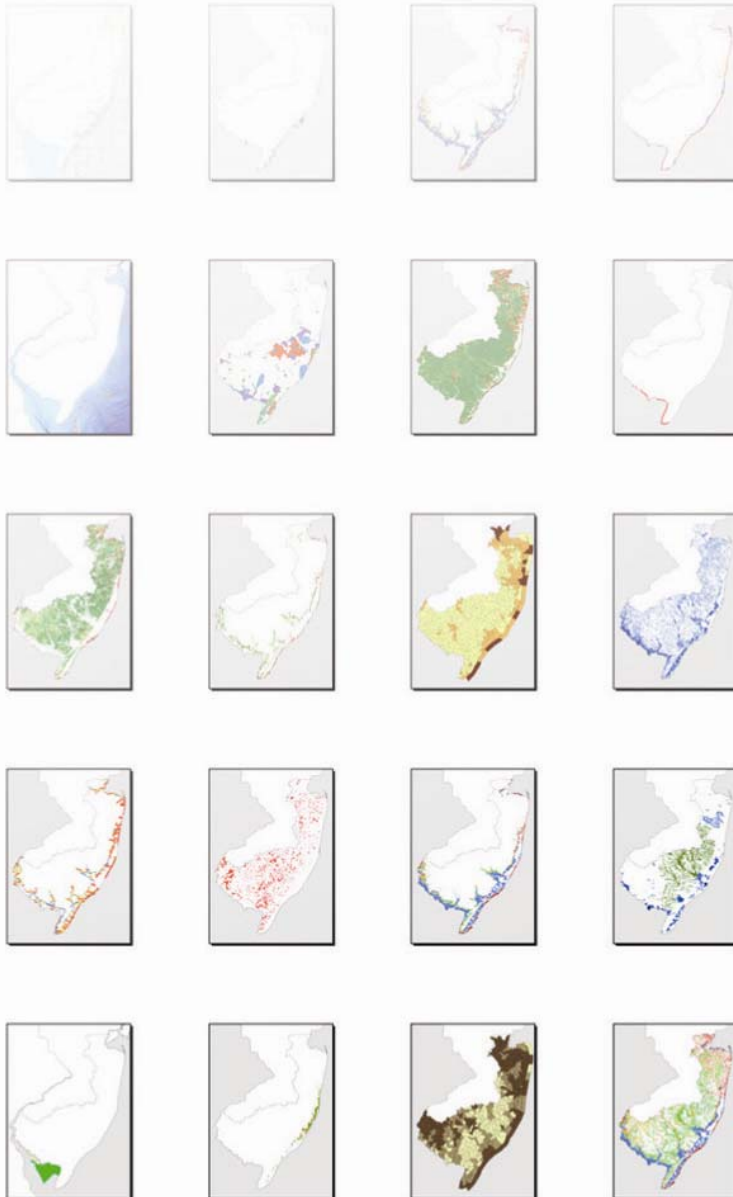


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New Jersey

Coastal Conservation & Restoration Targets



Coastal Data Summary January 2007

New Jersey Coastal Conservation & Restoration Targets: Coastal Data Summary

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January 2007

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In partnership with the

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I. Introduction: Mapping Conservation and Restoration Targets for New Jersey

Project Overview

The Center for Remote Sensing and Spatial Analysis at Rutgers University, in cooperation with the American Littoral Society, has developed a geographically-based assessment of New Jersey's coastal zone to identify, characterize and map critical coastal resources. This assessment is the first phase of a longer term effort to:

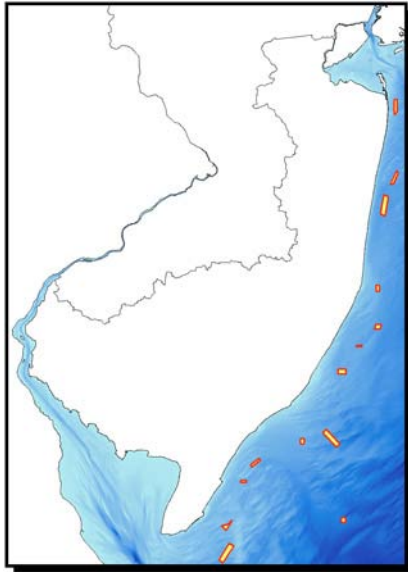
- Identify intact, high quality coastal habitat areas;
- Identify upland watershed areas that have an important functional role in maintaining estuarine water quality and larger ecosystem health; and
- Identify areas where restoration strategies should be focused.

The project entailed compiling and synthesizing relevant geographic information system (GIS) digital mapped data about the locations of species and elements of environmental systems important to protecting estuarine ecological values. Data was collected from various state and federal agencies for the upland, shoreline, and benthic zones documenting existing land cover and physical characteristics, valuable wildlife and plant habitats, sea-floor characteristics, and areas of human disturbance. The study area includes all or part of eight New Jersey coastal watershed management areas extending from Raritan Bay southward along the Atlantic coastline and westward along Delaware Bay to the Salem River. This analysis included portions of Middlesex, Monmouth, Ocean, Burlington, Atlantic, Cape May, Cumberland and Salem counties.

A series of maps created for public presentation summarizes the various resource themes as stand-alone graphics and in combination for the selected watersheds of interest. These compiled data sets are also available in a GIS-ready format for free public download.

II. Descriptions, Sources, and Analysis Methods

Offshore and Littoral Zone Characterization



Bathymetry

Shown at left is a 3 arc-second coastal relief grid from the National Geophysical Data Center (NGDC), NOAA Satellite and Information Service. The horizontal resolution of the grid cells is nominally 90 meters. The vertical resolution of the grid cells is bimodal: grid elevations of the onshore areas of the coastal zone are taken directly from the USGS/NIMA DEMs, which are resolved to one meter, whereas grid elevations in the offshore areas are resolved to one tenth of a meter.

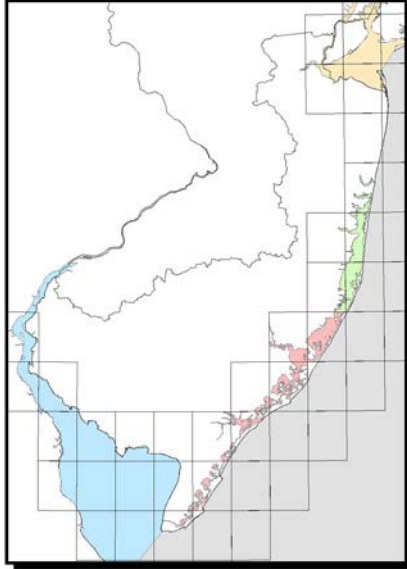
The vertical accuracy of the soundings is 0.3 m in 0 - 20 m of water, 1.0 m in 20 - 100 m of water, and 1% of the water depth in 100 m of water. The horizontal accuracy of the soundings is generally 30 m, but it can vary from as fine as 15 m in ports and estuaries to as coarse as 75 m in the offshore areas.

This dataset was mosaiced from 1° by 1° grids for US coastal waters distributed online by NOAA NGDC. Land elevations within the gridded dataset come from the United States Geological Survey/ National Image Mapping Agency (USGS/NIMA) 1:250,000 or 1° DEMs of the states. Water depth soundings are compiled from hydrographic surveys conducted by the National Ocean Service (NOS) and from various academic institutions. The surveys were carried out using a variety of sounding methods including 16- and 17-beam swath mapping systems, single-beam echosounders, and lead-line sounding method. These latter surveys date as far back as the late 1800's. See layer metadata for detailed process steps for grid creation from soundings and bathymetric maps.

Artificial Reef Locations (*shown above*)

Since 1984, the Bureau of Marine Fisheries has been involved in an intensive program of artificial reef construction and biological monitoring. The purpose is to create a network of artificial reefs in the ocean waters along the New Jersey coast to provide a hard substrate for fish, shellfish and crustaceans, fishing grounds for anglers, and underwater structures for scuba divers.

Reefs were mapped from X-Y coordinates provided by NJDEP.



Essential Fish Habitat

These files, and the accompanying look-up tables, were compiled from NOAA published data to delineate those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The data represents Essential Fish Habitat (EFH) for 48 marine fish and shellfish species in New Jersey's coastal waters to a distance of 10 miles from the coast. The data contains 10' x 10' (lat/lon) grid polygons for a distance of at least 10 miles from all parts of the New Jersey coast. Each grid cell is assigned an ID value for use with the accompanying look up tables (LUTs) to find the corresponding EFH listings for that cell area.

LUTs include presence/absence designations for EFH for marine fish and shellfish species in four life stages (as applies): egg, larvae, juvenile, and adult. Bay and estuary listings also include general notes on salinity preferences of each life stage. EFH spatial datasets were created at CRSSA to accompany tabular data published by NOAA Northeast Regional Office Habitat Conservation Division.

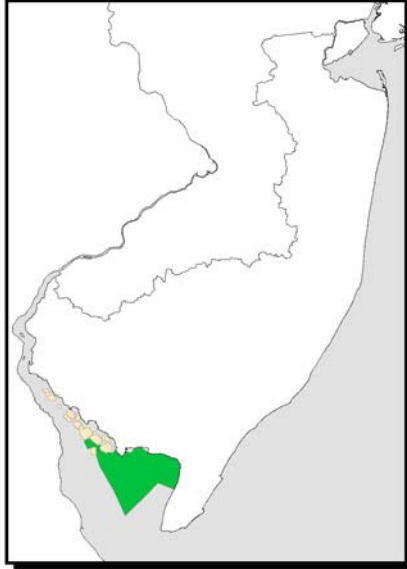


SAV and Tidal Flats

Submerged aquatic vegetation (SAV) is a term used to describe a variety of estuarine and marine plants including seagrasses and macroalgae. Due to their important ecological role in many coastal ecosystems as well as their sensitivity to degraded water quality, seagrass has been widely adopted as an indicator of estuarine ecosystem health.

SAV beds, tidal flats, and sand bars were mapped at CRSSA by means of visual interpretation of high resolution aerial imagery from 2002 and 2003. The targets were mapped in two stages: Barnegat Bay, Little Egg Harbor, and Great Bay were mapped using 2003 imagery as part of a National Estuary Program research project. SAV beds and other bottom features outside this study area were mapped subsequently from 2002 statewide orthoimagery.

While a rigorous accuracy assessment has been conducted to verify the results of the Barnegat Bay classification (see layer metadata for more information, <http://crssa.rutgers.edu/projects/runj/bbdata/savbtype03.htm>), the results of the visual interpretation outside this area have not been validated.



Shellfish Beds (Delaware Bay)

These datasets show the general area of shellfish leases and oyster seed beds off the New Jersey coast in the Delaware Bay. The Bureau of Shellfisheries of the NJDEP Division of Fish and Wildlife administers the shellfish leasing program which supports private aquaculture activities via the leasing of bay bottom for shellfish culture. Statewide, approximately 30,000 acres of bay bottom are currently leased by commercial interests, primarily for the culture of oysters and hard clams.

Naturally productive areas are not leased because the bureau and the Atlantic Coast Shellfish Council (empowered by statute to grant shellfish leases) want these areas to remain open for all shellfishers to use. This process facilitates aquaculture development while ensuring that naturally

productive areas remain available for use by all.

This data was provided by the Bureau of Shellfisheries and does not represent the full extent of naturally productive shellfish beds. Besides the active shellfish industry in Delaware Bay, recreational and commercial shellfishing is common in New Jersey's back bays, and in Raritan Bay.



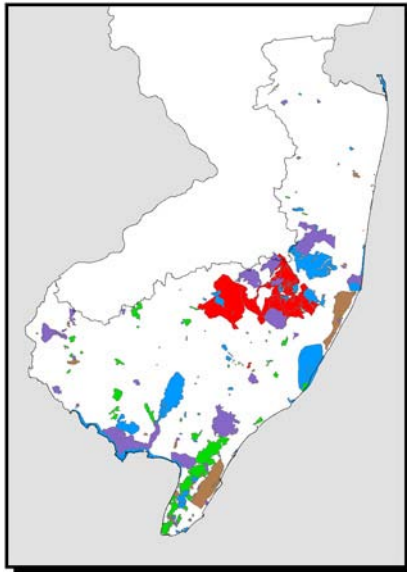
Horseshoe Crab Spawning Beaches

The CRSSA Delaware Bayshore Horseshoe Crab Spawning Habitat Mapping Project consisted of an inventory of the Delaware and New Jersey shorelines of the Delaware Bay to assess the availability and spatial distribution of spawning habitat for horseshoe crabs (*Limulus polyphemus*). The CRSSA project classified the Bayshore's beaches into five categories of spawning habitat suitability: optimal, suitable, less suitable, avoided and disturbed. This dataset includes only the shoreline land cover polygons assessed as suitable or optimal spawning habitat on the New Jersey shore of Delaware Bay.

Habitat was classified by visual interpretation of high spatial resolution (1 meter or better) color/color infrared digital aerial photography acquired in 2002. Optimal and suitable habitat consists mainly of undisturbed sand beach with little or no peat. Less suitable habitat includes exposed peat in the lower and middle intertidal zone. For more information on these data go to:

<http://crssa.rutgers.edu/projects/delbay/>

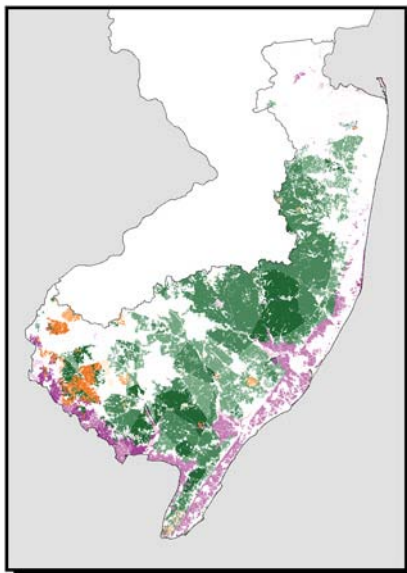
Specific Conservation Targets



Natural Heritage Database Priority Sites

The Natural Heritage Priority Sites Coverage was created to identify the best habitats for rare plant and animal species and natural communities through analysis of information in the NJ Natural Heritage Database. Natural Heritage Priority Sites contain some of the best and most viable occurrences of endangered and threatened species and natural communities. These areas are considered to be top priorities for the preservation of biological diversity in New Jersey. If these sites become degraded or destroyed, we may lose some of the unique components of our natural heritage.

Each site is ranked according to its significance for biological diversity using a scale developed by The Nature Conservancy and the network of Natural Heritage Programs. The ranks can be used to distinguish between sites that are of global significance for conservation of biological diversity vs. those that are of state significance. The scale ranges from B1 to B5 with sites ranked B1-B3 generally being of global significance and sites ranked B4-B5 being of state significance.



Landscape Project Habitat Rankings

This data set is a product of the NJDEP Endangered and Nongame Species Program Landscape Project II, a pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey. The data was created by intersecting imperiled and priority species data with NJDEP 1995/97 land use/ land cover data. Each patch is coded for the number of sightings of priority, state threatened, state endangered and federally listed species present. The data is designed to be used for state and local planning, open space acquisition and land-use regulation.

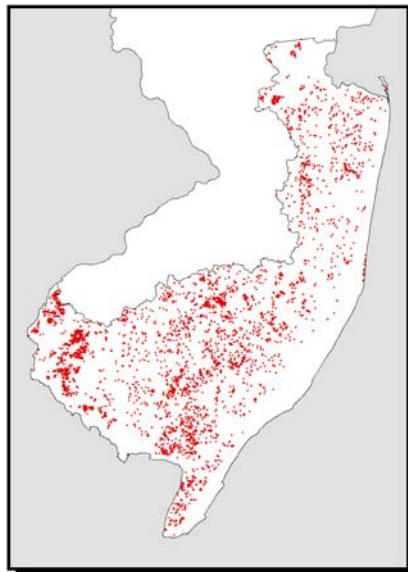
Four habitat types are ranked: emergent wetlands, forests, grasslands, and beaches. Rank 3, 4, and 5 habitat regions were extracted identifying potential habitat for state threatened, state endangered, and federally listed species respectively.



Colonial Waterbird Nesting Sites

This data set contains reported nesting locations for beach nesters, long-legged waders, and terns and skimmers along New Jersey's coastal marshes and beaches. These areas represent critical habitat for threatened and endangered colonial nesting species, including piping plovers, black skimmers, and several varieties of terns.

The data was compiled from Endangered and Nongame Species Program (ENSP) datasets, including version 2.0 of the Landscape Project habitat files; from surveys completed for habitat studies in Barnegat Bay by Rutgers University researchers; and from surveys conducted by NJDEP ENSP biologists.

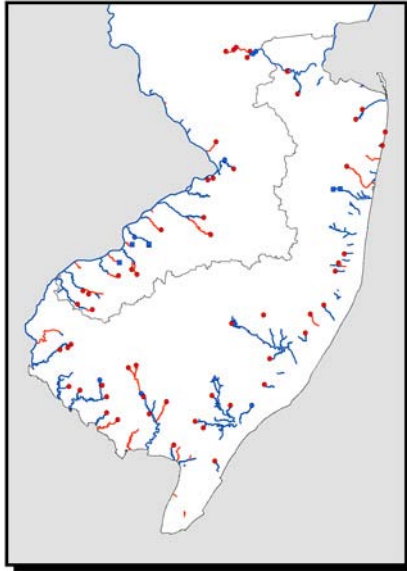


Vernal Pools

This dataset was created at CRSSA to document potential vernal pools across NJ. These potential vernal pools represent possible breeding habitats for amphibians and other vernal pool obligate (dependent upon) and facultative species. In its present state, this PVP file reveals potential vernal pool "hotspots," which are areas of likely amphibian strongholds. These population strongholds may be crucial to the survival of some endangered and threatened species in NJ region.

Potential pool locations were systematically digitized from 1995/97 orthoimagery. Some sites have been verified by site visits, for the purpose of official certification, and to improve the classification protocol.

The main objectives of this project are to map and inventory vernal pools statewide and determine the status, range and distribution of obligate vernal pool amphibians. Because staff resources are limited, the ENSP is relying primarily on trained volunteers to conduct herptile surveys at vernal pools. As data is collected on vernal pools, the information is integrated into the land use regulatory databases of the Department of Environmental Protection to implement vernal pool protection. The vernal pool survey and certification process is ongoing - this dataset and accompanying attribute table represents the vernal pools database through 2004.



Anadromous Fish Spawning Extents & Migratory Impediments

This data set contains selected rivers and streams where river herring (alewife and blueback) and American shad have been documented or reported to spawn according to year 2005 published data from the NJDEP Bureau of Freshwater Fisheries. Listed impediments to the spawning migration of anadromous fish, as well as locations of proposed and existing fish ladders, in the state's freshwaters are listed in a second point file. River and stream segments are delineated to an upper spawning extent corresponding to a migratory impediment or the furthest confirmed or reported usage by the migratory species.

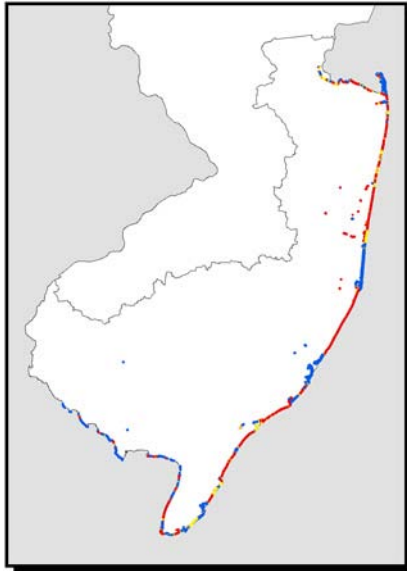
Spawning habitat for these and other anadromous fish species declined as migratory impediments, mostly in the form of dams, were built on NJ streams and rivers, preventing the upstream migration of fish during the breeding season in the spring. Particularly on large rivers, dams have been fitted with fish passage devices like fish ladders to allow migrating fish to bypass dams and reach upstream spawning grounds.

This data set was created at CRSSA from published descriptions of locations and extents and using NJDEP state rivers GIS data and USGS topographic maps to delineate migratory limits. The data was mapped in segments according to confirmed or reported status up to a listed barrier or upper extent, typically an impediment like a dam or a road.

