Overview of Resource Management Challenges in Barnegat Bay and Related Hydrologic Issues

Soil Health Conference
Burlington County College
Mount Laurel, New Jersey
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USGS

Barnegat Bay

An ecological treasure

A foundation of New Jersey's coastal economy

Threatened by a variety of human activities

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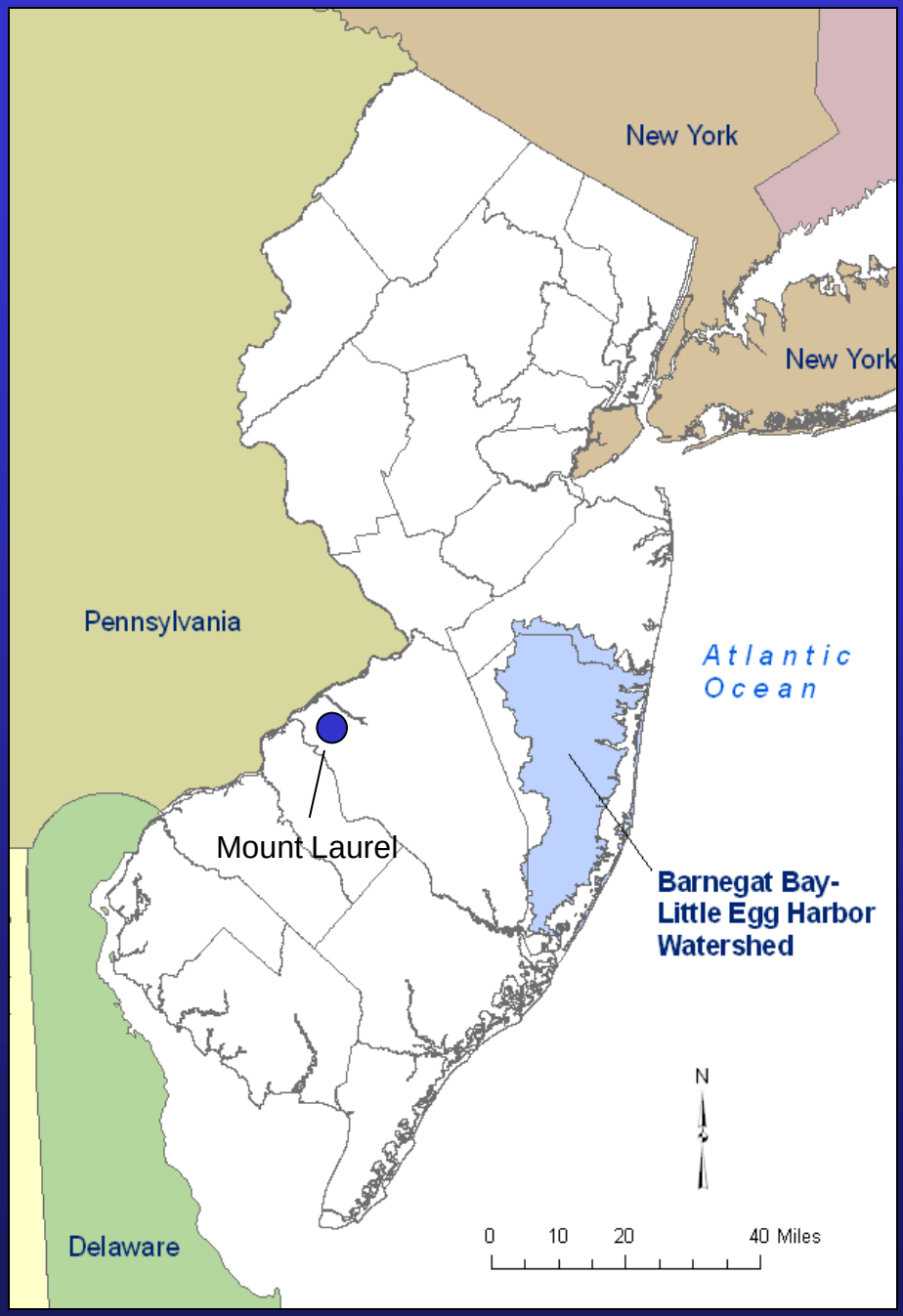
Barnegat Bay-Little Egg Harbor Estuary

