these programs, as well as other opportunities for coordination, must be integrated into a cumulative impacts management strategy.

In particularly severe situations in which the problems of high risk areas cannot be addressed by other means, coordination and management could be achieved through development of Special Area Management Plans. Since SAMP is a difficult process that requires the full commitment of all parties and often necessitates the development of new implementation mechanisms, its practicality for wide-scale cumulative impacts management is limited.

Conclusions

The potential for successful cumulative impacts management exists within the North Carolina Coastal Management Program. The basic statutory authorities and program structures are in place, and the regional assessment being performed by DCM will identify areas at highest risk. An overall cumulative impacts management strategy must be developed, adopted by the CRC, and implemented, however, to make the effort successful. The cumulative impacts management strategy must include a means of legally designating high risk areas, together with specific means of addressing the risks in those areas.

The CAMA land use planning program and inter-agency coordination are the most promising implementation mechanisms for cumulative impacts management. The CAMA regulatory program has limited value as a cumulative impacts management tool because of the limited geographic area to which it applies and the difficulty of assessing the cumulative impacts of individual projects. The use of Special Area Management Planning in cumulative impacts management is limited to highly unique situations because of its difficulty and expense.

Incorporating CAMA land use planning into a cumulative impacts management strategy will necessitate several changes in planning procedures and guidelines. Planning should be done by hydrological units, with particular attention to HUs designated as high risk areas. Specific guidelines for treatment of high risk areas in local plans need to be incorporated into the planning guidelines, and local policies for those areas must be consistent with regional goals. Land use plan updates should be performed simultaneously for all jurisdictions in a river basin to allow for better coordination and for implementation of the basinwide plan.

DCM must take the initiative in achieving coordination with other agencies in addressing situations in high risk areas. When appropriate, DCM can play a role in programs of other agencies by providing information, helping identify problem areas, and participating in plans and decisions. This is being performed with Basinwide Planning, Water Supply Planning, and the Coastal Nonpoint Pollution Control Program. When active DCM involvement is impractical or inappropriate, state consistency should be fully implemented to ensure consistent action in regard to cumulative impacts management. To the extent possible, formal consistency agreements should be developed with those agencies most involved in activities influencing the coastal area.

Application of this cumulative impacts management strategy to the North Carolina Coastal Area will provide a comprehensive means of managing and minimizing adverse effects of growth and development. The strategy recognizes that cumulative impacts are the result of total patterns of growth and development and, thus, cannot be managed through the CAMA regulatory program alone. It stresses the need for a renewed inter-agency and state-local cooperative effort "to establish a comprehensive plan for the protection, preservation, orderly development, and management of the coastal area of North Carolina" (G.S. 113A-102(a)). As such, it encourages the full implementation of CAMA through realization of the vision for coastal management expressed by the General Assembly in 1974 and in North Carolina's original coastal plan (NOAA, 1978).

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CUMULATIVE IMPACT INDICATORS CONTAINED IN PC-BASED POPULATION/DEVELOPMENT/RESOURCES INFORMATION SYSTEM

Agriculture: Livestock and Poultry
Beef Feedlots (< 300 Head, > 300 Head)
Dairy Farms (< 70 Head, > 70 Head)
Hog Farms (< 200 Head, > 200 Head)
Horse Stables (< 200 Head, > 200 Head)
Poultry Farms (< 15,000 Birds, > 15,000 Birds)

Agriculture: Farming
Land in Farms (acres, % of HU)
Land with Best Mgmt Practices (acres, % of HU)
Land w/o Best Mgmt Practices (acres, % of HU)
Land in Conservation Tillage (acres, % of HU)
Land w/o Conservation Tillage (acres, % of HU)
Harvested Cropland (acres, % of HU)
Hay Crops (acres, % of HU)
Irrigated Land (acres, % of HU)
Pasture Land (acres, % of HU)
Row Crops (acres, % of HU)

Primary
Estuarine Waters (acres, % of HU)
Freshwater Lakes
HU Name
Receiving HU
Receiving Water Body
Primary Water Body
Secondary Water Body
Shoreline
Waterways w/ Vegetated Buffers (miles, % of HU)
Population 1970
Population 1980
Population 1990
Population Growth '70-'80
Population Growth '80-'90
Counties
Total HU size
Land area (acres, % of HU)
Water area (acres, % of HU)
Stream length (miles)
Stream order (miles, % of stream length)

Development
Building Permits -All residential
Building Permits -Amusement/ Recreation
Building Permits -Multi-family Residential
Building Permits -One-family Residential
Building Permits -Hotels and Motels
Building Permits -Retail
Building Permits -Industrial
Highway Mileage:
  Total (miles)
  Primary (miles, % of total)
  Secondary (miles, % of total)
  Paved (miles, % of total)
  Unpaved (miles, % of total)
Rail lines (miles)
Increase of primary & secondary roads (miles, %)
Increase of paved vs. unpaved Roads (miles, %)

Economic
Ag-Related Business (number, employees, income)
Farms (number, employees, income)
Fisheries Business (number, employees, income)
Forestry/Wood-Using Business (number, employees, income)
Lodging Establishments (number, employees, income)
Manufacturing Establishments (number, employees, income)
Marinas (number, employees, income)
Mining Establishments (number, employees, income)
Recreation Business (number, employees, income)
Restaurants (number, employees, income)
Retail Establishments (number, employees, income)