These layers were compiled for the entire state. Attribute information for fish ladders and spawning extents included in this data set is current as of 2005, the date of publication of the mapped data, and may not be complete. It is noted and emphasized that all unlisted waters in coastal drainages have the potential to support anadromous fishes up to the first upstream barrier where suitable habitat is available.

It is noted and emphasized that all unlisted waters in coastal drainages have the potential to support anadromous fishes up to the first upstream barrier where suitable habitat is available.

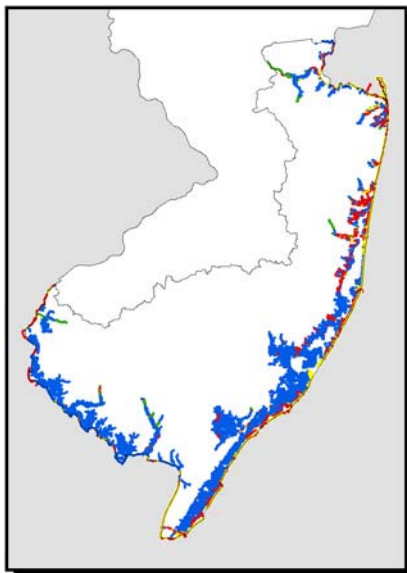
Shoreline and Adjacent Upland Characterization



Beach and Dune Communities

Beach and vegetated dune habitats were mapped from NJDEP 1995/97 land cover data. Beach and dune pixels are classified by Euclidean distance to the nearest developed pixel (residential/ commercial/ industrial development and altered/ transitional land uses) as an index of beach and dune habitat disturbance. Distances are classified in 50 meter classes to a maximum distance of 500 meters; beaches beyond this value are combined in a single class.

This dataset was created to provide a rough index of beach and dune habitat disturbance on the basis of proximity to areas of developed land use.



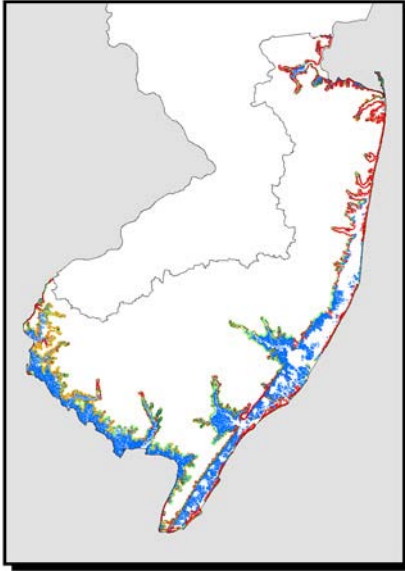
ESIL Shoreline Type

This data set contains vector lines and polygons representing the shoreline and coastal habitats of New Jersey, classified according to the Environmental Sensitivity Index (ESI) classification system. ESI data characterize the marine and coastal environments and wildlife by their sensitivity to spilled oil.

New Jersey shoreline was mapped by NOAA between 1999 and 2001 using overflights, ground surveys, existing data, and air photo interpretation.

The ESI rankings progress from low to high susceptibility to oil spills. To determine the sensitivity of a particular intertidal shoreline habitat, the following factors are integrated: 1)

Shoreline type (substrate, grain size, tidal elevation, origin); 2) Exposure to wave and tidal energy; 3) Biological productivity and sensitivity; 4) Ease of cleanup. The most susceptible classes are sheltered tidal marshes associated with high biological activity. Salt marsh comprises 75%, 4,900 km (3,000 mi) of New Jersey's shoreline. Human-altered shoreline accounts for 17% of the total, 1,080 km (670 mi). The remaining 8%, 500 km (315 mi) is characterized as other vegetated (2%) or beaches and flats (6%).



Coastal Upland Land Cover

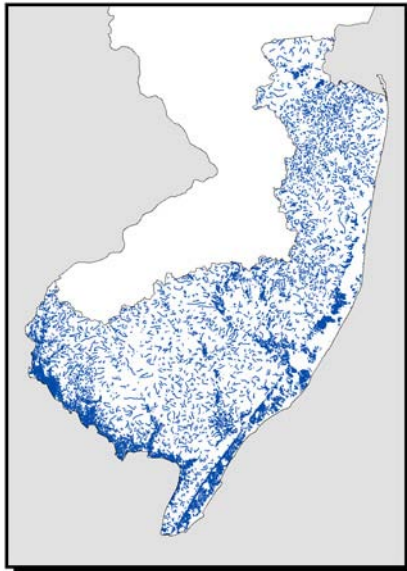
This dataset provides land use and land cover (LU/LC) data for a 500 meter coastal zone around tidal waters and coastal habitats (beaches, dune communities, and tidal marshes).

The purpose of this dataset is to identify areas of disturbance to coastal habitats by development and to quantify the composition of the coastal upland zone directly adjacent to natural coastal habitats.

Tidal waters, tidal marshes, beaches, and dunes were buffered by 500 meters to create a coastal uplands zone. NJDEP 1995/97 vector LU/LC layers updated with 2000/1999 developed change mapping from CRSSA was used to characterize this uplands zone.

Excluding open water 42%, 400 km² (150 mi.²), of the uplands zone is altered by development and other non-agricultural disturbed land cover types. 14%, 135 km² (50 mi.²), is in agricultural land covers; the remaining 44%, 420 km² (160 mi.²), is composed of natural land covers.

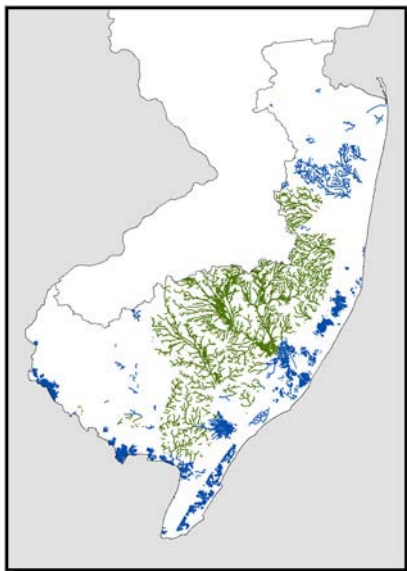
Watershed Characterization



First Order Headwater Streams

This data represents first order (headwater) streams within the ALS coastal assessment study area. This dataset was compiled at CRSSA from county-level hydrography layers generated as a line ArcInfo coverage from USGS 1:24,000 Digital Line Graph(DLG) files with subsequent editing and updating by the New Jersey Department of Environmental Protection. Streams in this layer are first order tributaries - they receive flow from no other stream sources.

This stream layer was created to identify source waters for the streams and rivers within the coastal watershed management areas.

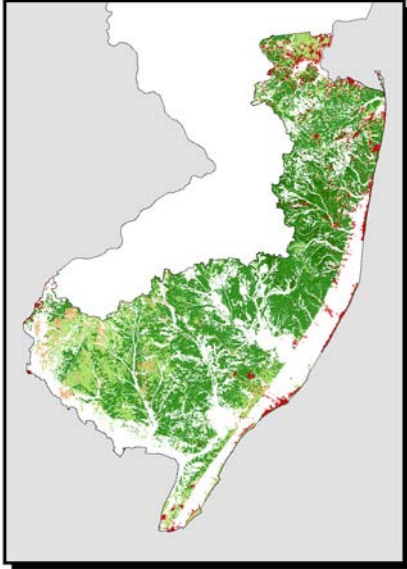


C1 and Outstanding Resource Streams

C1 and Outstanding Natural Resource (ON) waters were extracted from the state-wide Surface Water Quality Standards (SWQS) dataset.

The SWQS establish the designated uses to be achieved and specify the water quality (criteria) necessary to protect the State's waters. Designated uses include potable water, propagation of fish and wildlife, recreation, agricultural and industrial supplies, and navigation. These are reflected in use classifications assigned to specific waters.

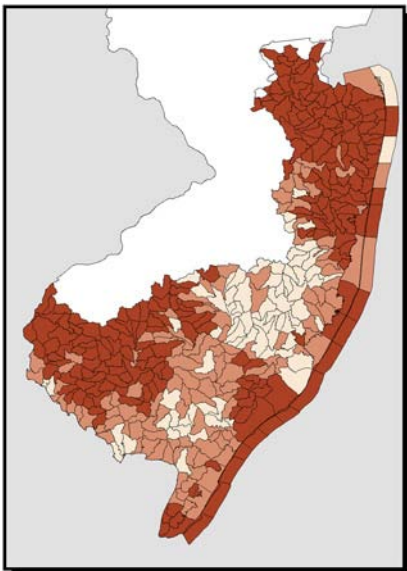
C1 or Category One waters are designated for purposes of implementing antidegradation policies established for protection from measurable changes in water quality characteristics. ON streams are high quality waters that constitute an outstanding national resource.



Ground-water Recharge Rates

Ground-water recharge was extracted from GIS data published by the New Jersey Geological Survey (NJGS). The NJGS methodology is based on the land use/ land cover, soils, and local climatic data. Each cell in this raster dataset is assigned to an estimated recharge rate class. Recharge is not calculated for hydric soils, wetlands, or open water.

Recharge values range from 0 to 23 inches/year. The highest recharge rankings are found in the Mullica and Barnegat Bay watershed areas, in the heart of the Pine Barrens. The high recharge areas represent areas of conservation priority and generally correspond to watersheds with low altered land cover, impervious cover, and riparian disturbance percentages.

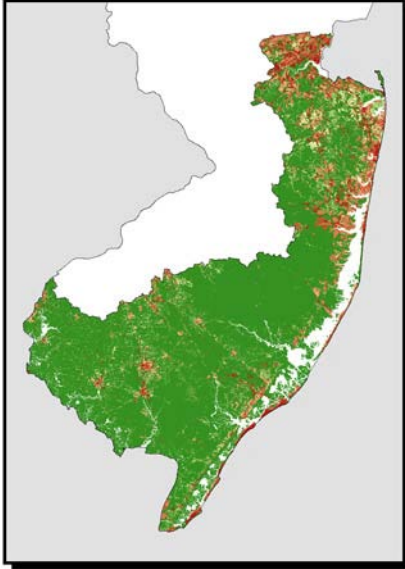


Altered Land Cover Percentage by Watershed

Land cover was summarized by HUC14 watershed areas to calculate the proportion of land area in each watershed that has been altered by human use.

Altered land cover classes include residential, commercial, industrial development, as well as farms and other agricultural land uses, extractive mining, and transitional land cover.

Watershed totals range between 0 and 92% altered land cover. Of the 414 watersheds that lie completely within the study area, altered land cover accounts for less than 10% of the total land area in 66 (16%); altered land cover in 123 (30%) ranges from 10 to 30%; and the remaining 225 (54%) are greater than 30% altered land cover.



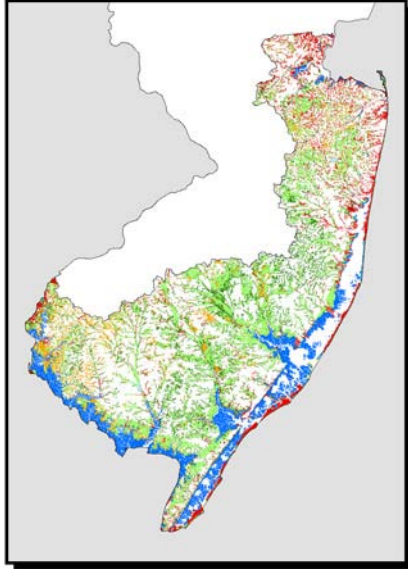
Impervious Surface Coverage

This raster dataset represents estimated impervious surface cover for all land pixels within the ALS coastal assessment study area. Impervious surface coverage was extracted from the NJDEP 1995/97 LU/LC datasets updated with 2000/99 developed change polygon data from CRSSA. Values for each 10 meter cell represent the averaged impervious cover, in square meters, for a 100 square meter area. Values therefore represent both the total cover (in m^2) and the average percent cover for the corresponding ground area.

This dataset was created to calculate impervious coverage by watershed zones as a measure of ecological integrity: disturbed watershed with greater relative impervious coverage represent areas prone to more frequent and more severe flooding due to loss of recharge area. Impervious surface is also a good measure of total built versus 'natural' or vegetated area because it takes into account areas of natural cover within an urban or suburban matrix.

Impervious surface coverage was estimated for the 1995/97 land cover data by visual inspection of 1 meter ground resolution cell aerial imagery. In those areas where new development occurred, as mapped by the 2000/99 CRSSA change update data, impervious coverage values were substituted by land cover type. Median values calculated from the 1995/97 data for residential, commercial/industrial/institutional, recreation, agricultural, extractive, and transitional land covers were assigned to the change polygons by class.

All tidal and ocean water features were masked from the final grid. Zonal analysis of land and freshwater pixels only will more accurately represent the altered/unaltered status of watersheds, especially coastal and barrier island watersheds.



Riparian Zone Land Cover

This layer represents landcover within the hydrologically-connected riparian zone defined as the intersection of six soils and hydrological components in four categories:

A. Wetlands as defined by NJDEP 1995/97 landcover updated with the CRSSA 2000/1999 development update. All wetland types, including 'Agricultural Wetlands (Modified),' that fall within 33 feet of a stream were considered to be hydrologically connected to streams. The 33 foot threshold was used as this distance represents the National Mapping Accuracy Standard for the possible inaccuracy in the spatial location of a mapped feature.

B. Flood-prone areas as defined by:

1. NJDEP/USGS documented and undocumented flood-prone areas. The flood-prone designation represents an average 1 in 100 change that the designated areas will be inundated in any year. The DEP-distributed flood-prone documentation was taken directly from USGS flood-prone maps, itself distributed by the USGS as county-wide Integrated Terrain Unit Mapping (ITUM) layers.
2. Special Flood Hazard Areas (SFHAs) were mapped from the county level FEMA Q3 datasets. SFHAs are areas subject to inundation by a flood having a one-percent or greater probability of being equaled or exceeded during any given year. This flood, which is referred to as the 1% annual chance flood (or base flood), is the national standard on which the floodplain management and insurance requirements of the National Flood Insurance Program are based.

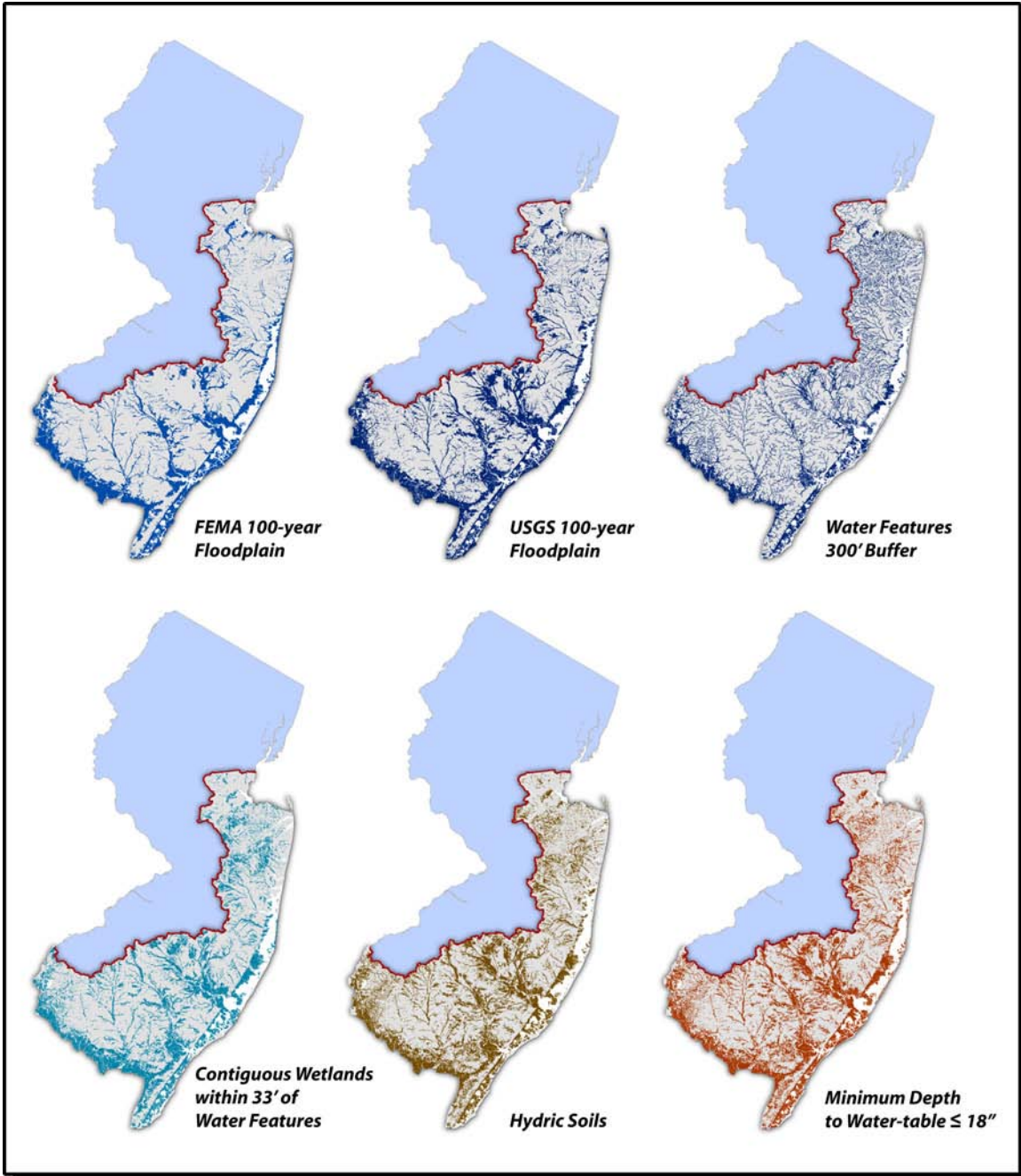
C. Riparian Soils as defined by the NRCS SSURGO county soil surveys:

1. Hydric soils were defined as soil association where at least one major component soils (greater than 25% average representation in the association) was defined as hydric.
2. Soils with seasonal depth to high water table of 18" or less were extracted for all soil association with a minimum annual water depth of 46 cm (18") or less.

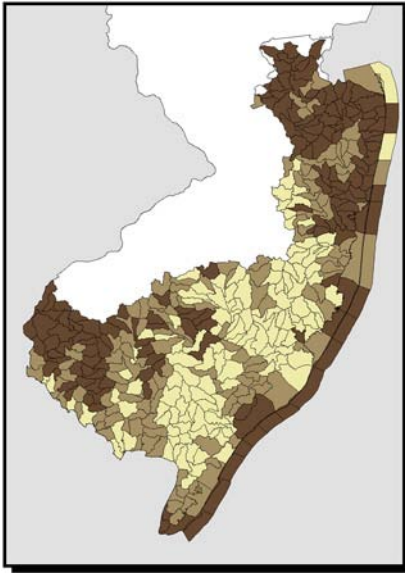
D. 300 foot buffer of all water features as defined by NJDEP 1995/97 landcover.

The riparian zone was used to extract rasterized landcover data created from the NJDEP 95/97 LU/LC watershed datasets updated with 2000/1999 CRSSA developed change data.

This riparian zone LU/LC dataset was created to aid regional-scale analysis of landcover trends that directly affect the stream and open water systems within the study area.



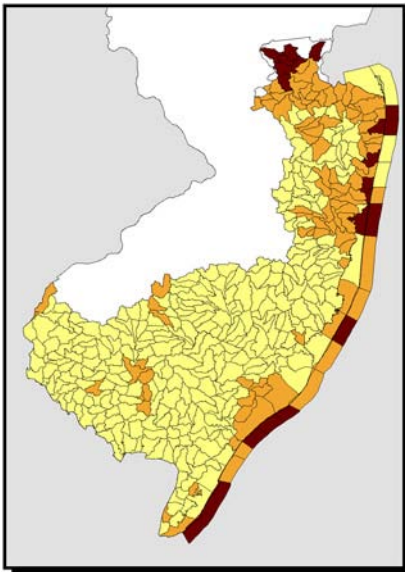
Riparian zone components. The riparian zone was mapped using an overlay of six hydrological components.



Riparian Zone Disturbance by Watershed

The proportion of the riparian zone that has been altered by human land uses has been summarized by watershed.