- Shallow (3 - 20 feet deep)
- Poorly flushed
  (rate = 1-2 months)
- Impacted by nutrient enrichment
- Highly eutrophic
  (NOAA, 2007)



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Barnegat Bay-Little Egg Harbor Resource Management Challenges

- Pressure from increasing human activity
- Excessive nutrient inputs
- Harmful algal blooms
- Declines in seagrass beds, fisheries
- Low DO in northern part of bay

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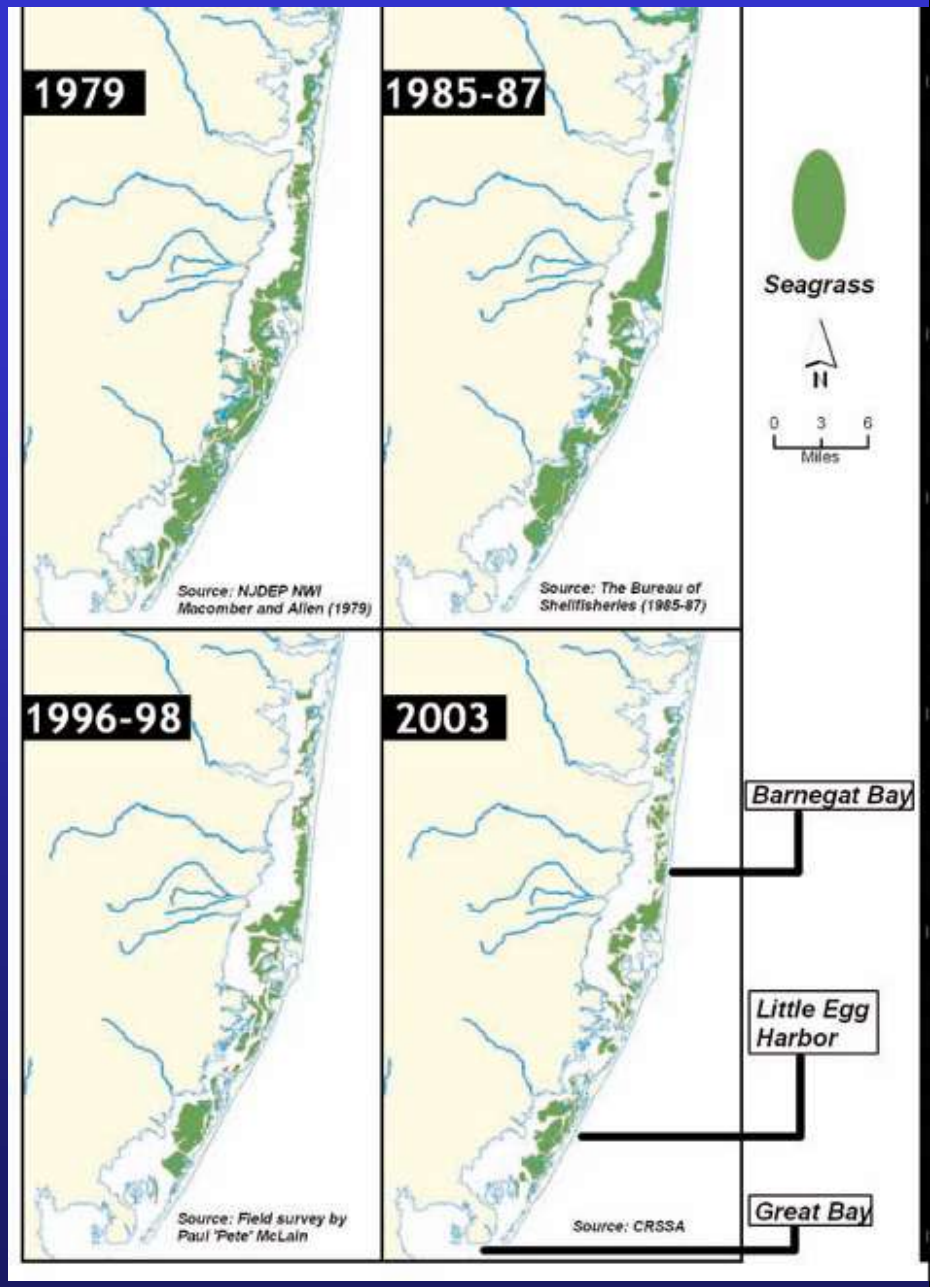
DECLINE IN SUBMERGED AQUATIC VEGETATION

