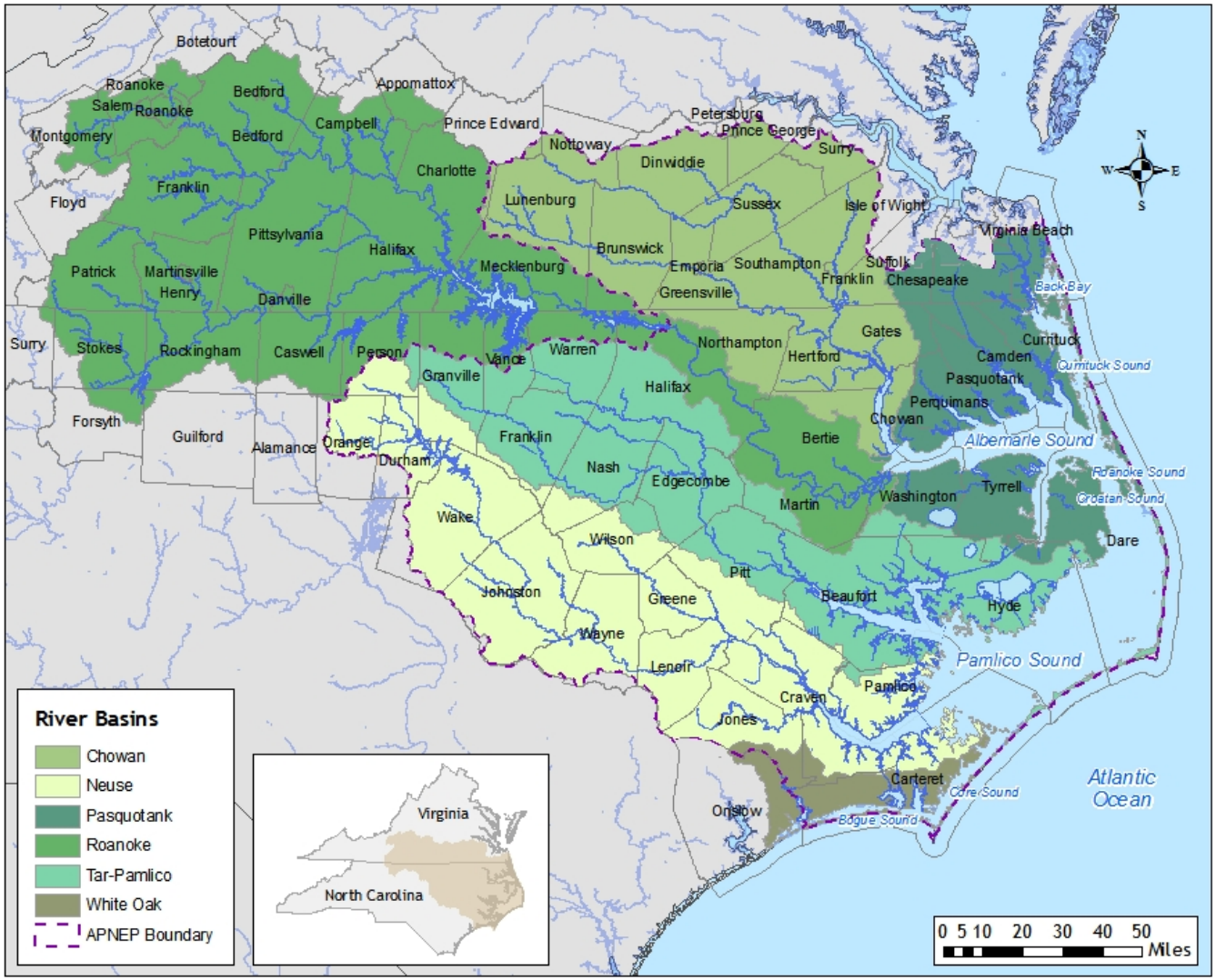
Albemarle-Pamlico National Estuary Program (APNEP) Implementation Area and Management Institutions