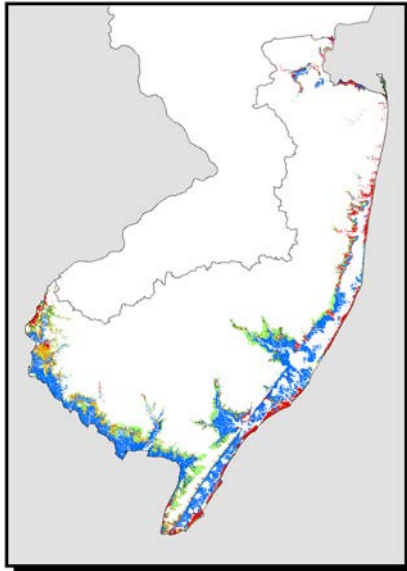
Watershed percentages range between 0 and 89% altered land cover in the riparian zone. The riparian zone in 118 watersheds (29%) is less than 10% altered by developed and agricultural land uses; 139 (33%) are between 10 and 30%; and the remaining 157 (38%) have greater than 30% altered land cover in the riparian zone.



Impervious Surface Percentage by Watershed

Impervious surface was summarized by HUC14 watershed areas to calculate the percentage of land area under impervious cover in each watershed.

Watershed percentages range between 0 and 64% impervious cover. Impervious cover in 287 watersheds (69%) accounts for less than 10% of the watershed's total land area; in 103 (25%) impervious cover fall between 10 and 30%; and in the remaining 24 (6%) impervious cover is greater than 30%.



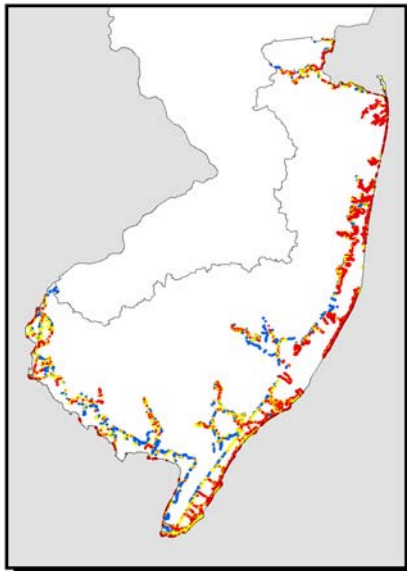
100-year (3 meter) Tidal Surge Inundation

Estimates by FEMA predict a 2.90 meter 100-year storm tidal surge (1% yearly likelihood) for the Atlantic coast of New Jersey. This dataset shows the coastal land area and LU/LC that would be affected by a 3 meter tidal surge based on a 3m threshold elevation value.

This dataset was created to assess the potential damage to New Jersey's built and natural coastal communities in the event of a 3 meter tidal surge. Land cover classification was extracted from NJDEP 1995/97 LU/LC data updated with 2000/1999 developed land cover change from CRSSA for all coastal areas at 3 meters elevation or lower.

The source elevation data were USGS 10 meter ground resolution cell digital elevation models (DEMs). The vertical resolution of the data is 0.1 meters. A 3 meter threshold has been adopted for all sea-level rise modeling in this report due to inconsistencies between the original quad-level DEMs used in mosaic for these analyses. 1 and 2 meter elevation contours are in many cases inconsistent between adjacent DEMs, resulting in many edge artifacts. At 3 meters, the approximate elevation of a 100-year storm surge, these inconsistencies were deemed to be minimal.

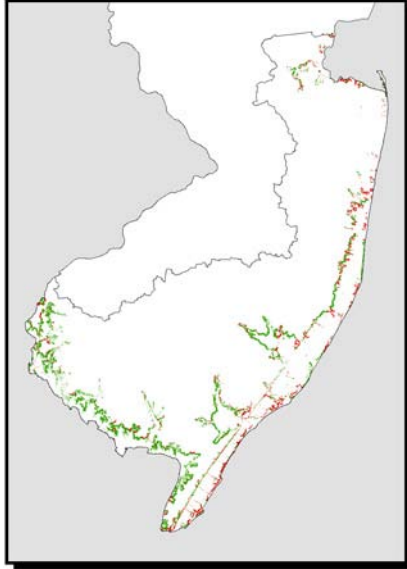
79% of the inundation area, 1,200 km² (460 mi.²), is in natural land cover. 16%, 240 km² (90 mi.²), is development or other altered non-agricultural lands. The remaining 6%, 90 km² (35 mi.²), is in agricultural land covers.



Sea Rise Distance to First Obstruction

The first line of development - including residential, commercial and industrial building as well as all county level and larger roads - was extracted from land use/land cover data and NJDOT roads layers to calculate the Euclidean (straight line) distance from coastal development to tidal water. Each 'developed fringe' cell in the 10 meter grid is assigned a value equal to the straight line distance to the nearest tidal water pixel. Values range between 0 and 7,000 meters and are measured as integers.

This dataset was created to estimate retreat zones for tidal marshes and other natural coastal habitat, the area into which tidal habitat can recede before it is limited by hardened or built features of the human landscape.



Salt Marsh Retreat Zones

Gradual shoreline retreat caused by rising sea levels will have an impact on both developed and natural shore communities. Land cover and elevation data was used to model buffer areas around existing tidal marshes that will be available as retreat zones for this habitat as sea levels rise. For the purposes of this model salt marsh retreat is limited by existing developed features, including major roads (600-level county roads and larger). Model parameters also limit the calculated retreat zones to areas within 500 meters of existing tidal marshes and to elevations of 3 meters or less.

Cells are assigned values 1 (limited retreat area) or 2 (natural retreat area). 29% of the 500 meter retreat area is limited by developed features and roads.

This dataset was created to model retreat zones for tidal marshes as sea levels rise, and to estimate the limiting effect of developed features on marsh retreat.

Developed polygons were extracted from the 1995/97 NJDEP LU/LC data updated using the 2000/99 development change data created at CRSSA. County-level and larger roads were extracted from the NJDOT 2005 roads database. 500 meter tidal marsh buffer polygons were clipped to areas bounded by both the roads and developed polygons so that no buffers extend across roads or outside of extents surrounded by developed features. The resulting polygons represent the available marsh retreat areas. The buffer was calculated again without the developed features and roads constraints. These polygons represent the potential retreat zones. The difference between the available and potential retreat zones represents the limited retreat zone that includes developed and natural areas unavailable for marsh colonization. All final data layers were clipped to areas of 3 meters or less in elevation, and to existing tidal shoreline conditions (no existing tidal water pixels can be classified as a retreat area).

III. Thematic Maps

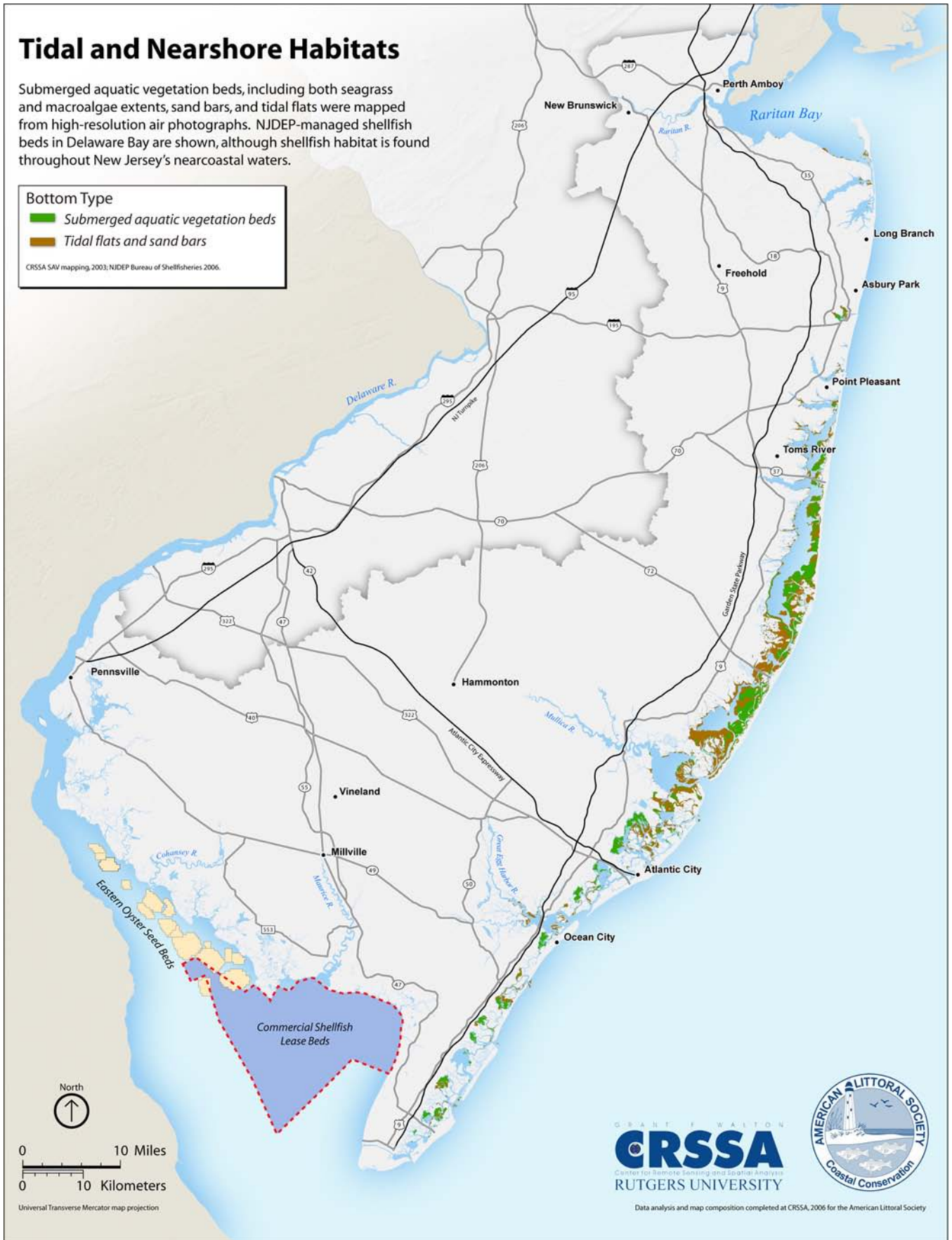
Tidal and Nearshore Habitats

Submerged aquatic vegetation beds, including both seagrass and macroalgae extents, sand bars, and tidal flats were mapped from high-resolution air photographs. NJDEP-managed shellfish beds in Delaware Bay are shown, although shellfish habitat is found throughout New Jersey's nearcoastal waters.

Bottom Type

- Submerged aquatic vegetation beds
- Tidal flats and sand bars

CRSSA SAV mapping 2003; NJDEP Bureau of Shellfisheries 2006.

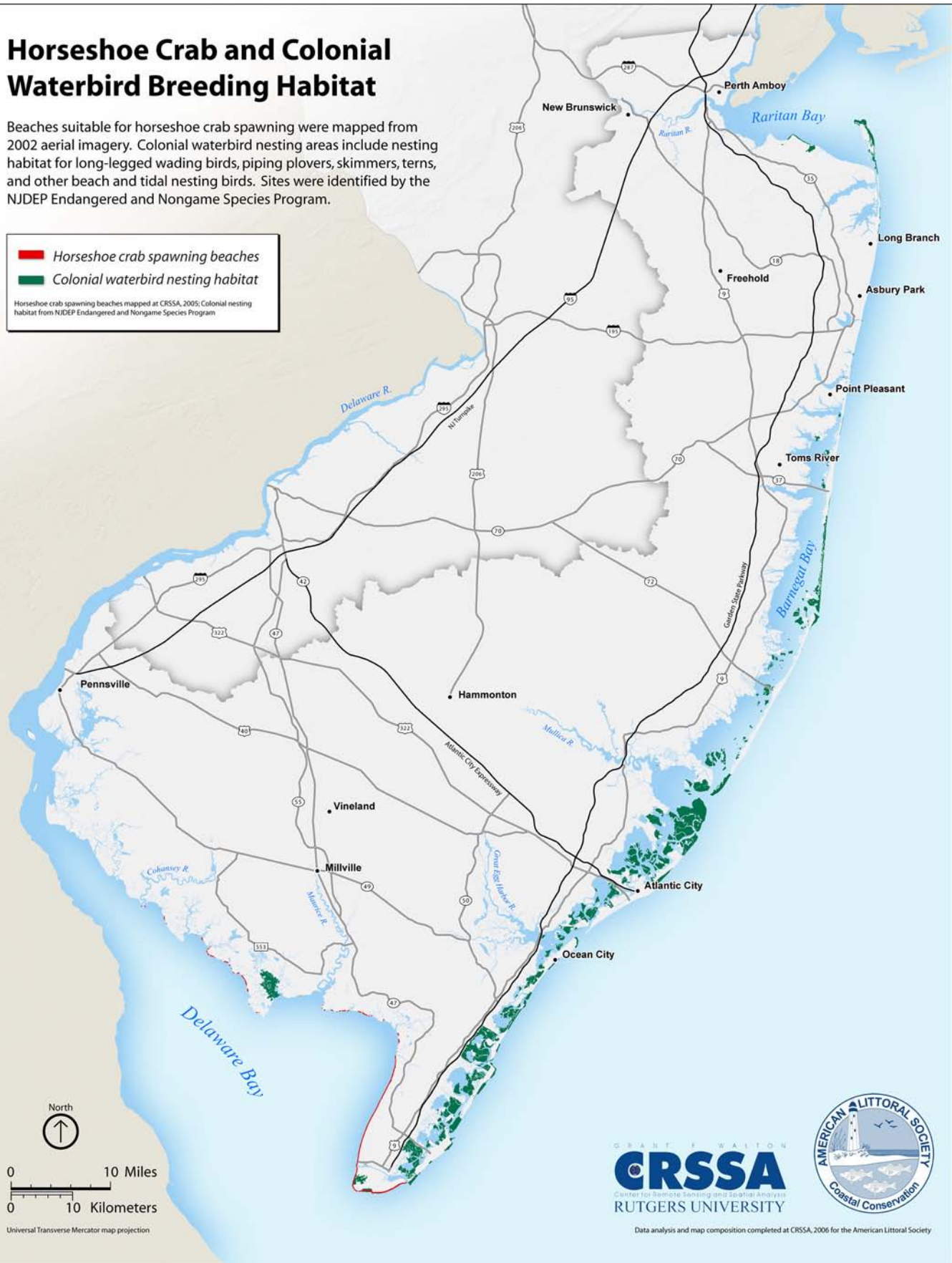


Horseshoe Crab and Colonial Waterbird Breeding Habitat

Beaches suitable for horseshoe crab spawning were mapped from 2002 aerial imagery. Colonial waterbird nesting areas include nesting habitat for long-legged wading birds, piping plovers, skimmers, terns, and other beach and tidal nesting birds. Sites were identified by the NJDEP Endangered and Nongame Species Program.

■ *Horseshoe crab spawning beaches*
■ *Colonial waterbird nesting habitat*

Horseshoe crab spawning beaches mapped at CRSSA, 2005; Colonial nesting habitat from NJDEP Endangered and Nongame Species Program



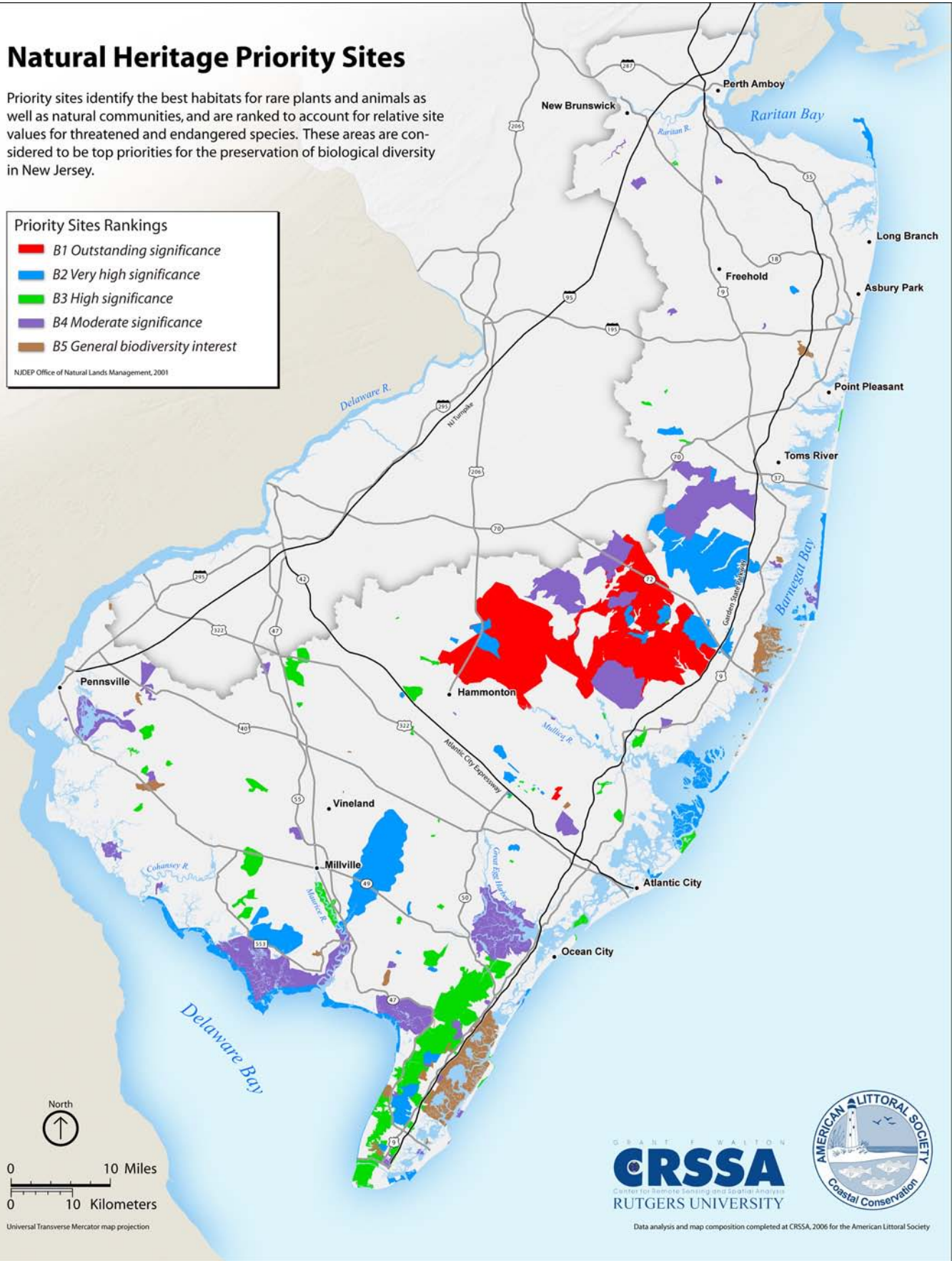
Natural Heritage Priority Sites

Priority sites identify the best habitats for rare plants and animals as well as natural communities, and are ranked to account for relative site values for threatened and endangered species. These areas are considered to be top priorities for the preservation of biological diversity in New Jersey.

Priority Sites Rankings

- B1 Outstanding significance
- B2 Very high significance
- B3 High significance
- B4 Moderate significance
- B5 General biodiversity interest

NJDEP Office of Natural Lands Management, 2001



Priority Wildlife Habitat Areas

These ranked areas identify habitat for state threatened, state endangered, and federally listed species. This habitat ranking was completed by the NJDEP Endangered and Nongame Species Program Landscape Project.