SAV surveys showed evidence of a decline in the seagrass extent between the late 1970's and the mid-1990's

Result is the reduction of essential fish habitat and the potential loss of commercially and recreationally important species.



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Rutgers/CRSSA 2005

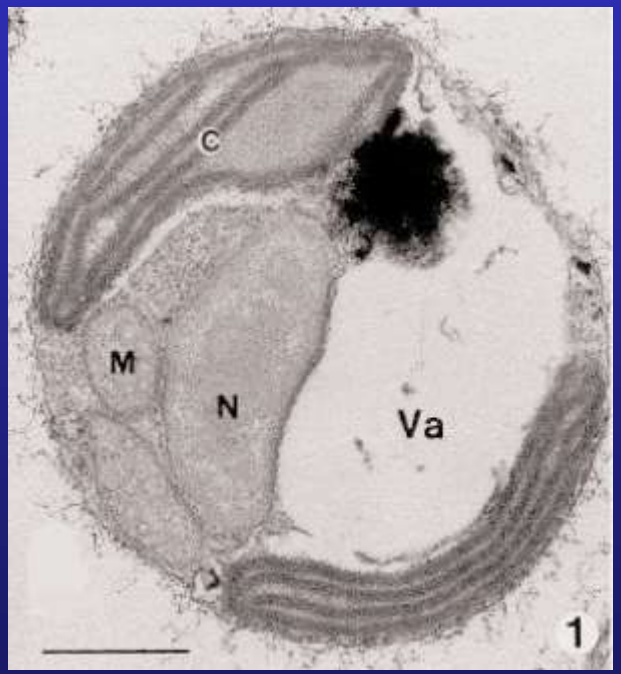
Brown Tide in Barnegat Bay

Brown Tide Occurrence

Suspected 1985-86
1995
1997
1999
2000
2002
??

Brown Tide organism is a minute alga

- Not harmful to humans
- Negatively impacts shellfish and SAV
- Favors high salinity waters
- Utilizes organic forms of nitrogen