APNEP's EBM Approach

1. Articulate **program goals**
2. Develop **system level model** for goal attainment
3. Assess current management efforts –identify **gaps**
4. Develop **management strategy**
5. Develop **monitoring program**
6. **Assess** performance
7. **Manage adaptively**

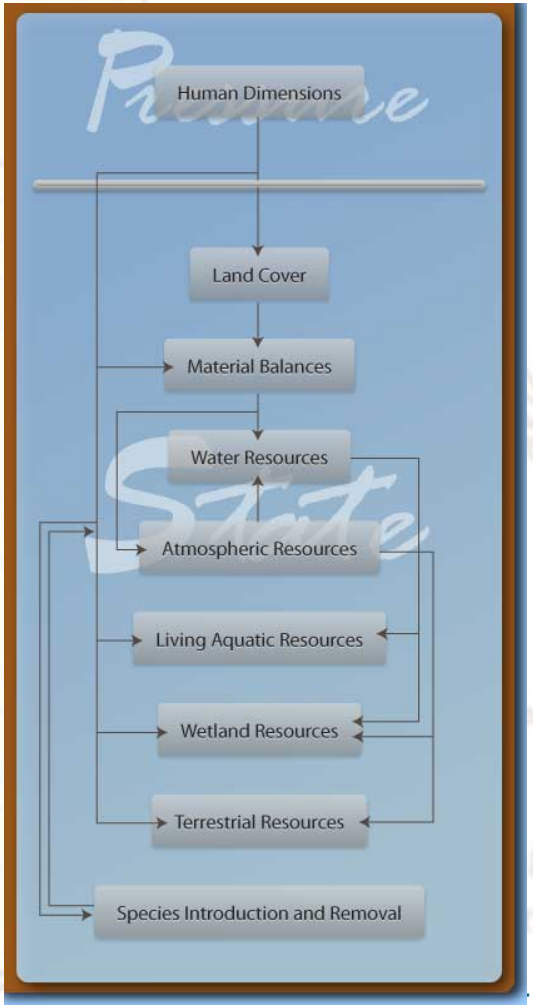
APNEP's Goals

- **A region where human communities are sustained by a functioning ecosystem**
- **A region where aquatic, wetland, and upland habitats support viable populations of native species**
- **A region where water quantity and quality maintain ecological integrity**