Habitat Rankings

Grassland

- > State threatened (class 3)
- > State endangered (4)
- > Federally listed (5)

Beach

- > State threatened
- > State endangered
- > Federally listed

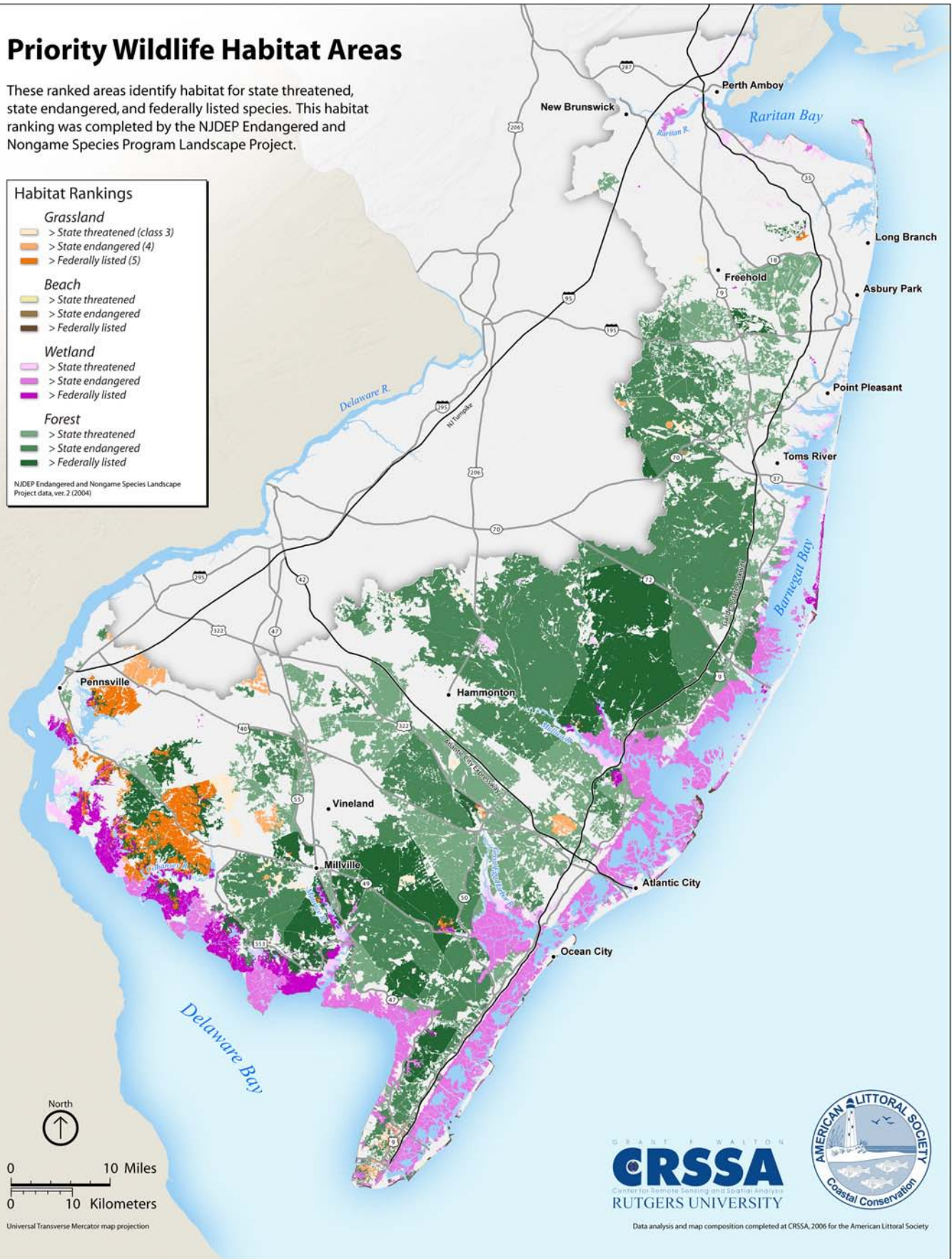
Wetland

- > State threatened
- > State endangered
- > Federally listed

Forest

- > State threatened
- > State endangered
- > Federally listed

NJDEP Endangered and Nongame Species Landscape Project data, ver. 2 (2004)



Anadromous Fish Spawning Runs

American shad and river herring spawning extents and migratory impediments were mapped for New Jersey's rivers and streams from the 2005 Bureau of Freshwater Fisheries draft management plan. This map shows extents for river herring; American shad are reported or confirmed in a smaller selection of these waters.

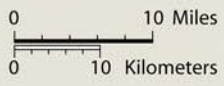
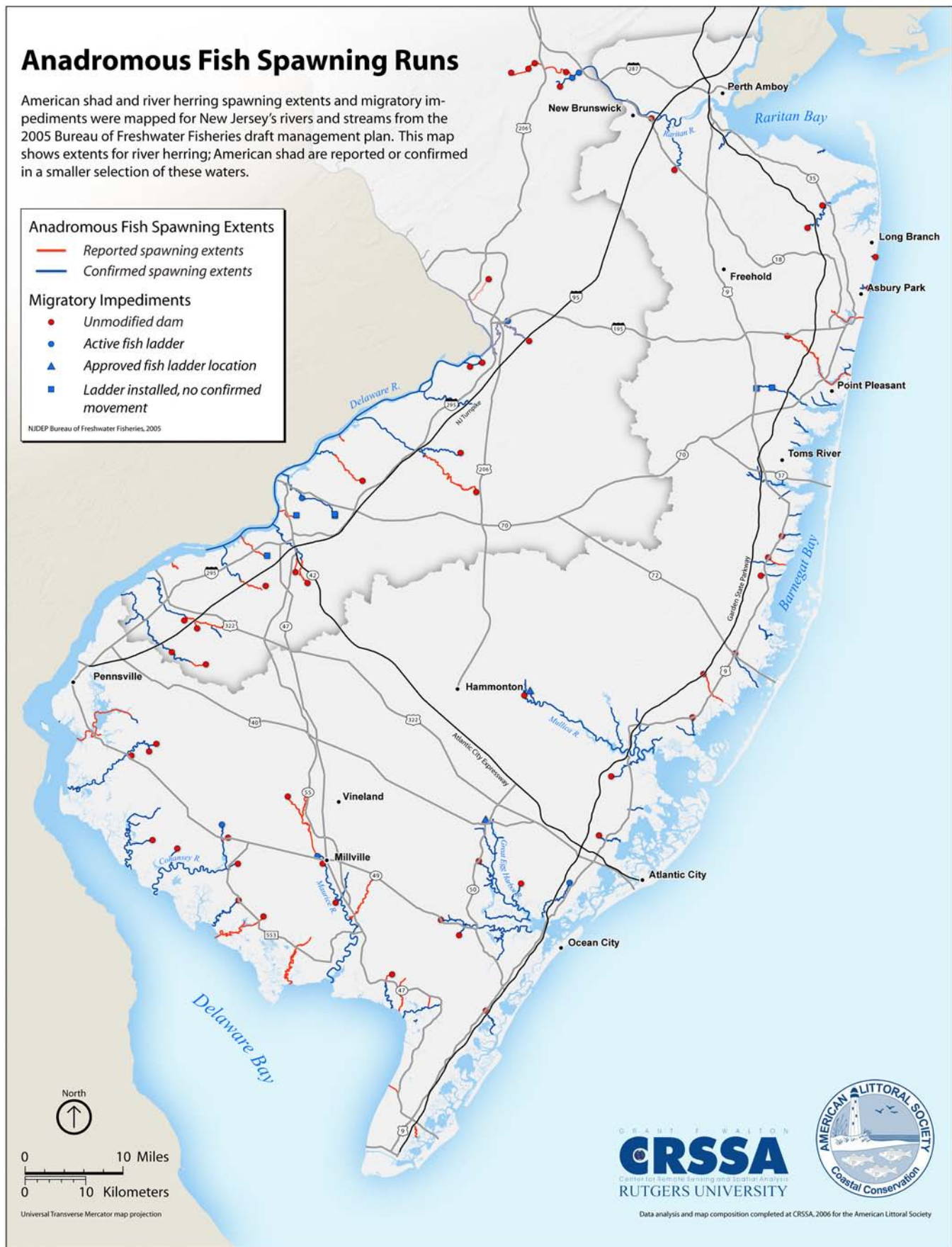
Anadromous Fish Spawning Extents

- Reported spawning extents
- Confirmed spawning extents

Migratory Impediments

- Unmodified dam
- Active fish ladder
- ▲ Approved fish ladder location
- Ladder installed, no confirmed movement

NJDEP Bureau of Freshwater Fisheries, 2005



Universal Transverse Mercator map projection



Data analysis and map composition completed at CRSSA, 2006 for the American Littoral Society

Beach and Coastal Dune Disturbance

Relative disturbance is calculated using the distance of beach and dune communities from the nearest developed land cover area, including residential, commercial, and industrial development, as well as extractive and transitional land uses.

Distance from Disturbed Land Cover

- 0 -- 50 meters
- 50 -- 100
- > 100

1995/97 NDEP land cover data was updated with CRSSA 2000/99 developed land cover change polygons for this analysis



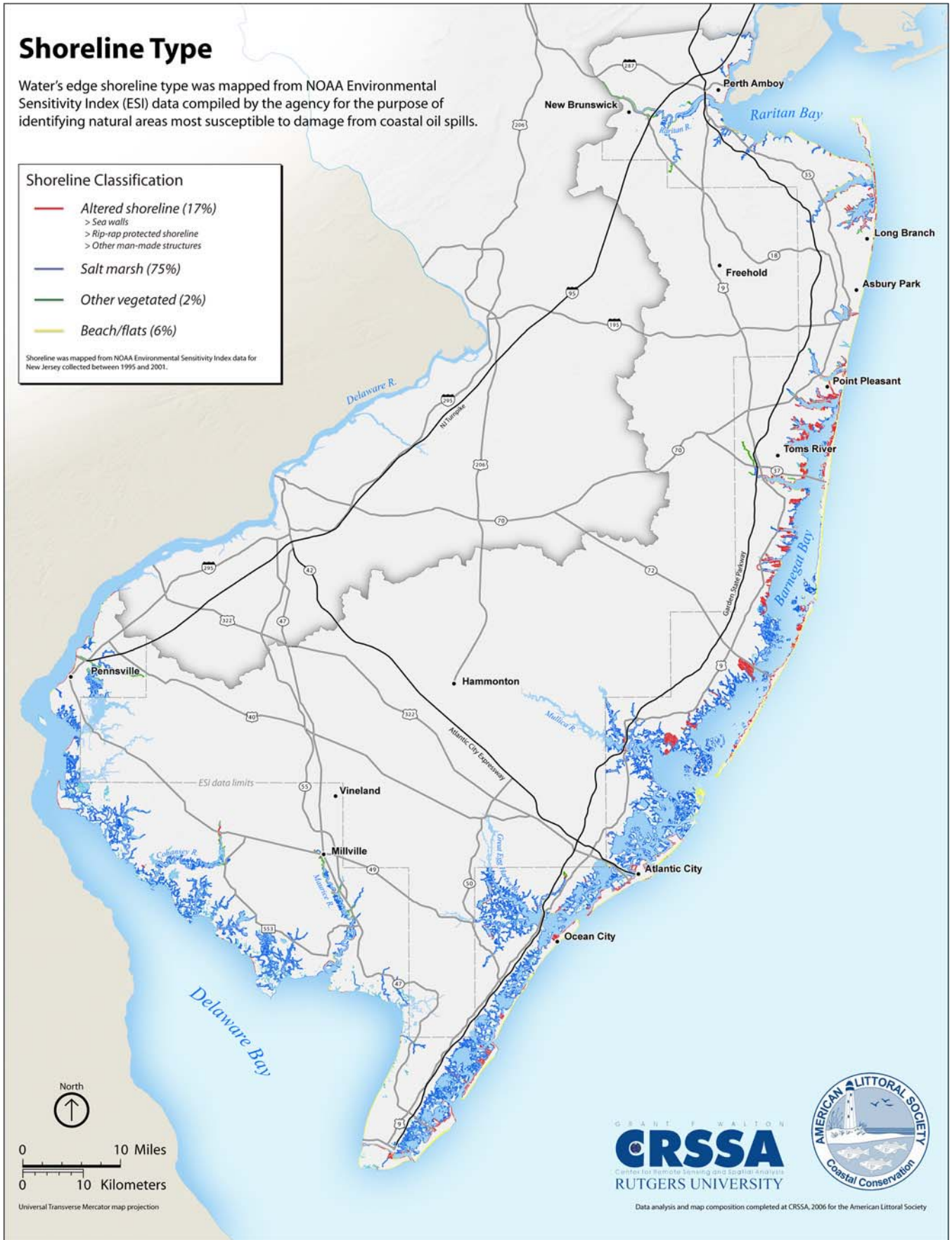
Shoreline Type

Water's edge shoreline type was mapped from NOAA Environmental Sensitivity Index (ESI) data compiled by the agency for the purpose of identifying natural areas most susceptible to damage from coastal oil spills.

Shoreline Classification

- Altered shoreline (17%)
 - > Sea walls
 - > Rip-rap protected shoreline
 - > Other man-made structures
- Salt marsh (75%)
- Other vegetated (2%)
- Beach/flats (6%)

Shoreline was mapped from NOAA Environmental Sensitivity Index data for New Jersey collected between 1995 and 2001.



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Data analysis and map composition completed at CRSSA, 2006 for the American Littoral Society

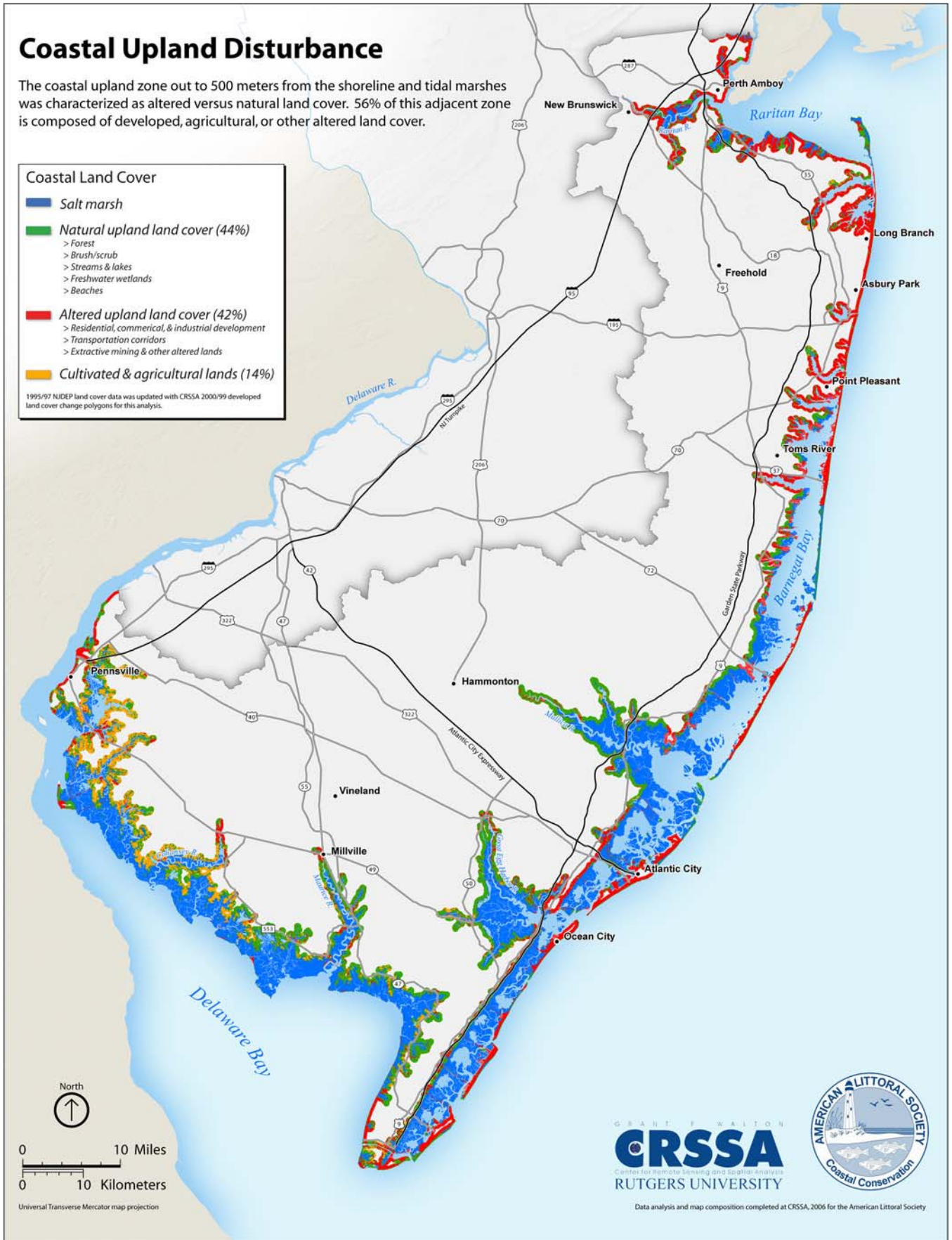
Coastal Upland Disturbance

The coastal upland zone out to 500 meters from the shoreline and tidal marshes was characterized as altered versus natural land cover. 56% of this adjacent zone is composed of developed, agricultural, or other altered land cover.

Coastal Land Cover

- Salt marsh
- Natural upland land cover (44%)
 - > Forest
 - > Brush/scrub
 - > Streams & lakes
 - > Freshwater wetlands
 - > Beaches
- Altered upland land cover (42%)
 - > Residential, commercial, & industrial development
 - > Transportation corridors
 - > Extractive mining & other altered lands
- Cultivated & agricultural lands (14%)

1995/97 NJDEP land cover data was updated with CRSSA 2000/99 developed land cover change polygons for this analysis.



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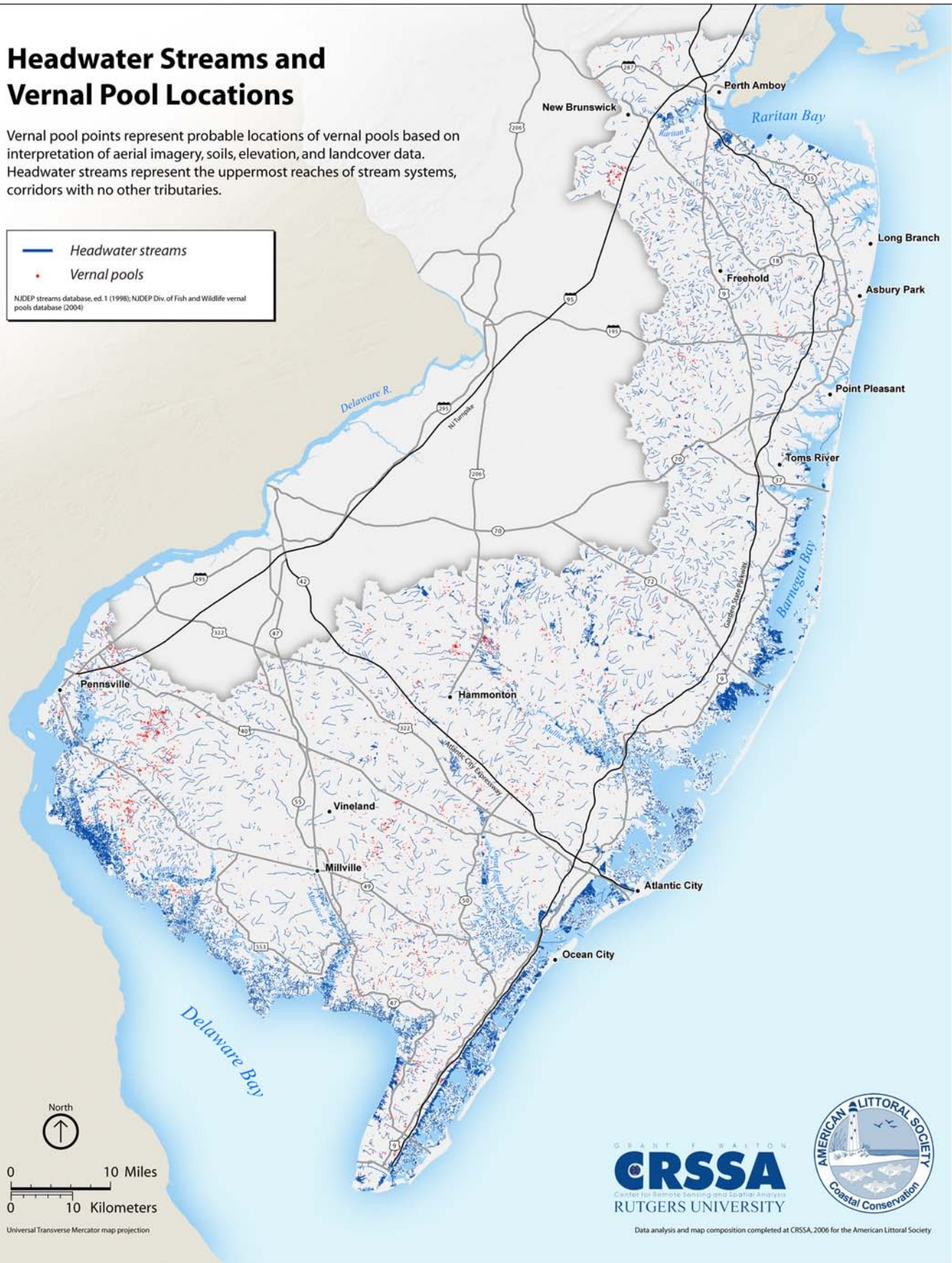
Data analysis and map composition completed at CRSSA, 2006 for the American Littoral Society

Headwater Streams and Vernal Pool Locations

Vernal pool points represent probable locations of vernal pools based on interpretation of aerial imagery, soils, elevation, and landcover data. Headwater streams represent the uppermost reaches of stream systems, corridors with no other tributaries.