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NJDEP, 2006

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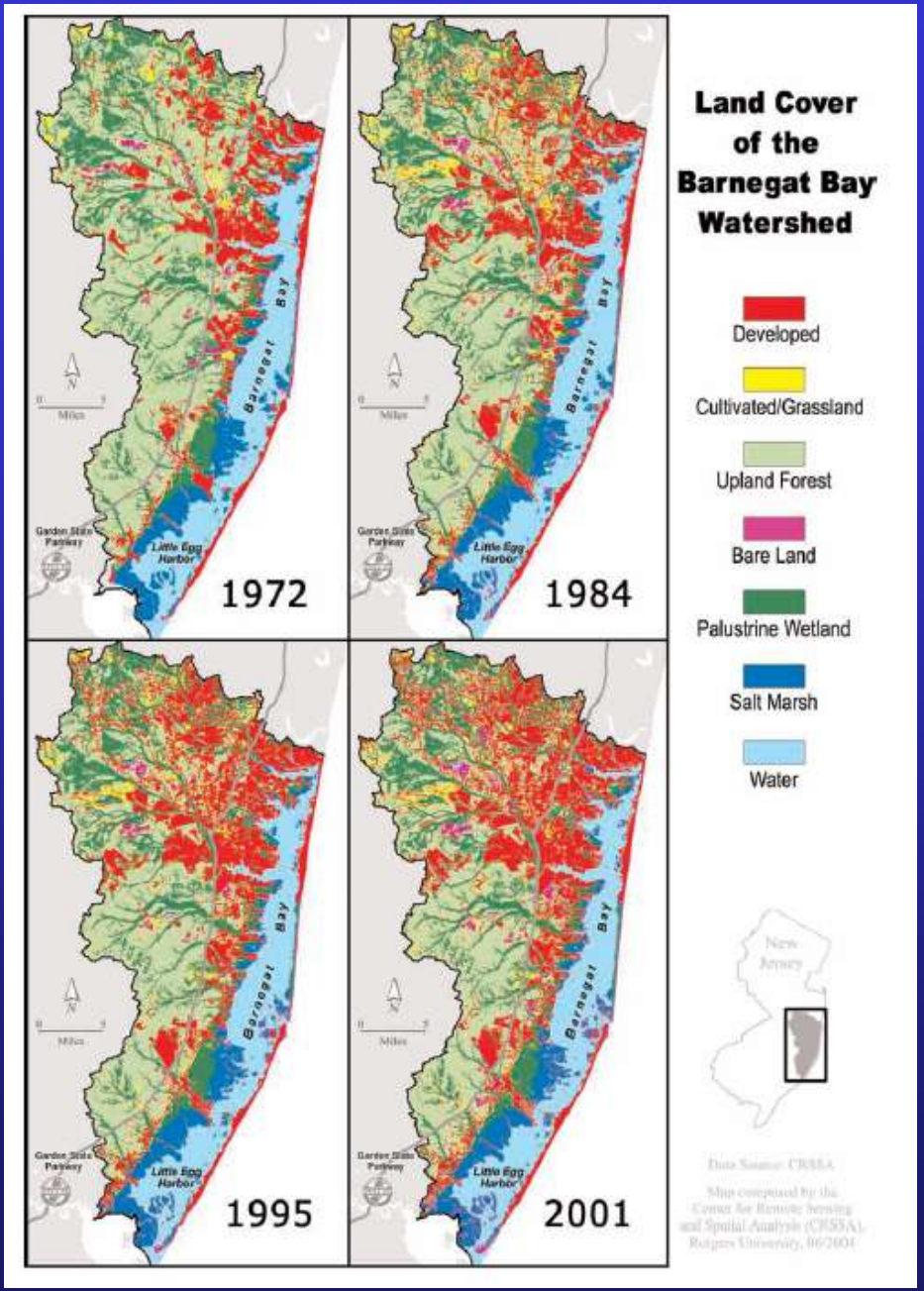
The Barnegat Bay watershed has experienced rapid changes in population and land cover during the past 30 years



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Rutgers/CRSSA 2005


1930s
USGS


1995
USGS

Freshwater Inputs

Annual freshwater flow to Barnegat Bay totals about 590 million gallons per day

During drought conditions, this flow is about 1/3 to1/2 of the average flow:

- flushing time is longer
- salinity is higher
- probably more susceptible to impacts from nutrient loading