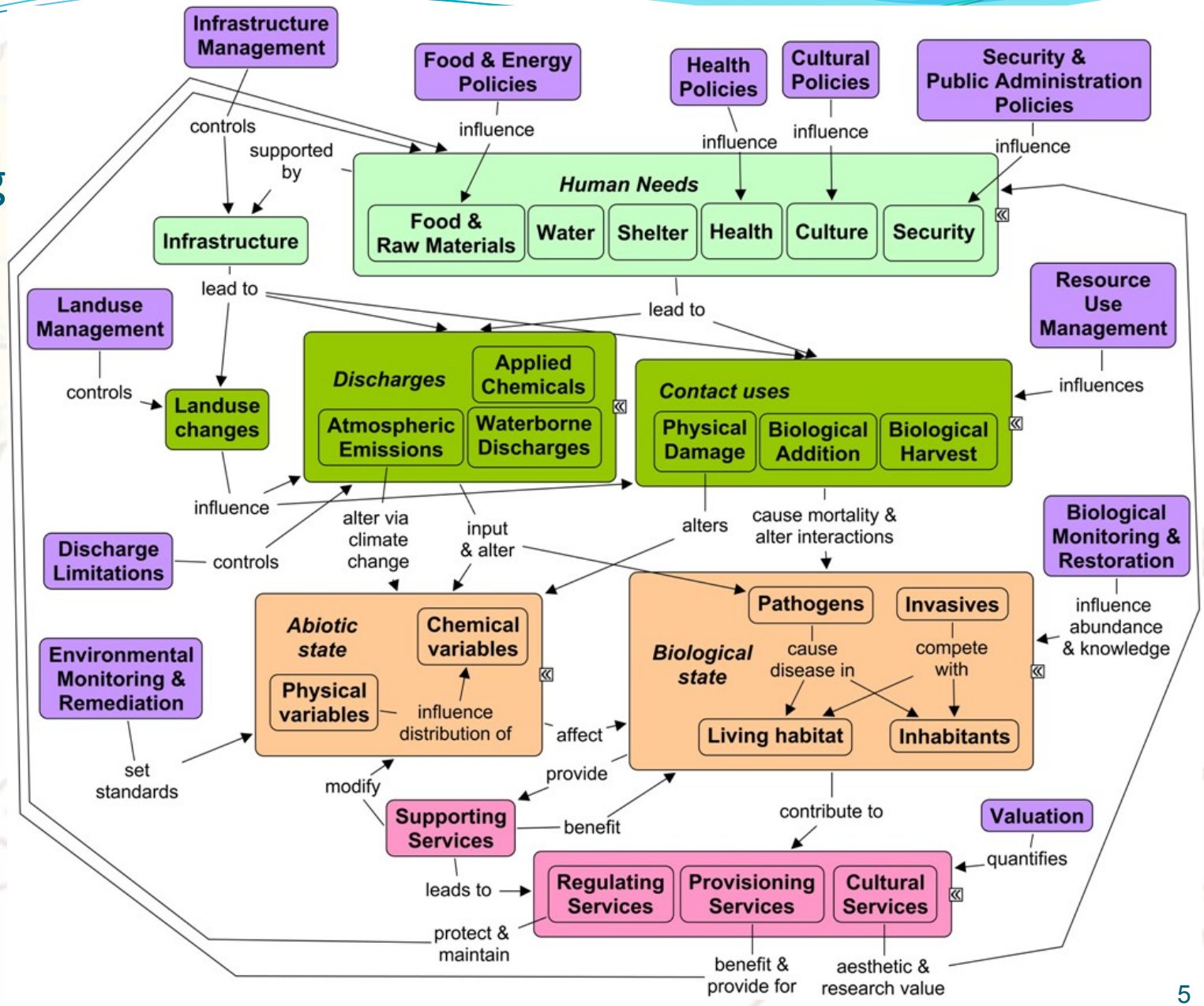
Step 2: Develop system level model for goal attainment

Ecological management actions (stressor mitigation) can impact multiple ecosystem endpoints

Multiple stressors (including other endpoints) impact directly and indirectly ecosystem endpoints