- Headwater streams
- Vernal pools

NJDEP streams database, ed. 1 (1998); NJDEP Div. of Fish and Wildlife vernal pools database (2004)



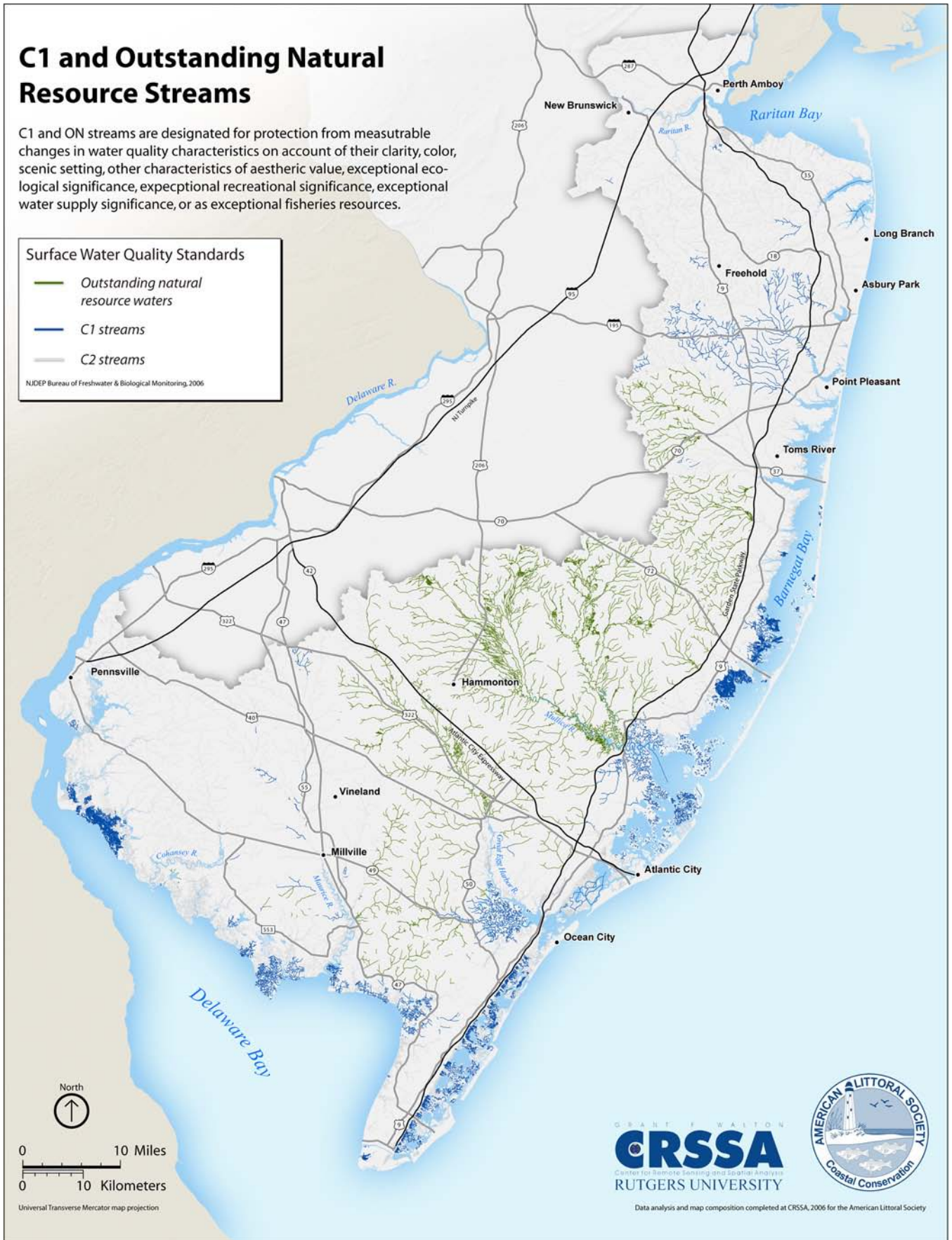
C1 and Outstanding Natural Resource Streams

C1 and ON streams are designated for protection from measurable changes in water quality characteristics on account of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or as exceptional fisheries resources.

Surface Water Quality Standards

- Outstanding natural resource waters
- C1 streams
- C2 streams

NJDEP Bureau of Freshwater & Biological Monitoring, 2006



Groundwater Recharge Rankings

Groundwater recharge is estimated using land use and land cover data, soils, and municipality-based climatic data. Recharge values are estimated in inches/year by the New Jersey Geological Survey.

Recharge Rankings

- 16 -- 23 in./yr.
- 11 -- 15
- 8 -- 10
- 1 -- 7
- 0
- Recharge not calculated
(hydric soils, wetlands,
open waters, etc.)

NJDEP Office of Natural Lands Management, 2001



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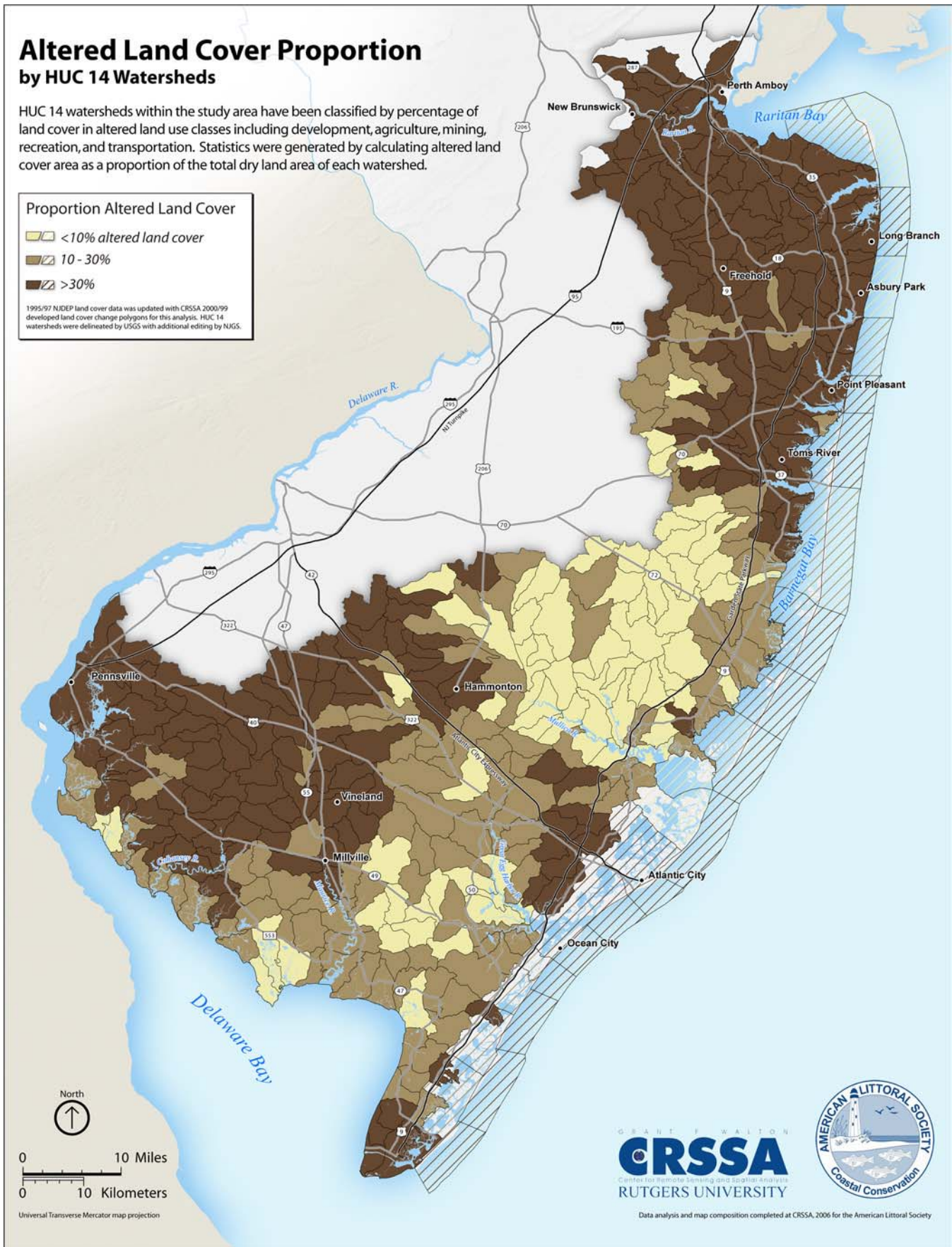
Altered Land Cover Proportion by HUC 14 Watersheds

HUC 14 watersheds within the study area have been classified by percentage of land cover in altered land use classes including development, agriculture, mining, recreation, and transportation. Statistics were generated by calculating altered land cover area as a proportion of the total dry land area of each watershed.

Proportion Altered Land Cover

-  <10% altered land cover
-  10 - 30%
-  >30%

1995/97 NDEP land cover data was updated with CRSSA 2000/99 developed land cover change polygons for this analysis. HUC 14 watersheds were delineated by USGS with additional editing by NIGS.



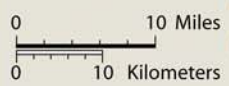
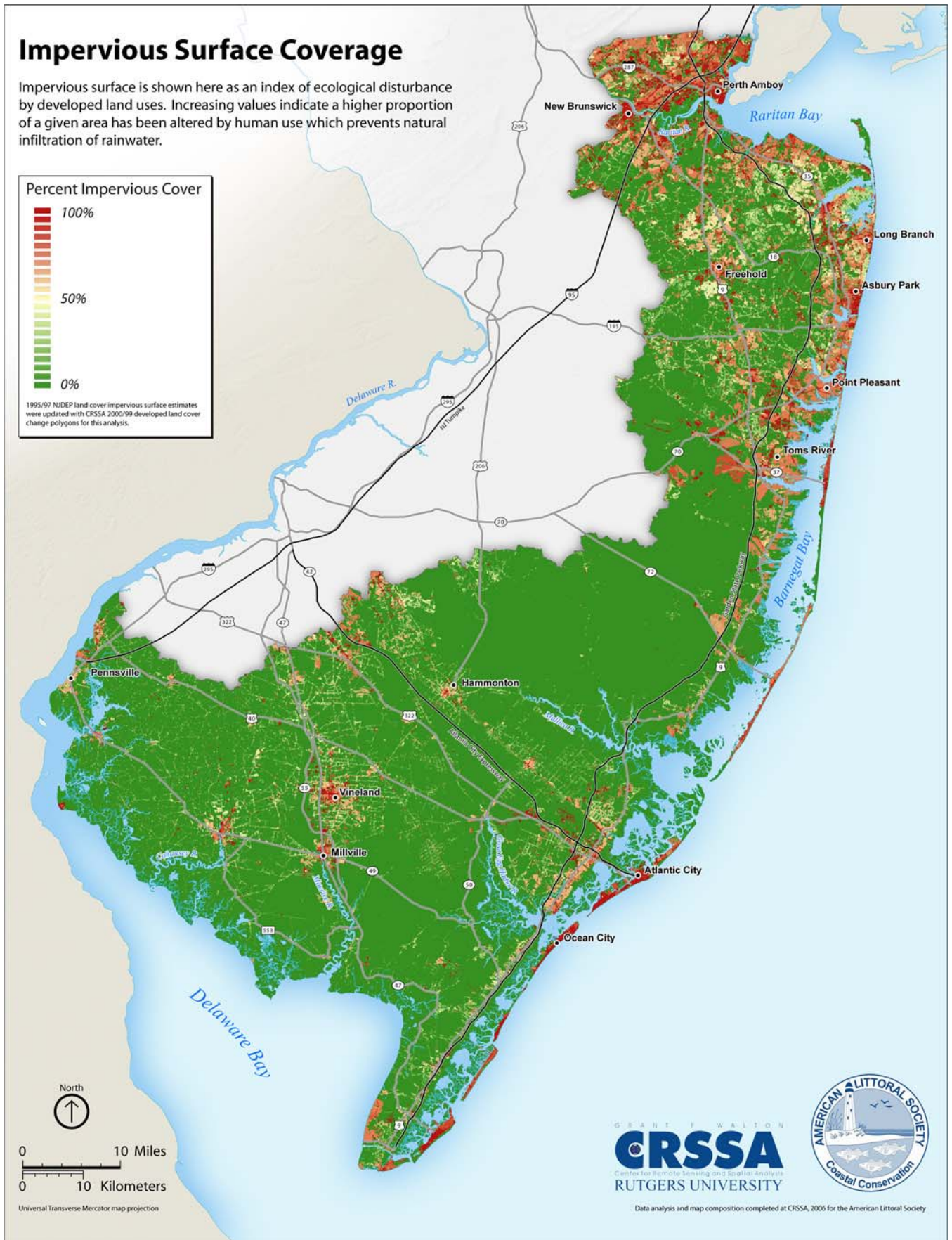
Impervious Surface Coverage

Impervious surface is shown here as an index of ecological disturbance by developed land uses. Increasing values indicate a higher proportion of a given area has been altered by human use which prevents natural infiltration of rainwater.

Percent Impervious Cover



1995/97 NIDEP land cover impervious surface estimates were updated with CRSSA 2000/99 developed land cover change polygons for this analysis.



Universal Transverse Mercator map projection



Data analysis and map composition completed at CRSSA, 2006 for the American Littoral Society

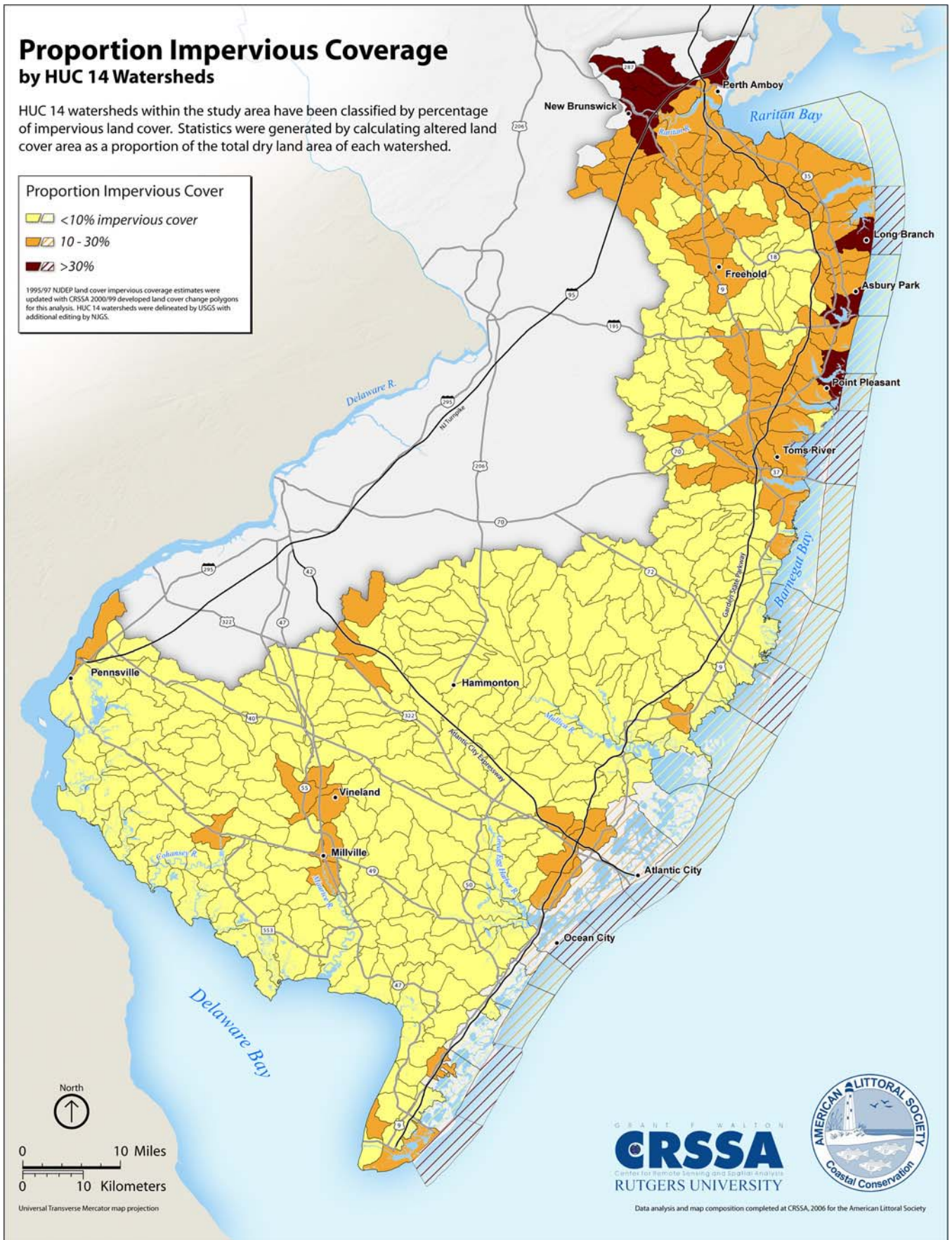
Proportion Impervious Coverage by HUC 14 Watersheds

HUC 14 watersheds within the study area have been classified by percentage of impervious land cover. Statistics were generated by calculating altered land cover area as a proportion of the total dry land area of each watershed.

Proportion Impervious Cover

- <10% impervious cover
- 10 - 30%
- >30%

1995/97 NJDEP land cover impervious coverage estimates were updated with CRSSA 2000/99 developed land cover change polygons for this analysis. HUC 14 watersheds were delineated by USGS with additional editing by NIGS.



0 10 Miles
0 10 Kilometers

Universal Transverse Mercator map projection



Data analysis and map composition completed at CRSSA, 2006 for the American Littoral Society

Riparian Zone Land Cover

Soils, land cover, and floodplain datasets were used to define a hydrologically connected riparian zone for the study area that extends beyond a simple buffer of surface water features.