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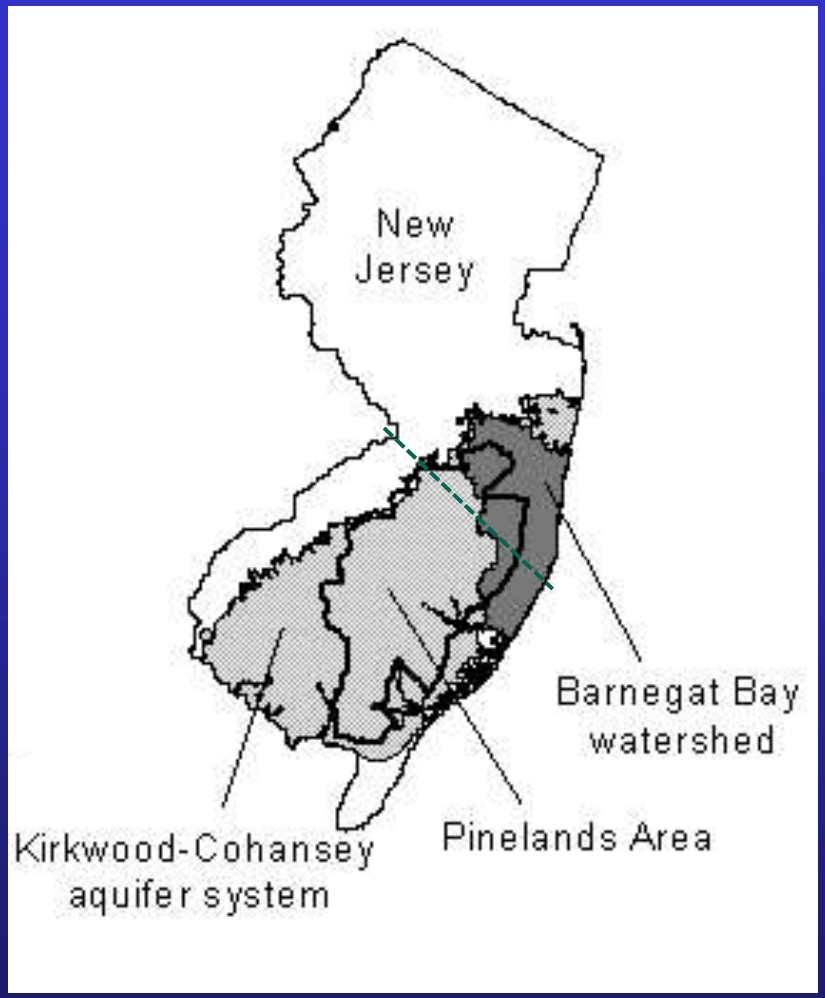
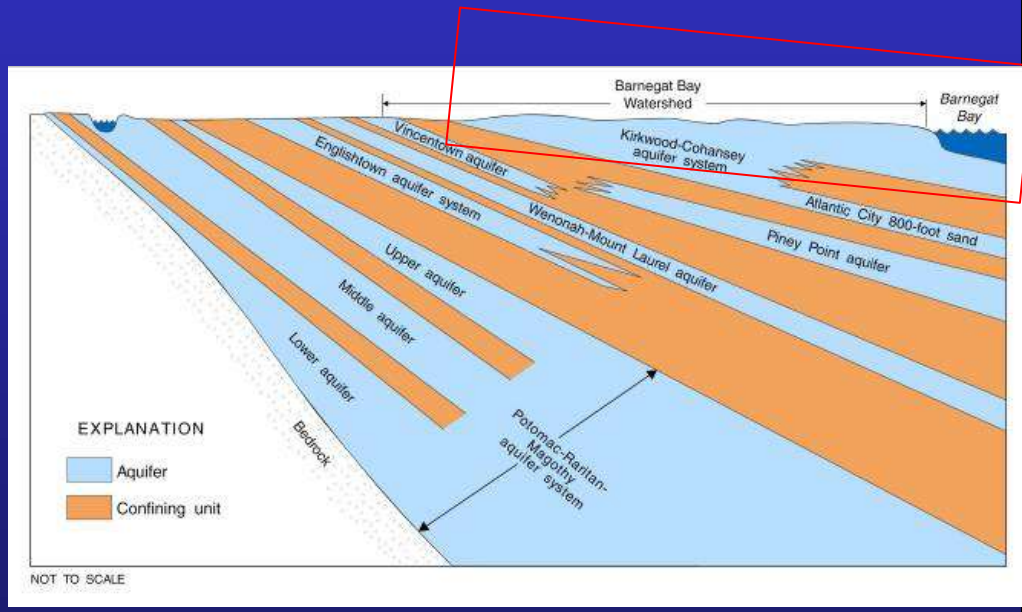
THE BARNEGAT BAY WATERSHED