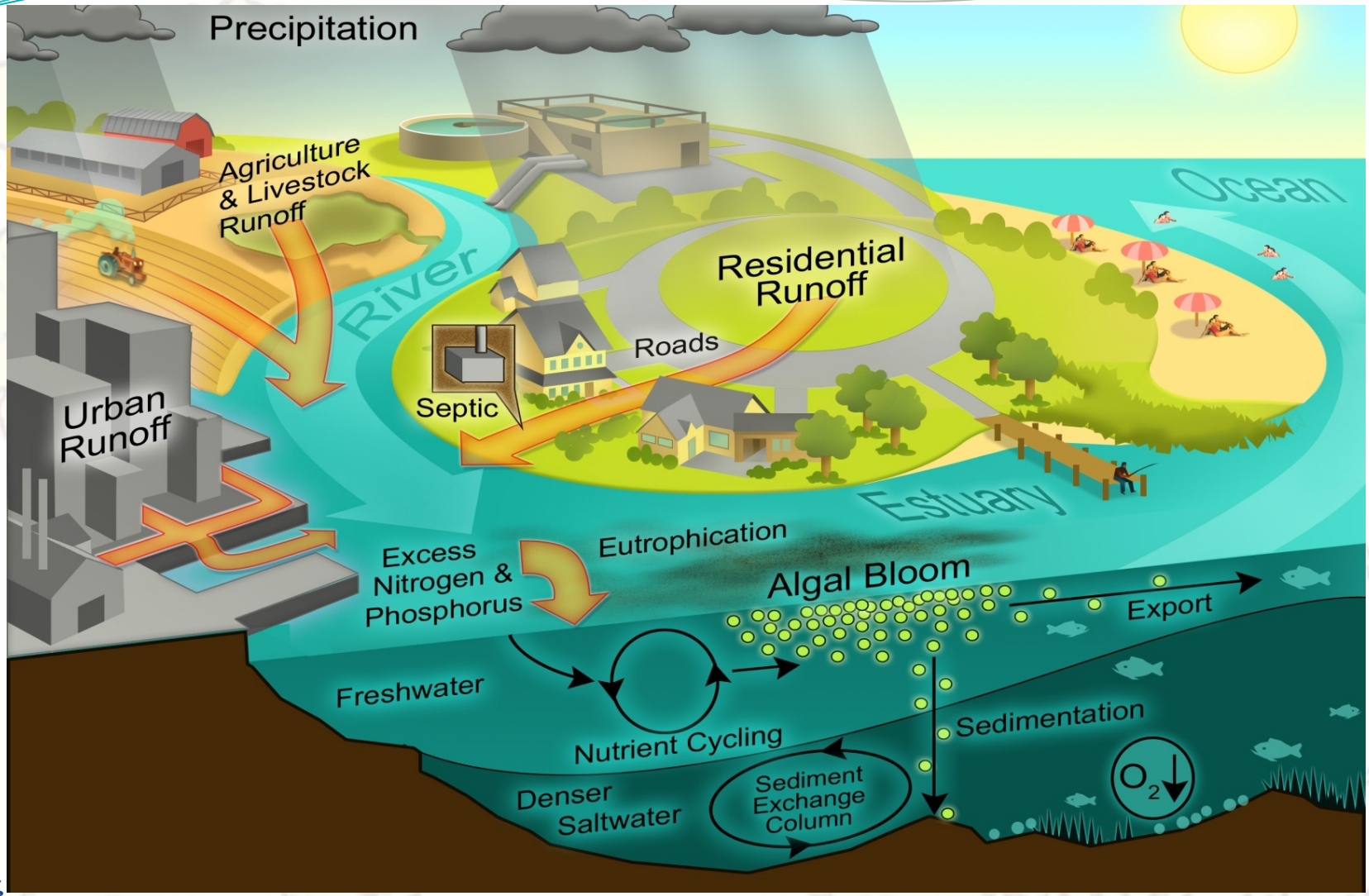
DPSER Modeling



Lt. green = Drivers
Dk. Green = Pressure
Orange = State
Red = Ecosystem Services
Purple = Response

EPA-ORD-ESRP 2010

Albemarle-Pamlico National Estuary Program North Carolina



Conceptual Model of Nutrient Cycle

Modified from H. Paerl

Outcome: Nutrients and pathogens do not harm the species that depend on the waters

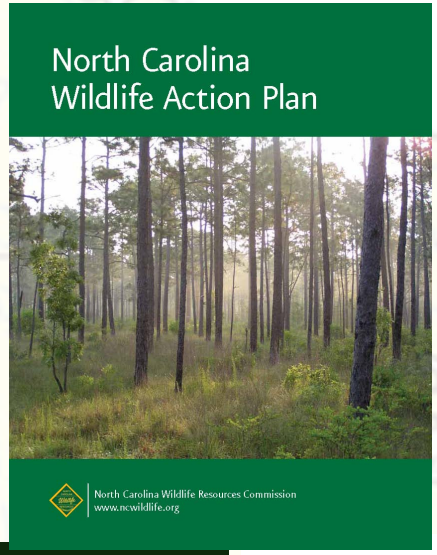
- ***Biological Factors***
  - ***Fauna***
  - ***Flora***
  - ***Microorganisms***
    - **pathogen source control**
      - **human (septic)**
      - **animal (pasture, CAFO manure management)**
      - **wildlife population (?)**
- ***Physical Factors***
  - ***Structure***
  - ***Hydrology***
  - ***Temperature***