Land Cover Classification

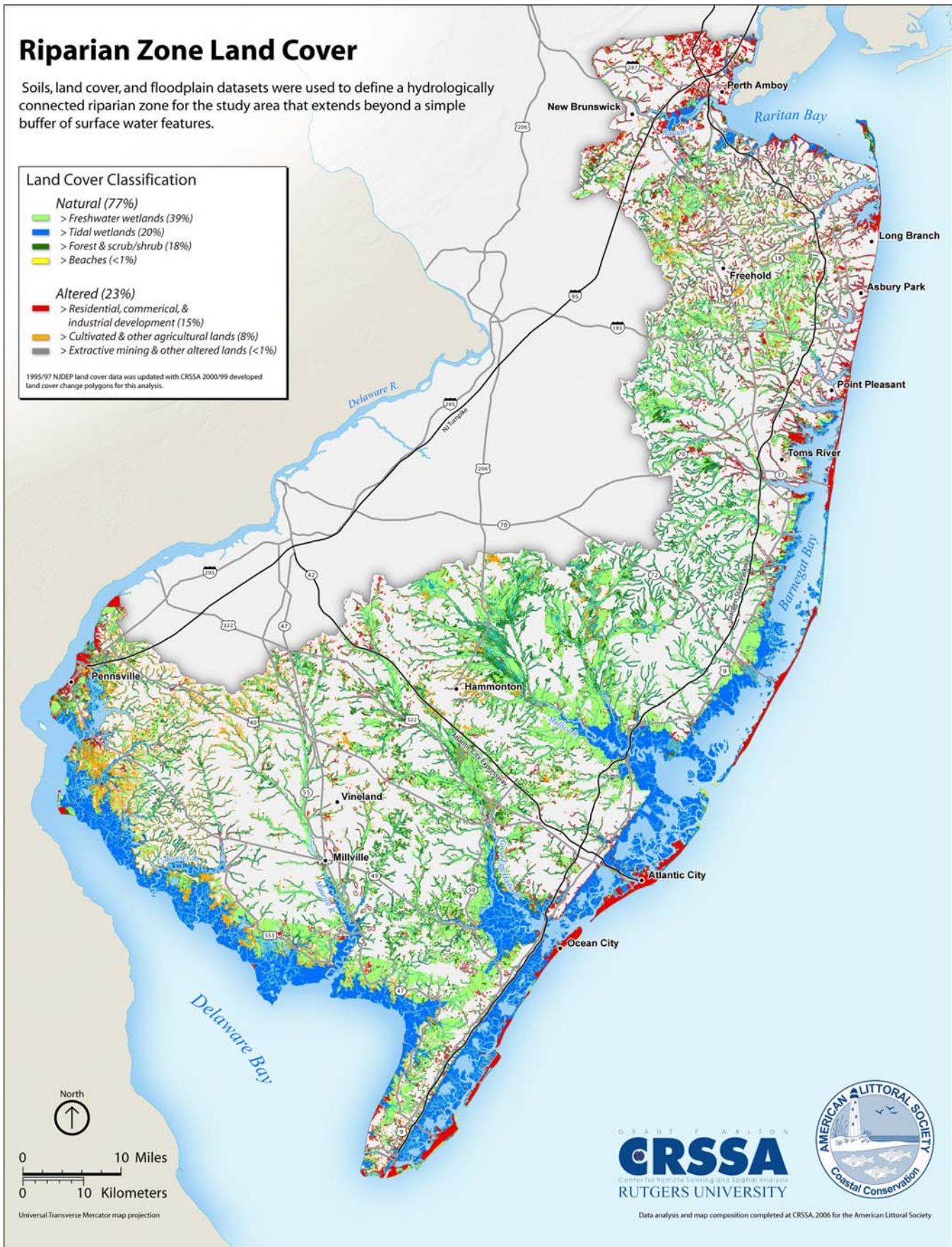
Natural (77%)

- > Freshwater wetlands (39%)
- > Tidal wetlands (20%)
- > Forest & scrub/shrub (18%)
- > Beaches (<1%)

Altered (23%)

- > Residential, commercial, & industrial development (15%)
- > Cultivated & other agricultural lands (8%)
- > Extractive mining & other altered lands (<1%)

1995/97 NJDEP land cover data was updated with CRSSA 2000/99 developed land cover change polygons for this analysis.



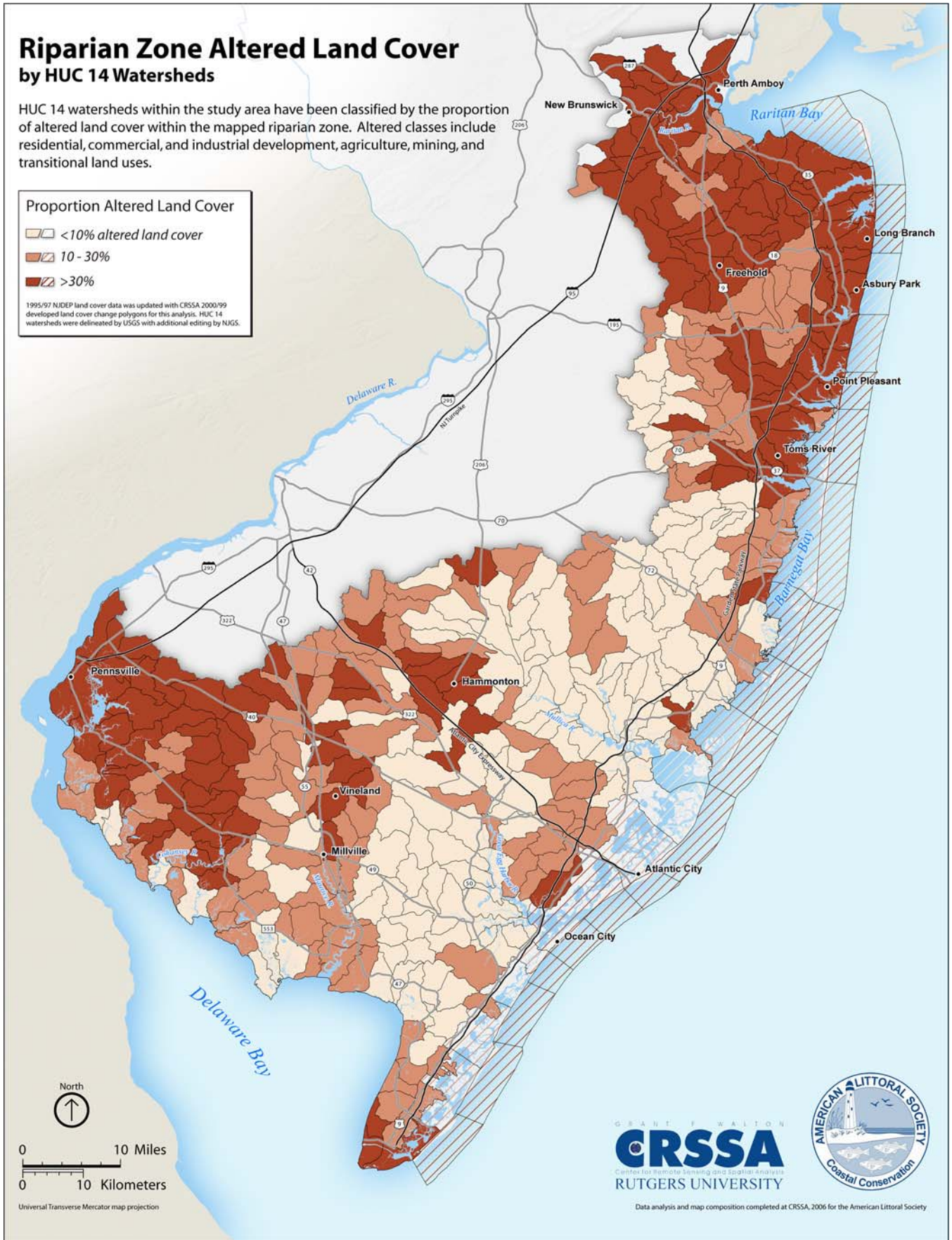
Riparian Zone Altered Land Cover by HUC 14 Watersheds

HUC 14 watersheds within the study area have been classified by the proportion of altered land cover within the mapped riparian zone. Altered classes include residential, commercial, and industrial development, agriculture, mining, and transitional land uses.

Proportion Altered Land Cover

-  <10% altered land cover
-  10 - 30%
-  >30%

1995/97 NDEP land cover data was updated with CRSSA 2000/99 developed land cover change polygons for this analysis. HUC 14 watersheds were delineated by USGS with additional editing by NIGS.



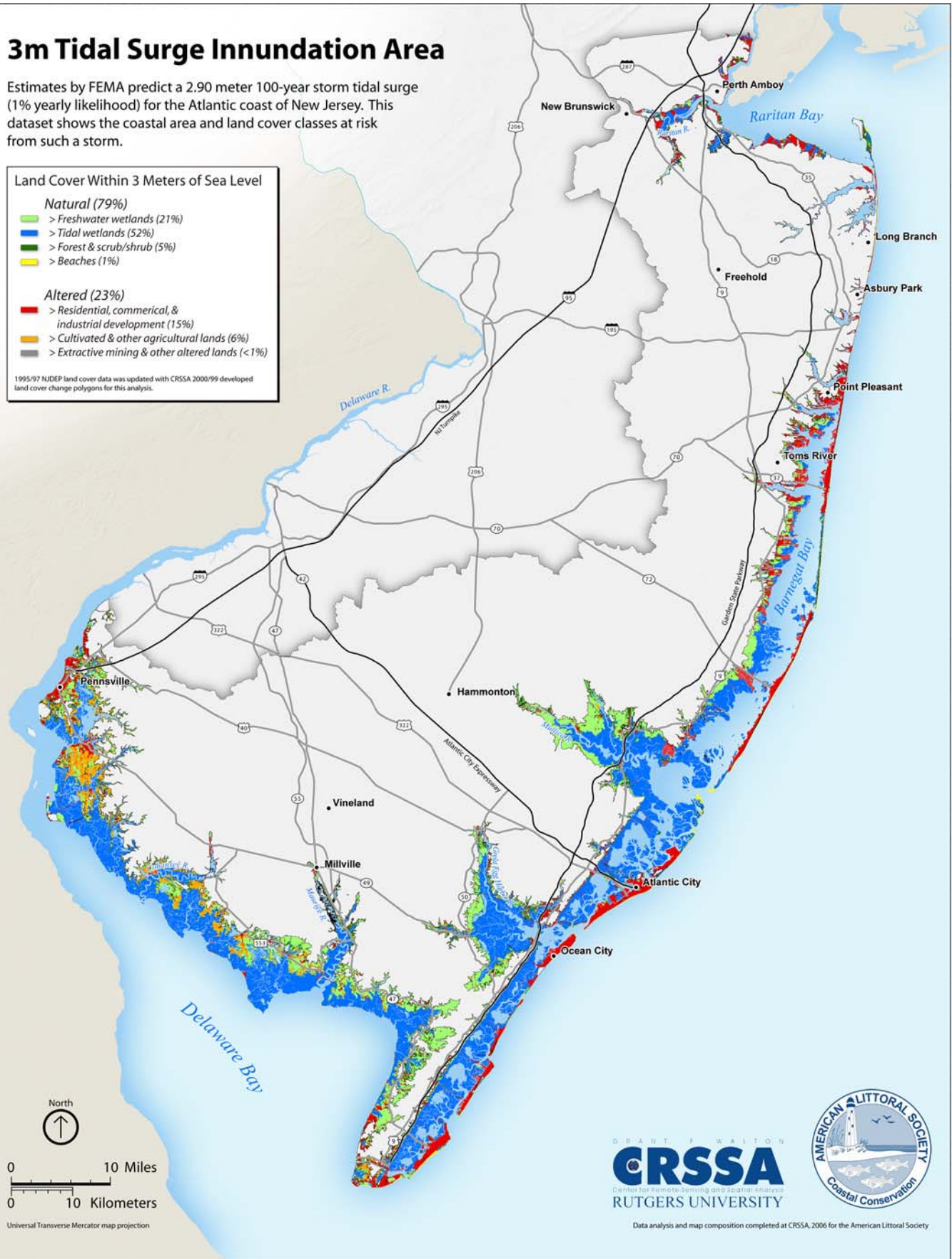
3m Tidal Surge Innundation Area

Estimates by FEMA predict a 2.90 meter 100-year storm tidal surge (1% yearly likelihood) for the Atlantic coast of New Jersey. This dataset shows the coastal area and land cover classes at risk from such a storm.

Land Cover Within 3 Meters of Sea Level

- Natural (79%)**
 - > Freshwater wetlands (21%)
 - > Tidal wetlands (52%)
 - > Forest & scrub/shrub (5%)
 - > Beaches (1%)
- Altered (23%)**
 - > Residential, commercial, & industrial development (15%)
 - > Cultivated & other agricultural lands (6%)
 - > Extractive mining & other altered lands (<1%)

1995/97 NJDEP land cover data was updated with CRSSA 2000/99 developed land cover change polygons for this analysis.



Sea-level Rise

Distance to First Man-made Obstruction

This map shows the distance from existing tidal waters to the first man-made structures (buildings and county or larger roads). The map identifies areas where gradual sea-level rise will have the earliest impact, and where retreat zones remain for beach, dune, and salt marsh communities. The analysis is limited to features at elevations of 3 meters or less.

Distance to First Obstruction

- Man-made features within 100 meters of tidal water
- 100 -- 500 meters
- > 500

1995/97 NIDEP land cover data was updated with CRSSA 2000/99 developed land cover change polygons for this analysis; USGS 10 meter GRC DEMs, 0.1 meter vertical resolution.



0 10 Miles
0 10 Kilometers

Universal Transverse Mercator map projection

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Data analysis and map composition completed at CRSSA, 2006 for the American Littoral Society

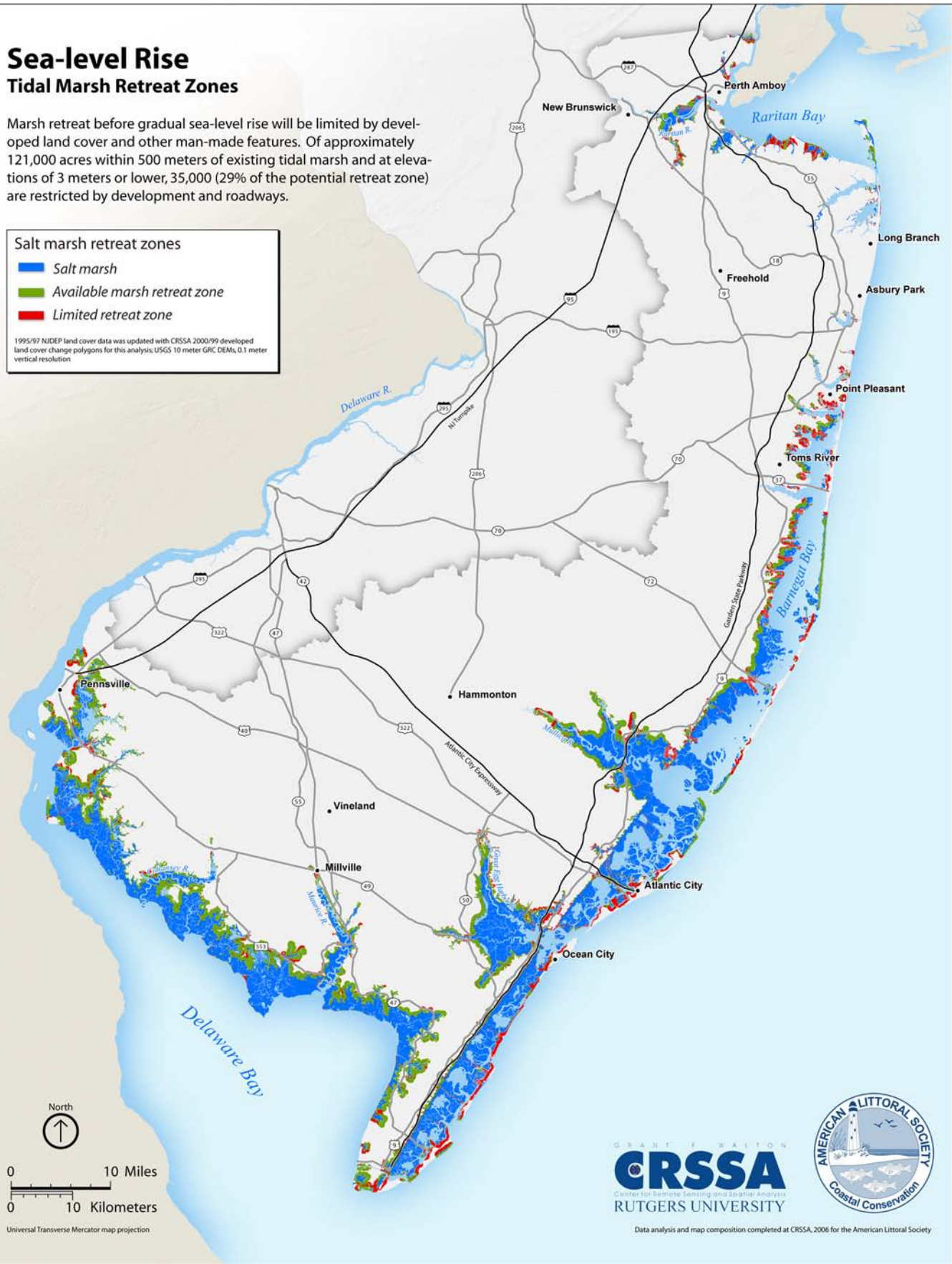
Sea-level Rise Tidal Marsh Retreat Zones

Marsh retreat before gradual sea-level rise will be limited by developed land cover and other man-made features. Of approximately 121,000 acres within 500 meters of existing tidal marsh and at elevations of 3 meters or lower, 35,000 (29% of the potential retreat zone) are restricted by development and roadways.

Salt marsh retreat zones

- Salt marsh
- Available marsh retreat zone
- Limited retreat zone

1995/97 NJDEP land cover data was updated with CRSSA 2000/99 developed land cover change polygons for this analysis. USGS 10 meter GRC DEMs, 0.1 meter vertical resolution



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IV. Watershed Management Area Maps



Monmouth Watershed Management Area (12)

Conservation Targets and Coastal Watersheds Land Cover Analysis



Anadromous Spawning Waters and Colonial Waterbirds Nesting Habitat

- Anadromous migratory impediment: unmodified dam
- Colonial waterbird nesting habitat

Tidal habitat and confirmed spawning extents for anadromous river herring and American shad. Colonial waterbirds include long-legged wading birds, terns, skimmers, and beach nesters.

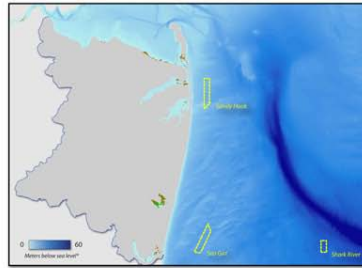
Source: NJDEP Bureau of Freshwater Fisheries, Aquatic Management Data Base (March 2005); NJDEP Endangered and Migratory Species Program Landcover Project Report 10/15, version 2.

Prime Habitat Conservation Areas

NJDEP Landscape Project habitat layers for threatened and endangered wildlife species.

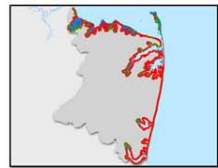
- Beach**
 - State threatened
 - State endangered
 - Federally listed
- Forest**
 - State threatened
 - State endangered
 - Federally listed
- Emergent Wetland**
 - State threatened
 - State endangered
 - Federally listed
- Grassland**
 - State threatened
 - State endangered
 - Federally listed

Source: NJDEP Endangered and Migratory Species Program Landscape Project, version 2.



Tidal and Benthic Conservation Targets
These targets represent tidal and benthic habitats for marine life in the back bays and open ocean.

Source: NJDEP Fish & Wildlife Artificial Reef Program, DNR and tidal features digitized by CRSSA from NJ 2003 bathymetry; NOAA National Oceanographic Service 1-m-resolution bathymetry. Bathymetry grid reported to rectangular coordinates. Features off-shore features may be deeper than maximum indicated.



Altered vs. Natural Land Cover in the Adjacent Coastal Upland Zone

A summary of LU/LC data in a 500-meter upland zone adjacent to tidal waters and tidal wetlands.

- Coastal Disturbance
 - Altered (77%)
 - Natural (23%)
 - Tidal Wetland

Shoreline Type

A summary of water's edge shoreline for tidal waters within WMA 12.

- Shoreline Type
 - Tidal Wetland (44%)
 - Altered (30%)
 - Beaches/Flats (23%)
 - Other Vegetated (3%)

Source: NJDEP 1995/97 LU/LC, 2000/1995 CRSSA update; NOAA Environmental Sensitivity Index, vol. 3.

Natural Heritage Priority Sites

Site Priority Rankings

- B2 - Very high significance
- B3 - High significance
- B4 - Moderate significance
- B5 - Significant
- Protected open space

These sites contain some of the best and most viable occurrences of threatened and endangered species and communities at the state and national levels.

Source: NJDEP Office of Natural Lands Management Natural Heritage digital data.

Groundwater Recharge Areas

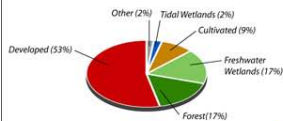
Recharge Rate (in/yr)

- 11 - 15
- 8 - 10
- 1 - 7
- 0
- Not calculated (open water, wetlands, hydro soils, etc.)