Underlain by the highly permeable Kirkwood-Cohansey aquifer system



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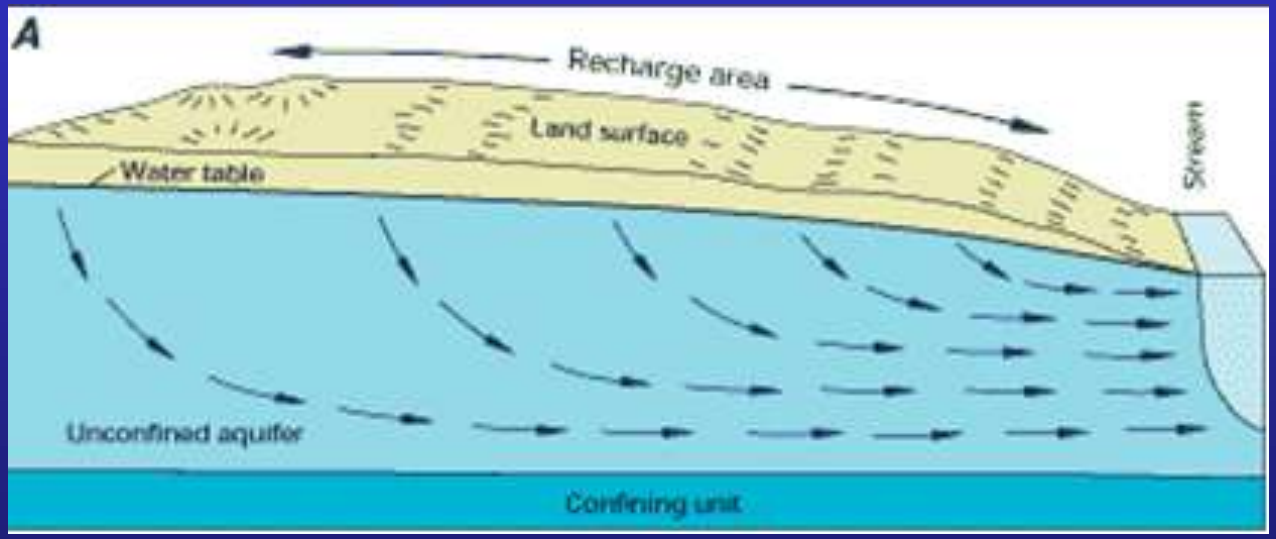
GROUNDWATER FLOW TO STREAMS



In southern New Jersey, 80% of streamflow is baseflow (comes from groundwater discharge)

Baseflow sustains flow during dry periods

Nearly all baseflow originates as aquifer recharge

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Undisturbed upland soils in the Barnegat Bay watershed:

- Highly permeable
- Virtually no runoff
- High infiltration rates
- Conduct high rates of aquifer recharge

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Soil disturbance during construction

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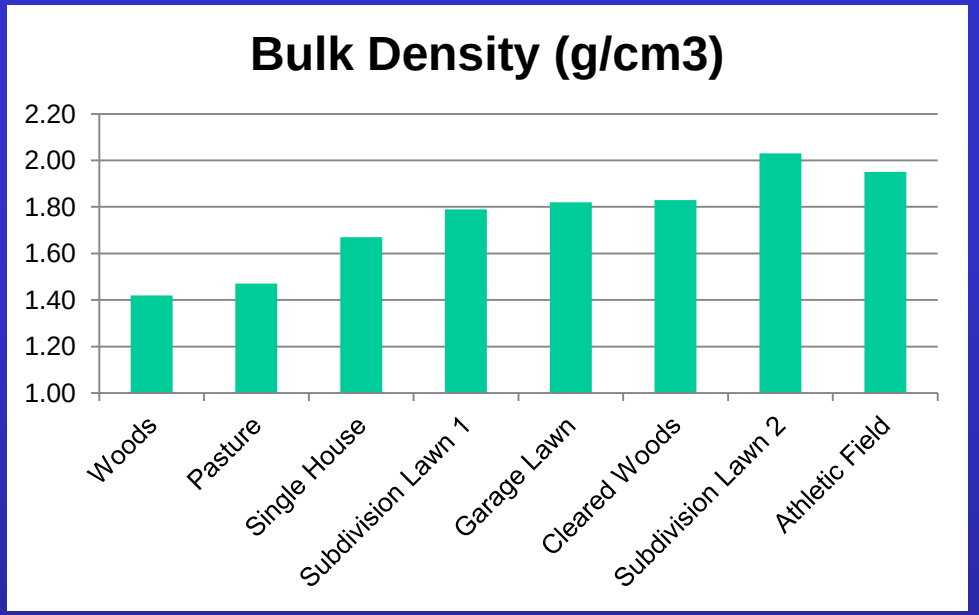
Investigation of the impact of soil disturbance during construction on bulk density and infiltration in Ocean County