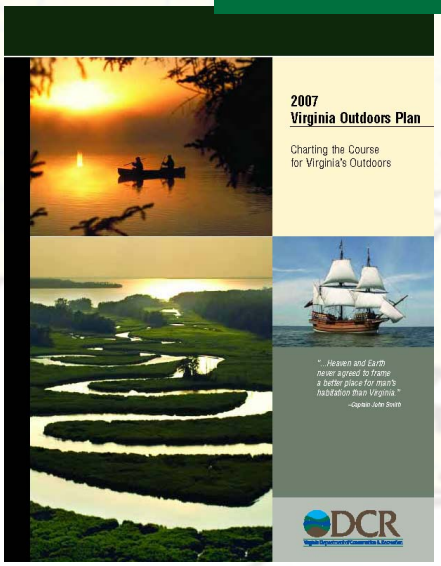
Outcome: Nutrients and pathogens do not harm the species that depend on the waters

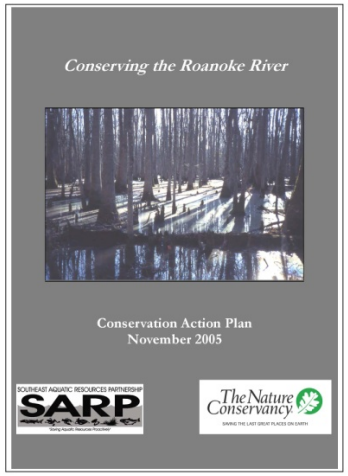
- *Chemical Factors*
  - *Salinity*
  - *pH*
  - *Nutrients*
    - Load controls for nitrogen and phosphorus (air deposition, runoff, groundwater, point source)
- *Human Factors*
  - *Use objectives*
    - Management of agricultural pollutant sources
    - Management of developed land pollutant sources (stormwater)
    - Water body use designation (WQ standard development)
  - *Modification of system*
    - Land-use management (particularly riparian lands)
  - *Knowledge*
    - Technical understanding of Contaminant Management Strategies to meet WQ standards
    - Public appreciation of risks and need for management
    - Policy appreciation of regulatory needs

Step 3: Assess current management efforts –identify gaps

- Directed by conceptual models
- Survey of partners' strategic/action plans
  - Specificity and publication date
  - Action extraction
  - Align with APNEP outcomes/strategies
- Interview partners







Step 4: Develop management strategy

- Stakeholder Questions
- Management Objectives
- Actions with Partner Responsibilities
- APNEP Management Conference Review
- Partner Review
- Public Review and Input
- CCMP Publication

CCMP's Four Questions

- **What is a healthy Albemarle-Pamlico Estuarine System?**
- **What is the status of Albemarle-Pamlico Estuarine System?**
- **What are the biggest threats to Albemarle-Pamlico Estuarine System?**
- **What actions should be taken that will move us from where we are today to a healthier Albemarle-Pamlico Sounds by 2020?**

APNEP CCMP Actions: Identify

- **Objective A1: Develop and refine a conservation atlas**
  - Action A1.1: Facilitate the mapping of significant ecological, bathymetric, geologic, demographic, and cultural features.
  - Action A1.2: Facilitate the refinement and use of online conservation planning tools.
- **Objective A2: Assess the impacts of targeted threats on the ecosystem**
  - Action A2.1: Facilitate the development of protocols and conduct rapid assessments to determine presence and potential threat of invasive species.
- **Objective A3: Assess current natural resource policy, laws, and regulations according to ecosystem-based management principles**
  - Action A3.3: Develop and refine ecological flow requirements for each major river.