NJGS groundwater recharge rate designations calculated from LU/LC, precipitation, and soils data.

Source: NJ Geological Survey groundwater recharge digital datasets.

Monmouth Watershed - Land Cover



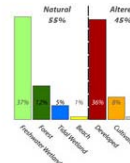
This rendering exaggerates the topography of the watershed area to emphasize elevation-related trends in land cover and land use. NJDEP 1995/97 LU/LC data was overlaid on a USGS 10m digital elevation model to create this effect.

Riparian Zone Characterization

The riparian zone was defined as the cumulative area of various interconnected hydrological elements:

- FEMA and USGS 100-year floodplains;
- NRCS SSURGO hydric soils;
- Contiguous wetlands adjacent to water bodies;
- NRCS SSURGO soils with shallow water-table;
- Proximity to water bodies (buffer).

Riparian Zone Composition



Altered Land Cover by HUC 14 Watersheds

Proportion of the land area in each watershed that falls into an altered LU/LC class - developed, extractive/mining, and agriculture.

- Altered Land Cover
 - < 10%
 - 10 - 30%
 - > 30%

Analysis based on 1995/97 NJDEP LU/LC data, updated with CRSSA 2000/1995 developed land use change data.

Impervious Cover by HUC 14 Watersheds

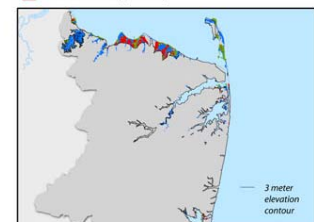
Proportion of the land area in each watershed that is impervious to water infiltration. NJDEP LU/LC updated with CRSSA 2000 developed land use change was used to derive statistics.

- Impervious Cover
 - < 10%
 - 10 - 30%
 - > 30%

Modeling Sea-level Rise: Tidal Marsh Retreat Zones

The map below shows the results of salt marsh retreat zone calculations. The model assumes that marshes will gradually retreat land-wards as sea-level increases. Our model examines marsh retreat within 500 meters of existing tidal wetlands, and places constraints on marsh colonization: marshes will not retreat beyond large roads (county level or greater), into developed areas, or beyond elevations of three meters. Of a total of approximately 4,500 acres of potential retreat area, 2,500 acres (50%) is limited by existing development and roadways segmentation.

- Existing tidal marsh area
- Available marsh retreat zone (2,500 acres)
- Limited retreat zone (2,500 acres)



Source: Elevation required using USGS 10m DEM; for vertical coordinates NJDEP 1995/97 LU/LC, updated with CRSSA 2000/1995 developed land use change data; NAD83 marsh database, 2005.

Modeling Sea-level Rise: Distance to First Obstruction

The map below shows the distance from existing tidal waters to the first man-made structure (buildings and county or larger roads). The map identifies areas where gradual sea-level rise will have the earliest impact, and where retreat zones exist for beach, dune, and salt marsh communities.

- Man-made features within 100 meters of tidal water
- 100 - 500 meters
- Greater than 500 meters





Barnegat Bay Watershed Management Area (13)

Conservation Targets and Coastal Watersheds Land Cover Analysis



Anadromous Spawning Waters and Colonial Waterbirds Nesting Habitat

- Migratory Impediments**
- Fish ladder installed, no confirmed use
 - Unmodified dam
- Colonial waterbird nesting habitat**

Tidal habitat and confirmed spawning extents for anadromous river herring and American shad. Colonial waterbirds include long-legged wading birds, terns, skimmers, and beach nesters.

Source: NJDEP Bureau of Freshwater Fisheries, Anadromous Management Study Plan (March 2005); NJDEP Endangered and Migratory Species Program Land Use Change Project Species (LULC) version 2.



Prime Habitat Conservation Areas

NJDEP Landscape Project habitat layers for threatened and endangered wildlife species.

- Beach**
- State threatened
 - State endangered
 - Federally listed
- Forest**
- State threatened
 - State endangered
 - Federally listed
- Grassland**
- State threatened
 - State endangered
 - Federally listed
- Emergent Wetland**
- State threatened
 - State endangered
 - Federally listed

Source: NJDEP Endangered and Migratory Species Program, Landscape Project (version 2)

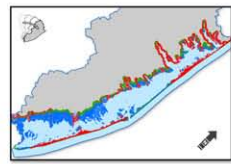


Tidal and Benthic Conservation Targets

These targets represent tidal and benthic habitats for marine life in the back bays and open ocean.

- Submerged aquatic vegetation beds
- Tidal flats and sand bars
- Artificial benthic reefs

Source: NJDEP Fish & Wildlife Artificial Reef Program (A/R) and Tidal Wetlands (published at CRSSA from NJ 2005 correspondence); NOAA National Oceanographic Service, 3 arc second bathymetry; "Bathymetry grid reworked to emphasize near-shore features - all shore features map to deeper than maximum depth indicated."



Altered vs. Natural Land Cover in the Adjacent Coastal Upland Zone

A summary of LULUC data in a 500 meter upland zone adjacent to tidal waters and tidal wetlands.

Coastal Disturbance

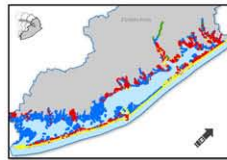
- Altered (64%)
- Natural (36%)
- Tidal Wetland

Shoreline Type

A summary of water's edge shoreline for tidal waters within WMA 13.

- Shoreline Type**
- Tidal Wetland (51%)
 - Altered (40%)
 - Beaches/Flats (7%)
 - Other Vegetated (2%)

Source: NJDEP 1995/01 LULUC, 2000/1998 CRSSA update; NOAA Environmental Sensitivity Index, vol. 3.



Natural Heritage Priority Sites

- Site Priority Rankings**
- B1 - Outstanding significance
 - B2 - Very high significance
 - B3 - High significance
 - B4 - Moderate significance
 - B5 - Significant
- Protected open space

These sites contain some of the best and most viable occurrences of threatened and endangered species and communities at the state and national levels.

Source: NJDEP Office of Natural Lands Management Natural Heritage digital data.



Groundwater Recharge Areas

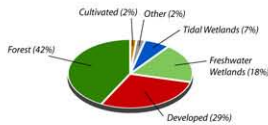
- Recharge Rate (in/yr)**
- 11 - 15
 - 8 - 10
 - 1 - 7
 - 0
 - Not calculated (open water, wetlands, hydric soils, etc.)

NJGS groundwater recharge rate designations calculated from LULUC, precipitation, and soils data.

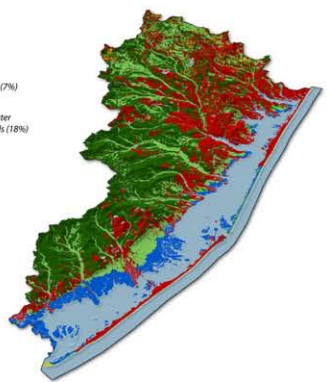
Source: NJ Geological Survey groundwater recharge digital datasets.



Mullica River WMA - Land Cover



This rendering exaggerates the topography of the watershed area to emphasize elevation-related trends in land cover and land use. NJDEP 1995/97 LULUC data was overlaid on a USGS 10m digital elevation model to create this effect.

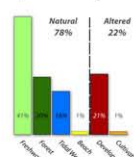


Riparian Zone Characterization

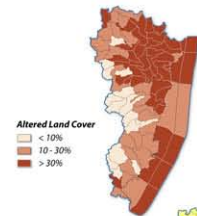
The riparian zone was defined as the cumulative area of various interconnected hydrological elements:

- FEMA and USGS 100-year floodplains;
- NRCS SSURGO hydric soils;
- Contiguous wetlands adjacent to water bodies;
- NRCS SSURGO soils with shallow water-table;
- Proximity to water bodies (buffer).

Riparian Zone Composition



Source: Elevation mapped using USGS 10m DEM; 1m vertical resolution; NJDEP 1995/97 LULUC; Updated with CRSSA 2005/1999 development/land use change data; RDOT road database, 2005.



- Altered Land Cover**
- < 10%
 - 10 - 30%
 - > 30%

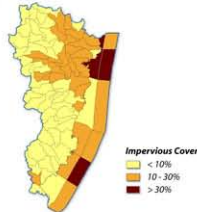
Altered Land Cover by HUC 14 Watersheds

Proportion of the land area in each watershed that falls into an altered LULUC class - developed, extractive/mining, and agriculture.

Analysis based on: NJDEP 1995/97 LULUC data combined with CRSSA 2005/1999 development/land use change data.

Impervious Cover by HUC 14 Watersheds

Proportion of the land area in each watershed that is impervious to water infiltration. NJDEP LULUC updated with CRSSA 19, 2000 developed land use change was used to derive statistics.

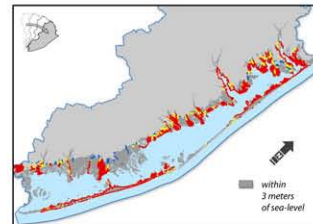
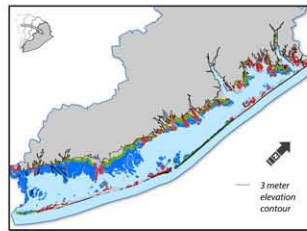


- Impervious Cover**
- < 10%
 - 10 - 30%
 - > 30%

Modeling Sea-level Rise: Tidal Marsh Retreat Zones

The map below shows the results of salt marsh retreat zone calculations. The model assumes that marshes will gradually retreat landward as sea level increases. Our model examines marsh retreat within 500 meters of existing tidal wetlands, and places constraints on marsh colonization: marshes will not retreat beyond large roads (county level or greater), into developed areas, or beyond elevations of three meters. Of a total of approximately 19,400 acres of potential retreat area, 5,000 acres (46%) is limited by existing development and roadway segmentation.

- Existing tidal marsh area
- Available marsh retreat zone (10,400 acres)
- Limited retreat zone (9,000 acres)



Modeling Sea-level Rise: Distance to First Obstruction

The map above shows the distance from existing tidal waters to the first man-made structure (buildings and county or larger roads). The map identifies areas where gradual sea-level rise will have the earliest impact, and where retreat zones exist for beach, dune, and salt marsh communities.

- Man-made features within 100 meters of tidal water
- 100 - 500 meters
- Greater than 500 meters

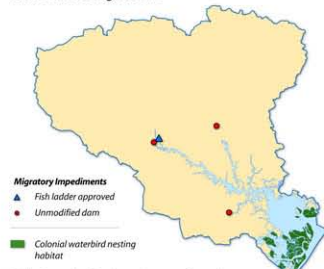


Mullica River Watershed Management Area (14)

Conservation Targets and Coastal Watersheds Land Cover Analysis



Anadromous Spawning Waters and Colonial Waterbirds Nesting Habitat

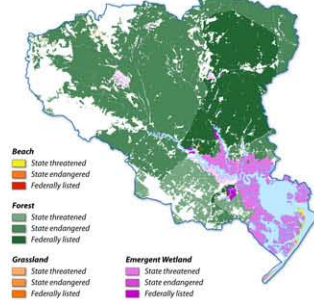


Tidal habitat and confirmed spawning extents for anadromous river herring and American shad. Colonial waterbirds include long-legged wading birds, terns, skimmers, and beach nesters.

Source: NJDEP Bureau of Freshwater Fisheries, Anadromous Management Draft Plan (March 2002); NJDEP Endangered and Nongame Species Program Landscape Project system (L2), version 2.

Prime Habitat Conservation Areas

NJDEP Landscape Project habitat layers for threatened and endangered wildlife species.



Source: NJDEP Endangered and Nongame Species Program Landscape Project, version 2.



Tidal and Benthic Conservation Targets

These targets represent tidal and benthic habitats for marine life in the back bays and open ocean.

- Submerged aquatic vegetation beds
- Tidal flats and sand bars
- Artificial benthic reefs

Source: NJDEP Fish & Wildlife Artificial Reef Program; Salt and Tidal Wetlands digitized as CRSSA from NOAA 2002 bathymetry; NOAA National Oceanographic Service 3 arc second bathymetry.



Altered vs. Natural Land Cover in the Adjacent Coastal Upland Zone

A summary of LU/LC data in a 500 meter upland zone adjacent to tidal waters and tidal wetlands.

- Coastal Disturbance**
- Altered (19%)
 - Natural (81%)
 - Tidal Wetland

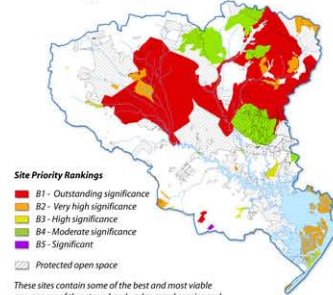
Shoreline Type

A summary of water's edge shoreline for tidal waters within WMA 14.

- Shoreline Type**
- Tidal Wetland (86%)
 - Altered (10%)
 - Beaches/Flats (4%)
 - Other Vegetated (<1%)

Source: NJDEP 1995/97 LU/LC; 2000/1999 CRSSA update; NOAA 6 Environmental Sensitivity Index, ver. 3.

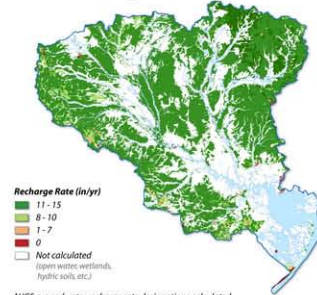
Natural Heritage Priority Sites



These sites contain some of the best and most viable occurrences of threatened and endangered species and communities at the state and national levels.

Source: NJDEP Office of Natural Lands Management National Heritage digital data.

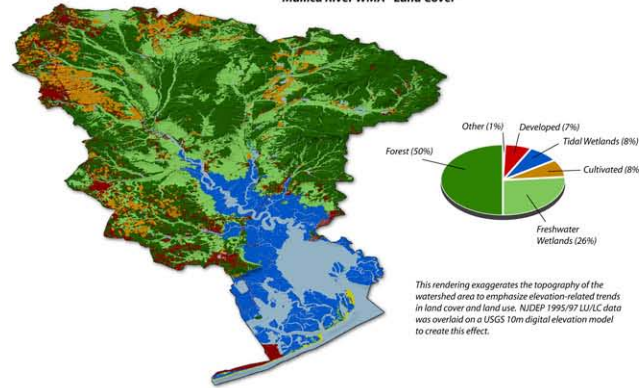
Groundwater Recharge Areas



NJGS groundwater recharge rate designations calculated from LU/LC, precipitation, and soils data.

Source: NJ Geological Survey groundwater recharge digital datasets.

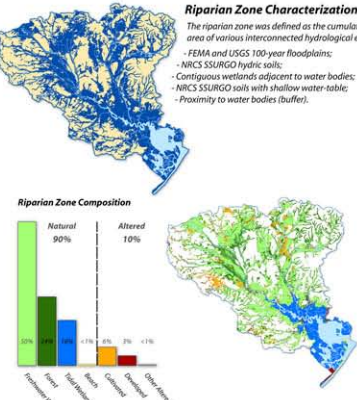
Mullica River WMA - Land Cover



Riparian Zone Characterization

The riparian zone was defined as the cumulative area of various interconnected hydrological elements:

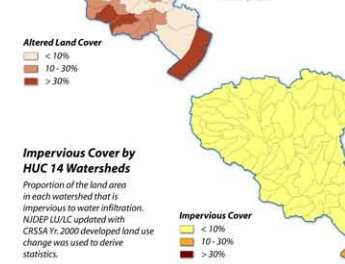
- FEMA and USGS 100-year floodplains;
- NRCS SSURGO hydric soils;
- Contiguous wetlands adjacent to water bodies;
- NRCS SSURGO soils with shallow water-table;
- Proximity to water bodies (buffer).



Altered Land Cover by HUC 14 Watersheds

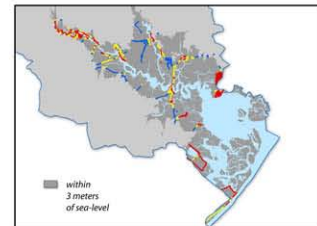
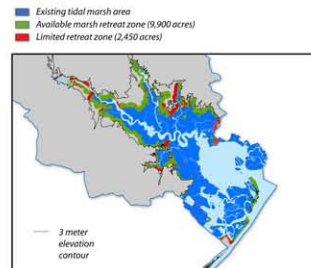
Proportion of the land area in each watershed that falls into an altered LU/LC class - developed, extractive/mining, and agriculture.

Analysis based on 1995/97 NJDEP LU/LC B601, equated with CRSSA 2000/1999 developed land use change data.



Modeling Sea-level Rise: Tidal Marsh Retreat Zones

The map below shows the results of salt marsh retreat zone calculations. The model assumes that marshes will gradually retreat land-wards as sea level increases. Our model examines marsh retreat within 500 meters of existing tidal wetlands, and places constraints on marsh colonization: marshes will not retreat beyond large roads (county level or greater), into developed areas, or beyond elevations of three meters. Of a total of approximately 12,350 acres of potential retreat area, 2,450 acres (20%) is limited by existing development and roadway segmentation.



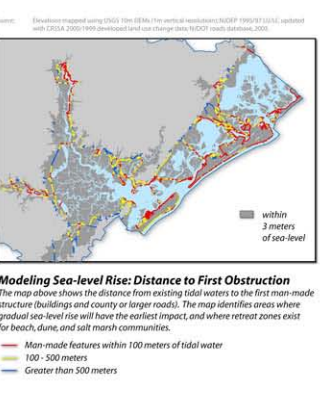
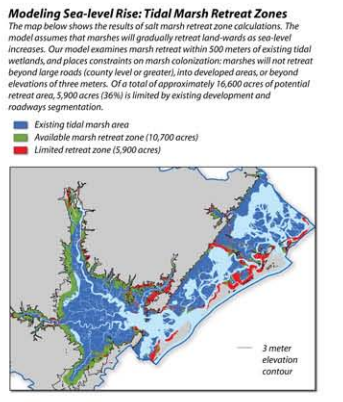
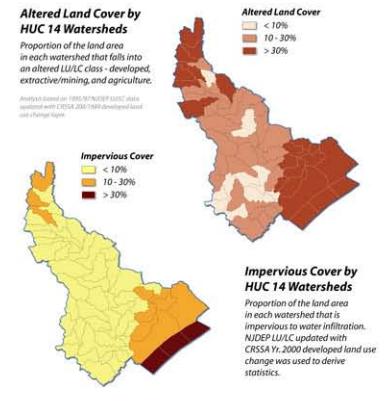
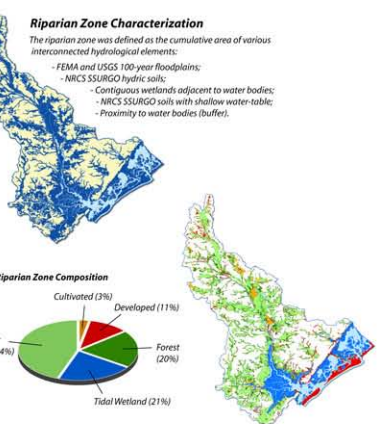
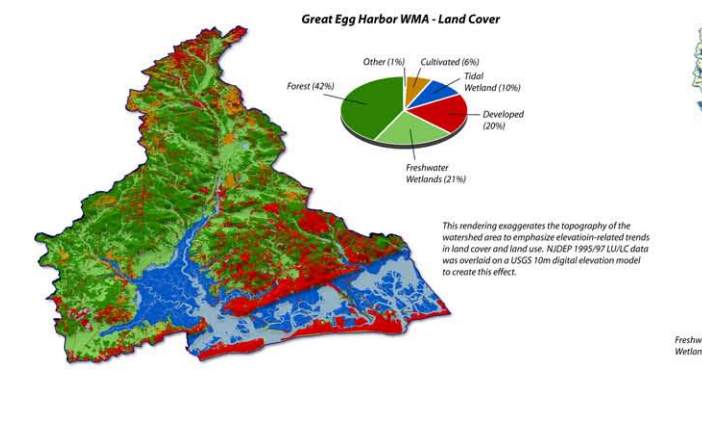
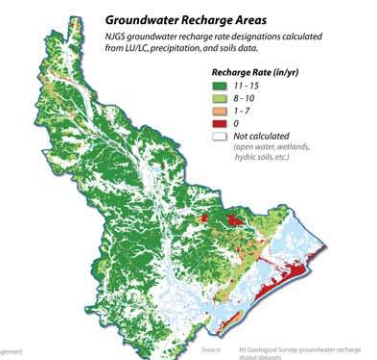
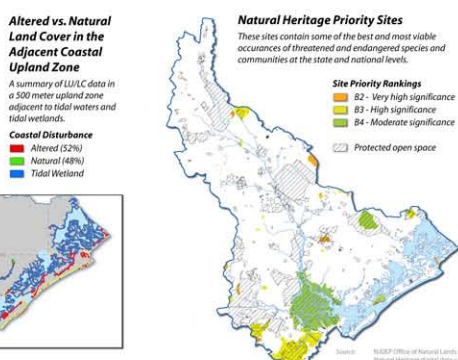
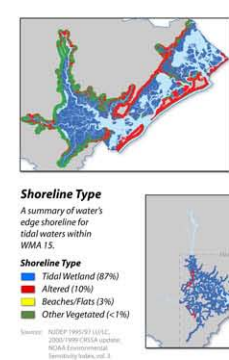
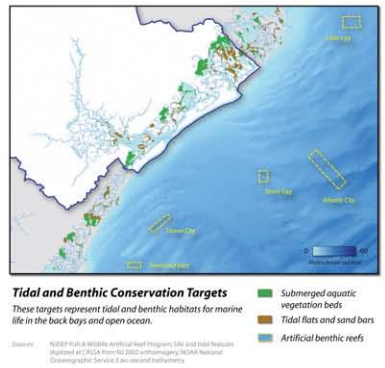
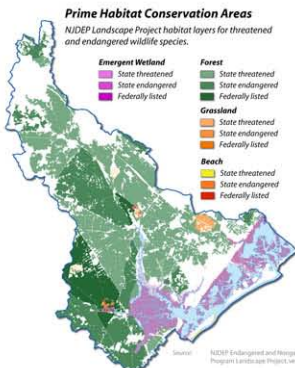
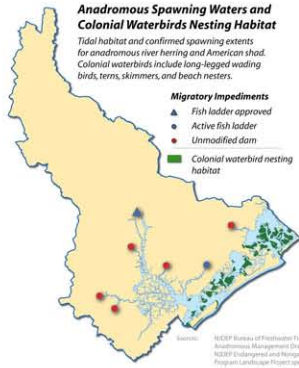
Modeling Sea-level Rise: Distance to First Obstruction

The map above shows the distance from existing tidal waters to the first man-made structure (buildings and county or larger roads). The map identifies areas where gradual sea-level rise will have the earliest impact, and where retreat zones exist for beach, dune, and salt marsh communities.