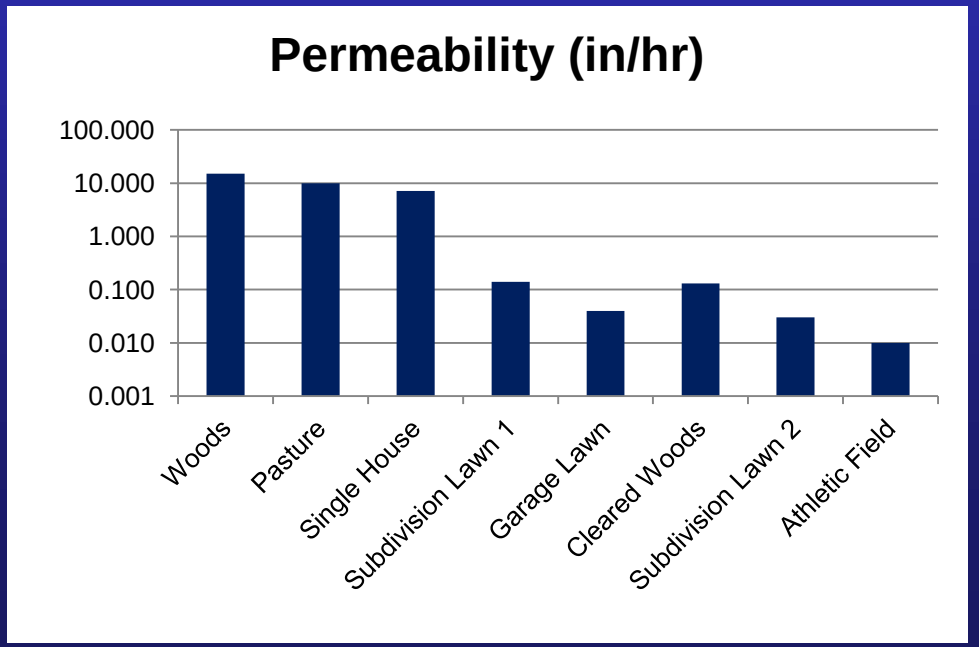
- Eight sites in Ocean County
- Bulk density and infiltration tests

Ocean County Soil Conservation District
Schnabel Engineering Associates, Inc.
USDA Natural Resources Conservation Service

March 2001

The study demonstrated higher bulk densities and lower permeabilities at sites where soils had been disturbed during construction





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Stormwater basins…

If not properly constructed can malfunction

Resulting in less infiltration of stormwater, less aquifer recharge, and less stream baseflow…