APNEP CCMP Actions: Protect

- **Objective B1: Minimize the introduction of additional water pollution sources**
  - Action B1.4: Facilitate the development of state and local policies that support the use of low impact development (LID) practices to reduce runoff.
- **Objective B2: Protect and manage areas containing significant natural communities and habitats**
  - Action B2.1: Facilitate the development and implementation of an integrated freshwater habitat protection strategy.
  - Action B2.2: Develop and implement a submerged aquatic vegetation (SAV) protection strategy.
  - Action B2.3: Facilitate the development of incentives for protection and management of targeted natural communities and habitats.
  - Action B2.4: Facilitate the development of policies to minimize dredge and fill activities in naturalized areas and sensitive habitats.
  - Action B2.5: Facilitate protection of designated anadromous fish spawning areas and inland primary nursery areas from marina impacts.
  - Action B2.6: Minimize and rapidly respond to the introduction of invasive species through the development and implementation of integrated prevention and control strategies.
- **Objective B3: Utilize natural and constructed "living" shorelines to maintain estuarine and riverine ecosystem processes**
  - Action B3.3: Facilitate the development of requirements for living shoreline stabilization projects that optimally protect estuarine aquatic and shoreline habitats while minimizing regulatory requirements.

APNEP CCMP Actions: Restore

- **Objective C1: Restore water quality by eliminating targeted sources of water pollution**
  - Action C1.3: Facilitate the restoration of riparian and estuarine shorelines.
- **Objective C2: Restore hydrological processes in rivers and estuaries to support significant natural communities and ecosystem functions**
  - Action C2.3: Facilitate the hydrologic restoration of floodplains and streams.
- **Objective C3: Facilitate collaborative and integrative restoration programs and projects**
  - Action C3.1: Develop and refine integrated invasive species eradication and control strategies.
  - Action C3.2: Develop and implement a coordinated wetland restoration strategy.
  - Action C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- **Objective C4: Remove in-stream barriers and restore spawning areas for diadromous fish**
  - Action C4.1: Install fish ladders and eel-ways on existing dams and other permanent barriers.
  - Action C4.2: Facilitate the removal of dams, culverts, and other in-stream barriers.
  - Action C4.3: Restore degraded anadromous fish spawning habitats.
  - Action C4.4: Facilitate research to improve fish passage.

APNEP CCMP Actions: Engage

- **Objective D1: Foster environmental stewardship**
  - Action D1.3: Coordinate outreach and engagement efforts regarding the impacts of invasive species.
- **Objective D2: Conduct targeted environmental education efforts regarding sustainable use, habitats, and ecosystem services**
  - Action D2.1: Provide and promote opportunities for outdoor experiences that connect individuals with the Albemarle-Pamlico ecosystem.
  - Action D2.3: Increase public understanding of the relationship between ecosystem health and human health advisories relating to water, fish, and game.
- **Objective D3: Provide tools and training to support ecosystem-based management.**
  - Action D3.2: Facilitate the development and implementation of basinwide water management plans to ensure no less than minimum in-stream flows are maintained.
  - Action D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

APNEP CCMP Actions: Monitor

- **Objective E2: Develop and maintain a comprehensive spatial database for pertinent environmental data and modeling information**
  - Action E2.1: Facilitate the design and content acquisition of a regional database based on partners' data and information needs.
  - Action E2.2: Develop and maintain an online resource that clearly conveys regional information in support of ecosystem-based management.