Great Egg Harbor Watershed Management Area (15)

Conservation Targets and Coastal Watersheds Land Cover Analysis





Cape May Watershed Management Area (16)

Conservation Targets and Coastal Watersheds Land Cover Analysis



Anadromous Spawning Waters and Colonial Waterbirds Nesting Habitat

Tidal habitat and confirmed spawning extents for anadromous river herring and American shad. Colonial waterbirds include long-legged wading birds, terns, skimmers, and beach nesters.

- Anadromous migratory impediment unmodified dam
- Colonial waterbird nesting habitat

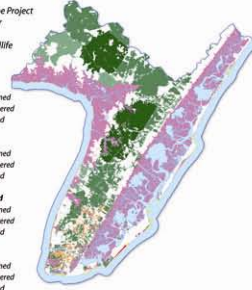


Source: NIDEP Bureau of Freshwater Fisheries, Anadromous Management Draft Plan, March 2005; NIDEP Endangered and Threatened Species Program Landscape Project Update (LULC), version 2.

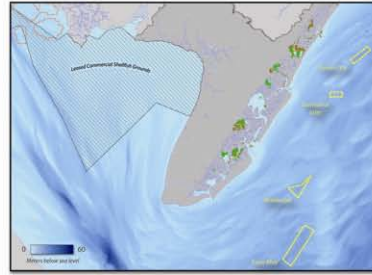
Prime Habitat Conservation Areas

NIDEP Landscape Project habitat layers for threatened and endangered wildlife species.

- Beach**
 - State threatened
 - State endangered
 - Federally listed
- Forest**
 - State threatened
 - State endangered
 - Federally listed
- Emergent Wetland**
 - State threatened
 - State endangered
 - Federally listed
- Grassland**
 - State threatened
 - State endangered
 - Federally listed



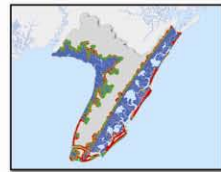
Source: NIDEP Endangered and Threatened Species Program Landscape Project, version 2.



Tidal and Benthic Conservation Targets
These targets represent tidal and benthic habitats for marine life in the back bays and open ocean.

- Submerged aquatic vegetation beds
- Tidal flats and sand bars
- Eastern oyster seed beds
- Artificial benthic reefs

Source: NIDEP Fish & Wildlife Artificial Reef Program; Fish and Shell Fisheries Division of CRSSA from NJ 2002 watersheds; NOAA National Oceanographic Service 3rd second bathymetry; NIDEP Bureau of Freshwater Fisheries.



Altered vs. Natural Land Cover in the Adjacent Coastal Upland Zone

A summary of LULC data in a 500 meter upland zone adjacent to tidal waters and tidal wetlands.

- Coastal Disturbance
 - Altered (99%)
 - Natural (1%)
 - Tidal Wetland

Shoreline Type

A summary of water's edge shoreline for tidal waters within WMA 16.

- Shoreline Type
 - Tidal Wetland (85%)
 - Altered (9%)
 - Beaches/Flats (7%)
 - Other Vegetated (<1%)

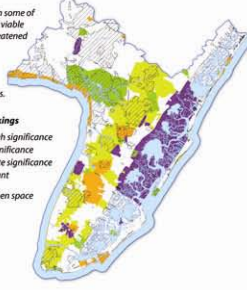
Source: NIDEP 1995/97 LULC; 2000/1998 CRSSA update; NOAA Environmental Sensitivity Index, ver. 3.



Natural Heritage Priority Sites

These sites contain some of the best and most viable occurrences of threatened and endangered species and communities at the state and national levels.

- Site Priority Rankings
 - B2 - Very high significance
 - B3 - High significance
 - B4 - Moderate significance
 - B5 - Significant
 - Protected open space

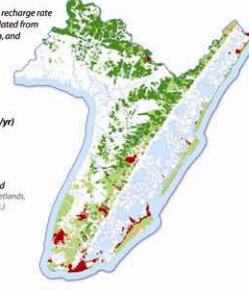


Source: NIDEP Office of Natural Lands Management Natural Heritage original data.

Groundwater Recharge Areas

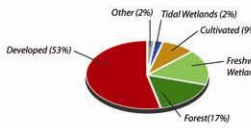
NUGS groundwater recharge rate designations calculated from LULC, precipitation, and soils data.

- Recharge Rate (in/yr)
 - 11 - 15
 - 8 - 10
 - 1 - 7
 - 0
 - Not calculated (open water, wetlands, hydric soils, etc.)

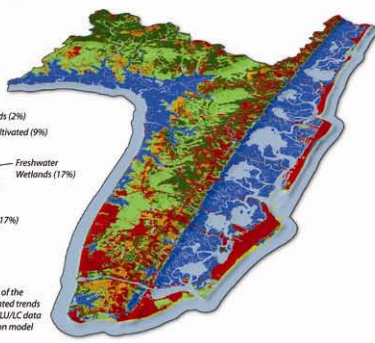


Source: NJ Department of Environmental Protection, NUGS digital datasets.

Monmouth Watershed - Land Cover



This rendering exaggerates the topography of the watershed area to emphasize elevation-related trends in land cover and land use. NIDEP 1995/97 LULC data was overlaid on a USGS 10m digital elevation model to create this effect.

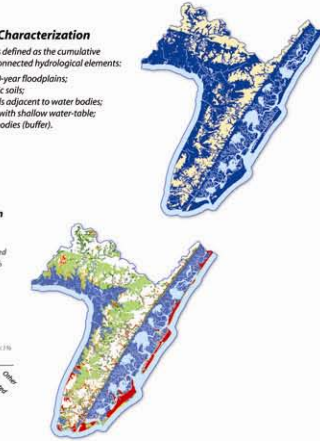
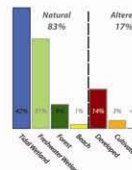


Riparian Zone Characterization

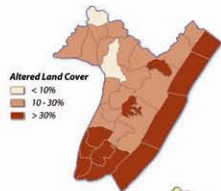
The riparian zone was defined as the cumulative area of various interconnected hydrological elements:

- FEMA and USGS 100-year floodplains;
- MRC SSURGO hydric soils;
- Contiguous wetlands adjacent to water bodies;
- MRC SSURGO soils with shallow water-table;
- Proximity to water bodies (buffer).

Riparian Zone Composition



Source: Watershed mapped using USGS 10m DEMs; FEMA 100-year floodplains; NIDEP 1995/97 LULC; overlaid with CRSSA 2000/1998 developed land use change data; NIDEP 2000/1998 LULC.



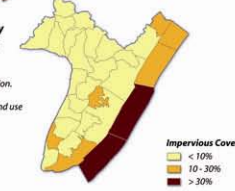
Altered Land Cover by HUC 14 Watersheds

Proportion of the land area in each watershed that falls into an altered LULC class - developed, extractive/mining, and agriculture.

- Altered Land Cover
 - < 10%
 - 10 - 30%
 - > 30%

Impervious Cover by HUC 14 Watersheds

Proportion of the land area in each watershed that is impervious to water infiltration. NIDEP LULC updated with CRSSA Yr. 2000 developed land use change was used to derive statistics.

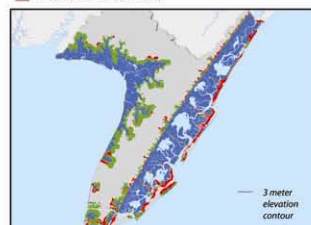


- Impervious Cover
 - < 10%
 - 10 - 30%
 - > 30%

Modeling Sea-level Rise: Tidal Marsh Retreat Zones

The map below shows the results of salt marsh retreat zone calculations. The model assumes that marshes will gradually retreat land-wards as sea-level increases. Our model examines marsh retreat within 500 meters of existing tidal wetlands, and places constraints on marsh colonization: marshes will not retreat beyond large roads (county level or greater), into developed areas, or beyond elevations of three meters. Of a total of approximately 24,600 acres of potential retreat area, 8,000 acres (33%) is limited by existing development and roadways segmentation.

- Existing tidal marsh area
- Available marsh retreat zone (16,600 acres)
- Limited retreat zone (8,000 acres)



Modeling Sea-level Rise: Distance to First Obstruction

The map above shows the distance from existing tidal waters to the first man-made structure (buildings and county or larger roads). The map identifies areas where gradual sea-level rise will have the earliest impact, and where retreat zones exist for beach, dune, and salt marsh communities.

- Man-made features within 100 meters of tidal water
- 100 - 500 meters
- Greater than 500 meters



Maurice, Salem, and Cohansey Rivers Watershed Management Area (17)

Conservation Targets and Coastal Watersheds Land Cover Analysis



Anadromous Spawning Waters and Colonial Waterbirds Nesting Habitat

Tidal habitat and confirmed spawning extents for anadromous river herring and American shad. Colonial waterbirds. Include long-legged wading birds, terns, skimmers, and beach nesters.

Migratory Impediments
 ● Active fish ladder
 ● Unmodified dam

■ Colonial waterbird nesting habitat

Source: NIDEP Bureau of Freshwater Fisheries, Anadromous Management Draft Plan, March 2005; NIDEP Endangered and Management Species Program Landscape Project Update (LULC), version 2.

Prime Habitat Conservation Areas

NIDEP Landscape Project habitat layers for threatened and endangered wildlife species.

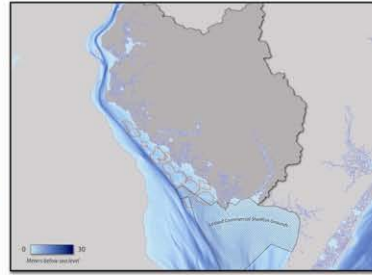
Forest
 ■ State threatened
 ■ State endangered
 ■ Federally listed

Emergent Wetland
 ■ State threatened
 ■ State endangered
 ■ Federally listed

Grassland
 ■ State threatened
 ■ State endangered
 ■ Federally listed

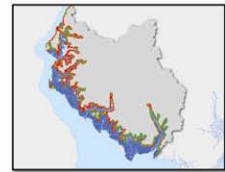
Beach
 ■ State threatened
 ■ State endangered
 ■ Federally listed

Source: NIDEP Endangered and Management Species Program Landscape Project, version 2.



Tidal and Benthic Conservation Targets
 These targets represent tidal and benthic habitats for marine life in the back bays and open ocean.

Source: NIDEP Fish & Wildlife Artificial Reef Program, Fish and Tidal Habitats Distributed at CRSSA from NJ 2002 watershed map; NOAA National Oceanographic Service 3rd second bathymetry; NIDEP Bureau of Freshwater Fisheries.



Altered vs. Natural Land Cover in the Adjacent Coastal Upland Zone

A summary of LULC data in a 500 meter upland zone adjacent to tidal waters and tidal wetlands.

Coastal Disturbance
 ■ Altered (56%)
 ■ Natural (44%)
 ■ Tidal Wetland

Shoreline Type

A summary of water's edge shoreline for tidal waters within WMA 17.

Shoreline Type
 ■ Tidal Wetland (90%)
 ■ Altered (4%)
 ■ Beaches/Flats (3%)
 ■ Other Vegetated (3%)

Source: NIDEP 1995/97 LULC; 2000/1998 CRSSA update; NOAA Environmental Sensitivity Index, ver. 3.

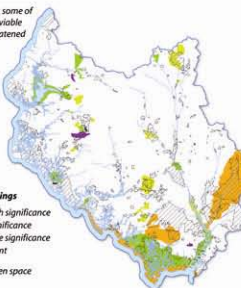


Natural Heritage Priority Sites

These sites contain some of the best and most viable occurrences of threatened and endangered species and communities at the state and national levels.

Site Priority Rankings
 ■ B2 - Very high significance
 ■ B3 - High significance
 ■ B4 - Moderate significance
 ■ B5 - Significant
 □ Protected open space

Source: NIDEP Office of Natural Lands Management National Heritage digital data.

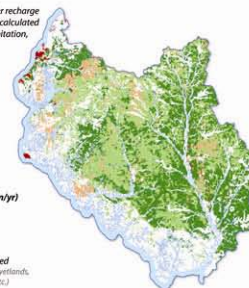


Groundwater Recharge Areas

NIGS groundwater recharge rate designations calculated from LULC, precipitation, and soils data.

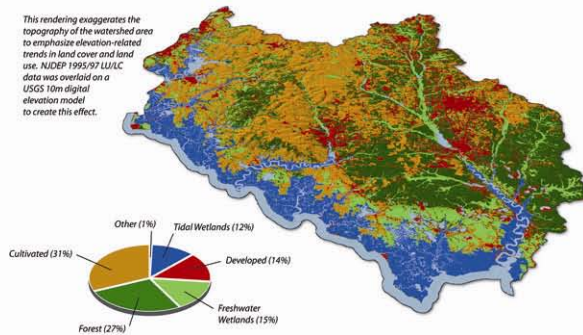
Recharge Rate (in/yr)
 ■ 11 - 15
 ■ 8 - 10
 ■ 1 - 7
 ■ 0
 □ Not calculated (open water, wetlands, aquatic soils, etc.)

Source: NJ Geological Survey groundwater recharge digital database.



Maurice, Salem, and Cohansey Rivers Watershed - Land Cover

This rendering exaggerates the topography of the watershed area to emphasize elevation-related trends in land cover and land use. NIDEP 1995/97 LULC data was overlaid on a USGS 10m digital elevation model to create this effect.



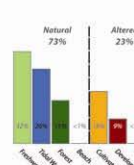
Land Cover Legend:
 Forest (27%)
 Cultivated (31%)
 Tidal Wetlands (12%)
 Developed (14%)
 Freshwater Wetlands (15%)
 Other (1%)

Riparian Zone Characterization

The riparian zone was defined as the cumulative area of various interconnected hydrological elements:
 - FEMA and USGS 100-year floodplains;
 - NRCS SSURGO hydric soils;
 - Contiguous wetlands adjacent to water bodies;
 - NRCS SSURGO soils with shallow water-table;
 - Proximity to water bodies (buffer).



Riparian Zone Composition

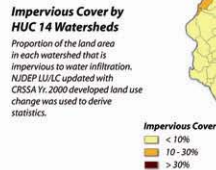


Altered Land Cover by HUC 14 Watersheds

Proportion of the land area in each watershed that falls into an altered LULC class - developed, extractive/mining, and agriculture.

Altered Land Cover
 ■ < 10%
 ■ 10 - 30%
 ■ > 30%

Analysis based on 1995/97 NIDEP LULC data updated with 2000/1998 CRSSA developed land use change data.



Impervious Cover by HUC 14 Watersheds

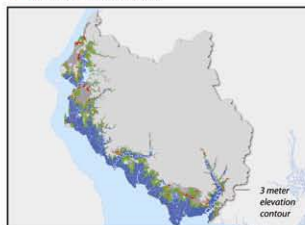
Proportion of the land area in each watershed that is impervious to water infiltration. NIDEP LULC updated with CRSSA Yr. 2000 developed land use change was used to derive statistics.

Impervious Cover
 ■ < 10%
 ■ 10 - 30%
 ■ > 30%

Modeling Sea-level Rise: Tidal Marsh Retreat Zones

The map below shows the results of salt marsh retreat zone calculations. The model assumes that marshes will gradually retreat landward as sea level increases. Our model examines marsh retreat within 500 meters of existing tidal wetlands, and places constraints on marsh colonization: marshes will not retreat beyond large roads (county level or greater), into developed areas, or beyond elevations of three meters. Of a total of approximately 40,000 acres of potential retreat area, 6,000 acres (15%) is limited by existing development and roadways segmentation.

■ Existing tidal marsh area
 ■ Available marsh retreat zone (34,000 acres)
 ■ Limited retreat zone (6,000 acres)



Modeling Sea-level Rise: Distance to First Obstruction

The map above shows the distance from existing tidal waters to the first man-made structure (buildings and county or larger roads). The map identifies areas where gradual sea-level rise will have the earliest impact, and where retreat zones exist for beach, dune, and salt marsh communities.

■ Man-made features within 100 meters of tidal water
 ■ 100 - 500 meters
 ■ Greater than 500 meters

V. GIS Data Sources

Center for Remote Sensing & Spatial analysis (CRSSA). 2004. New Jersey land use/land cover update: 2000-2001. Last accessed March, 2006.

(http://crssa.rutgers.edu/projects/lc/download/reportsdata00_01/index.html).

National Oceanic and Atmospheric Administration (NOAA): National Ocean Service (NOS). 2002. Rhode Island, Connecticut, New York, and New Jersey Environmental Sensitivity Index Shoreline Types. NOAA: NOS, Office of Response and Restoration, Hazardous Materials Response Division, Seattle, Washington. Vector GIS data for northern New Jersey.

National Oceanic and Atmospheric Administration (NOAA): National Ocean Service (NOS). 2000. Delaware, New Jersey, and Pennsylvania Environmental Sensitivity Index Shoreline Types. NOAA: NOS, Office of Response and Restoration, Hazardous Materials Response Division, Seattle, Washington. Vector GIS data for southern New Jersey.

New Jersey Department of Environmental Protection: Bureau of Geographic Information and Analysis (BGIA). 2000. NJDEP 1995/97 Land use/Land cover Update. Vector GIS data for Watershed Management Areas 7, 9, 12, 13, 14, 15, 16, and 17. Last accessed March, 2006. <http://www.nj.gov/dep/gis/>

New Jersey Department of Transportation: Bureau of Transportation Data Development (BTDD). 2005. NJDOT Statewide Public Road Network (1:24,000). NJDOT, Trenton, NJ. Vector GIS data for New Jersey.

U.S. Geological Survey. Various dates. USGS 10-meter resolution 7.5-minute Digital Elevation Model data. USGS EROS Data Center, Sioux Falls, SD. Raster GIS data for New Jersey.

VI. Acknowledgements

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