Groundwater
Groundwater Contamination Incidents
Groundwater Class (acres, % of HU)
Groundwater Contamination Area (acres, % of HU)
Groundwater Capacity Use Areas (acres, % of HU)

Land and Estuarine Resources
Anadromous Fish Streams (miles, % of streams)
Coastal Reserve Waters (acres, % of HU)
Coastal Reserve Lands (acres, % of HU)
Federal Ownership:
  National Parks (acres, % of HU)
  National Forests (acres, % of HU)
  Military Reservations (acres, % of HU)
  USFWS Refuges (acres, % of HU)
  Federal Ownership--other (acres, % of HU)
State Ownership:
  Game Lands (acres, % of HU)
  State parks (acres, % of HU)
  State Forests (acres, % of HU)
  State Ownership--other (acres, % of HU)
Natural Heritage Inventory Sites (count)
Primary Nursery Areas (acres, % of water area)
Private Preservation (acres, % of HU)
Secondary Nursery Areas (acres, % of water area)
Threatened/Endangered Species Habitat
Water Supply Watersheds (acres, % of HU)

Land Use
Total Wetland Area (acres, % of HU)
High Value Wetland (acres, % of HU)
Medium Value Wetlands (acres, % of HU)
Low Value Wetlands (acres, % of HU)
Predominant Land Cover

Population and Housing
Avg Seasonal Population
Peak Seasonal Population
Units w/o indoor plumbing
Units with Septic Tanks
Units on Central Water Systems
Units on Central Sewer
Units with Wells

Permits
Air Emission Permits - PSD
Air Emission Permits - Toxic
CAMA Minor Permits
CAMA General Permits
CAMA Major Permits
CAMA Exemptions
CWA Sect. 404/10 Permits
Landfill Permits - Municipal
Landfill Permits - Industrial
Non-Discharge Permits
NPDES Permits - Industrial
NPDES Permits - Other
NPDES Permits - POTW
Stormwater Discharge Permits
Sedimentation Control Plans
Septic Tank Permits

Shellfish
Shellfish Waters (acres, % of HU)
Shellfish Closures-Permanent (acres, % of HU)
Shellfish Closures-Temporary (acres, % of HU)

Water Quality--Open water
Class B Waters (acres, % of water area)
Class C Waters (acres, % of water area)
HQW Waters (acres, % of water area)
NSW Waters (acres, % of water area)
ORW Waters (acres, % of water area)
Swamp Waters (acres, % of water area)
SA Waters (acres, % of water area)
SB Waters (acres, % of water area)
SC Waters (acres, % of water area)
WS-I Waters (acres, % of water area)
WS-II Waters (acres, % of water area)
WS-III Waters (acres, % of water area)

Water Quality--Streams
Class B Streams (miles, % of streams)
Class C Streams (miles, % of streams)
HQW Streams (miles, % of streams)
NSW Streams (miles, % of streams)
ORW Streams (miles, % of streams)
Swamp Water Streams (miles, % of streams)
SA Streams (miles, % of streams)
SB Streams (miles, % of streams)
SC Streams (miles, % of streams)
WS-I Streams (miles, % of streams)
WS-II Streams (miles, % of streams)
WS-III Streams (miles, % of streams)

Water Quality--Use Support
Algal Blooms (Count, Extent/Severity)
Fish Kills (Count, Extent/Severity)
Streams Fully Supporting (miles, % of streams)
Streams Support Threatened (miles, % of streams)
Streams Partially Supporting (miles, % of streams)
Streams Non-Supporting (miles, % of streams)
Waters Fully Supporting (acres, % of water area)
Waters Support Threatened (acres, % of water area)
Water Partially Supporting (acres, % of water area)
Waters Non Supporting (acres, % of water area)

GIS DATABASES IN POPULATION/DEVELOPMENT/RESOURCES INFORMATION SYSTEM

Ambient Water Quality Monitoring Sites
Anadromous Fish Spawning Areas
Artificial Marine Reefs
Bottom Sediment Sampling Sites
Business Locations by SIC Code
CAMA Major Permits
Census Blocks
Census Block Groups
Closed Shellfish Areas
Coastal Marinas
Coastal Reserves
County Boundaries with Shorelines
Federally Owned Lands
Fisheries Nursery Areas
Geodetic Control - NAD83
Geology - general bedrock, faults, dikes, and sills
Ground Water Recharge/Discharge Areas
Hard Bottom/Live Bottom Trawl and Dive Locations
Hazardous Waste Facilities
Historic Sites and Districts
Hurricane Storm Surge Inundation Areas
Hydrography - detailed
Hydrography - general
Land Use/Land Cover from TM Imagery - 1988
Military Airspace
Municipal Boundaries
National Wetlands Inventory
NPDES Permit Sites
Natural Heritage Element Occurrence Sites
Natural Areas
Outstanding Resource Waters
Peat Resources
Proposed Critical Habitat Areas
SCS Hydrologic Unit Boundaries
Shipwreck Locations
Soil Associations - General
Soil Series - Detailed
Solid Waste Facilities
Spiny Mussel Locations
State Owned Complexes
State Parks
Stream Gauging Stations
Submerged Rooted Vascular Plants (SAV)
Superfund Sites
Surface Water Intakes
Transportation - primary roads
Transportation - detailed
Transportation - general
USGS 1:24,000 Scale Neatlines
USGS 1:100,000 Scale Neatlines
Water Supply Watersheds
Wetland Restoration Sites
Wetland Types
Wetland Functional Significance
Wildlife Resources Commission Gamelands