Example

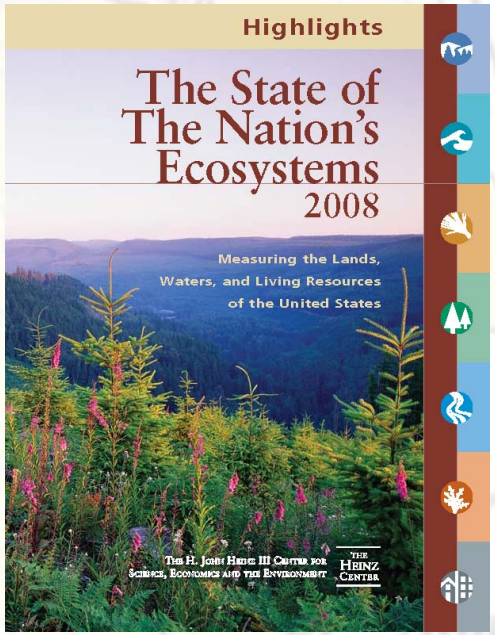
Step 5: Develop monitoring program

- Linking candidate indicators to CCMP outcomes
- Indicator-specific monitoring strategies
  - Justification for indicator
  - Goal of sampling/monitoring program
  - Existing sampling/monitoring program
  - Enhanced sampling/monitoring program
  - Reference(s)
- Integrated monitoring strategy

Goal	Ecosystem Outcome	CCMP Supporting Actions	Candidate Indicator
1: Human Communities A region where human communities are sustained by a functioning ecosystem	1a: Waters are safe for personal contact.	A1.1, 1.2, 2.3, 3.3; B1.2; C1.1,1.2, 1.4; D1.1, 1.2, 2.3,3.1,3.3; E1.1, 1.2, 2.1, 2.2	Beach action days/closings by water body type (sounds, freshwater river, lake, brackish river)
	1b: Designated surface and ground water supplies are safe for human consumption.	A1.1, 1.2, 2.3, 3.3; B1.2; C1.1,1.2, 1.4; D1.1, 1.2, 2.3,3.1,3.3; E1.1, 1.2 , 2.1, 2.2	Water Quality standard violations (surface waters)
			Drinking water standard violations (aquifers)
	1c: Surface hydrologic regimes sustain regulated human uses.	A 1.1, 1.2, 1.2, 2.3, 3.4; D 1.2, 2.2, 3.2; E1.1, 1.2, 2.1 2.2	Severity and frequency of droughts
	1d: Fish and game are safe for human consumption.	A1.1, 1.2, 2.3, 3.3; B1.2; C1.1,1.2; D 1.1, 1.2, 2.3,3.1,3.3; E1.1, 1.2, 2.1, 2.2	Fish consumption advisories
			Shellfish area closures
	1e: Opportunities for recreation and access to public lands and waters are protected and enhanced.	A 1.1, 1.2, 2.3; D 1.1, 1.2, 1.5, 2.2, 3.3; E1.1, 1.2, 2.1 2.2	Total distance of land and paddle trails
			Water access points: number & location
2: Native Species A region where aquatic, wetland, and upland habitats support viable populations of native species	2a: The biodiversity, function, and populations of species in aquatic, wetland, and upland communities are protected, restored, or enhanced.	A1.1, 1.2, 2.2, 3.1, 3.4: B 1.3, 2.1, 2.3, 2.4, 2.5, 3.3; C 1.3, 1.4, 2.2, 3.2, 3.3, 4.1, 4.2, 4.3, 4.4; D1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 3.3; E 1.1, 1.2, 2.1, 2.2	Oyster bed extent
			River herring abundance
			King rail, Swainson's warbler population /occurrences
			Box Turtle population /occurrences
			Longleaf Pine extent, location
			Firefly population
	2b: The extent and quality of upland, freshwater, estuarine and near-shore marine habitats fully support biodiversity and ecosystem function.	A 1.1, 1.2, 2.3, 3.1, 3.2, 3.4; B 1.1, 1.2, 1.3, 1.4, 1.5, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3; C 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3; D 1.2, 1.4, 2.2, 3.1, 3.3; E1.1, 1.2, 2.1, 2.2	SAV extent and composition
			Quality & extent of anadromous fish spawning/nursery areas
	2c: Non-native invasive species do not significantly impair native species' viability or function, nor impair habitat quality, quantity, and the processes that form and maintain habitats.	A 1.2, 2.1, 2.3; B 2.6; C 3.1; D 1.2, 1.3, 2.2, 3.3; E 1.1, 1.2, 2.1, 2.2	Hydrilla population status/occurrences
			Phragmites australis extent (common reed)
			Kudzu population status/occurrences
3: Water Quantity & Quality A region where water quantity and quality maintain ecological integrity	3a: Appropriate hydrologic regimes support ecological integrity.	A 1.2, 2.1, 2.3; B 2.6; C 3.1; D 1.2, 1.3, 2.2, 3.3; E 1.1, 1.2, 2.1, 2.2	Dissolved oxygen concentration
			Major river flows
	3b: Nutrients and pathogens do not harm species that depend on the waters.	A 1.1, 1.2, 2.3; B 1.2, 1.3, 1.4, 1.5; C 1.2, 2.1, 2.3, 2.4; D 1.1,1.2, 1.4, 2.1,2.2, 3.3, E1.1, 1.2, 2.1, 2.2	Amount and extent of impaired waters
			Chlorophyll-a concentration
	3c: Toxics in waters and sediments do not harm species that depend on the waters.	A 1.1, 1.2, 2.3, 2.4; B 1.1; C 1.2; D 1.2, 3.1, 3.3; E 1.1, 1.2, 2.1, 2.2	Amount and extent of impaired waters
			Dissolved metals concentrations
	3d: Sediments do not harm species that depend on the waters.	A 1.1, 1.2, 2.3; B 1.3, 1.4, 1.5, 2.3, 2.6, 3.1, 3.2; C 1.3, 1.5, 2.1, 2.3, 3.1, 3.2; D 1.2, 3.1, 3.3; E 1.1, 1.2, 2.1, 2.2	Amount and extent of impaired waters
			Average secchi disk depth

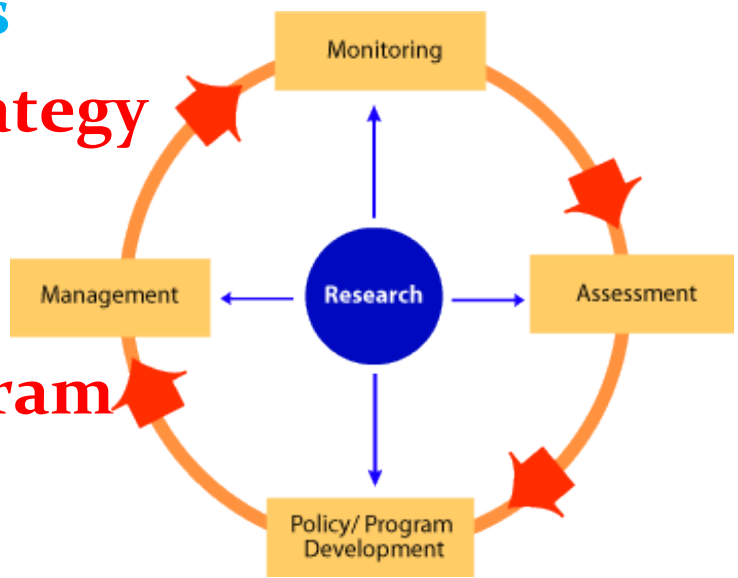
Step 6: Assess performance

- "Interim" regional ecosystem assessment (2012)
  - Select provisional indicators
  - Status & trends from 1995 to present
  - Heinz Center format
- Phase 2 assessment (2013?)
  - Diagnosis
- Phase 3 assessment (2014?)
  - Forecasting



Step 7: Manage adaptively

- Most difficult step?
- Senior management engagement
- Trigger levels in plan

APNEP's EBM Approach

1. Articulate **goals**
2. Develop **model(s)** for goal attainment
3. Identify **gaps and overlaps**
4. Develop **management strategy**
   1. **Indicators**
   2. **Targets**
5. Develop **monitoring program**
6. **Assess** performance
7. **Manage adaptively**