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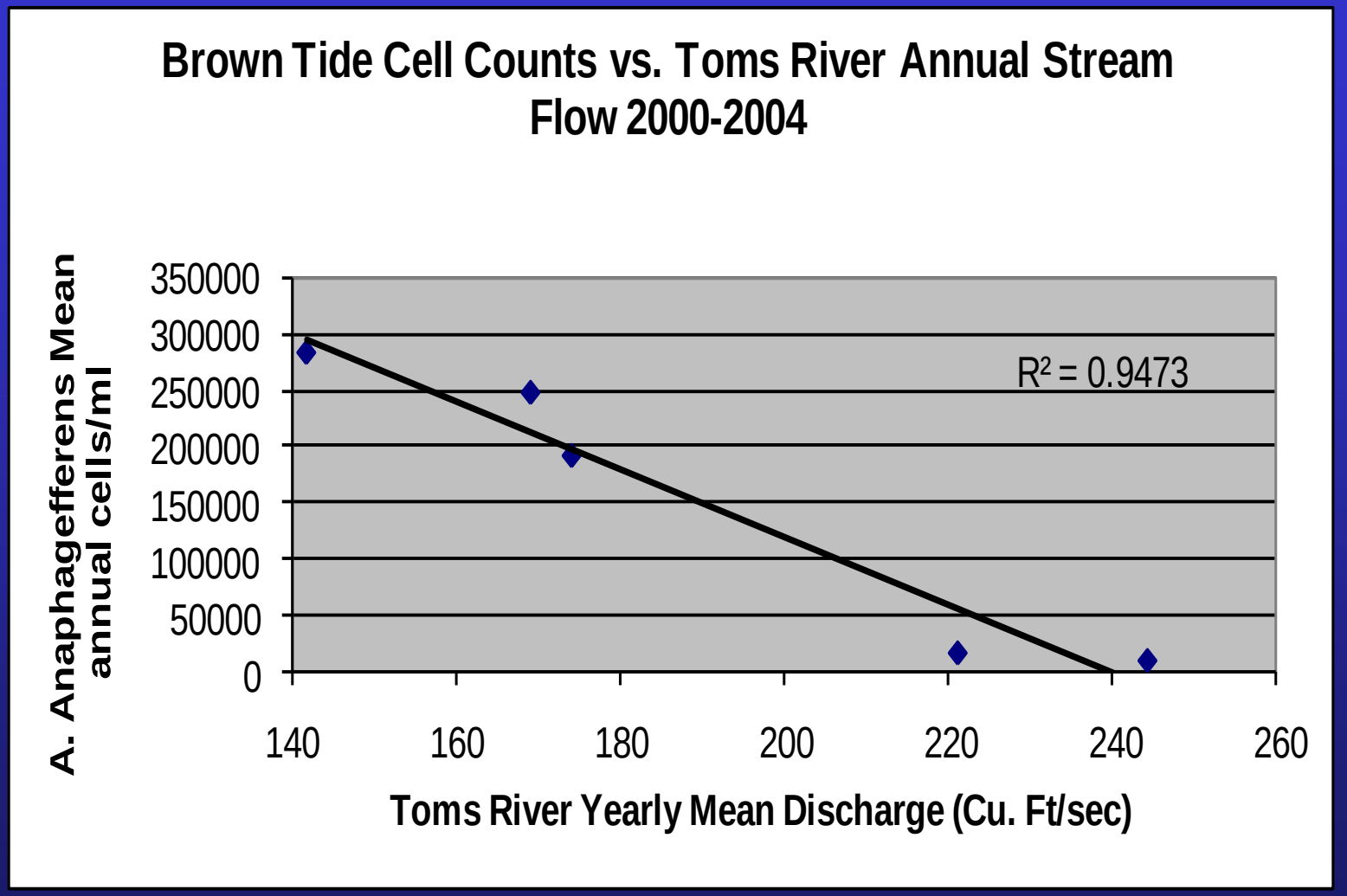

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NJDEP, 2010

Nitrogen

Importance -- Biological productivity in coastal waters is normally limited by the availability of nitrogen, with Secondary P limitation (demonstrated in Barnegat Bay by Seitzinger, et al, 2001)

Common forms

- Organic nitrogen
- Inorganic forms: NO_3^-, NO_2^-, NH_3, NH_4^+

Common sources

- Residential and commercial areas
  - Lawn fertilizer, septic system waste, leaky sewer pipes, industrial discharge
- Agricultural areas
  - Crop fertilizer, animal manure, septic system waste
- Atmosphere
  - Automobile emissions, industrial emissions, natural N-fixation processes, emissions from agricultural sources

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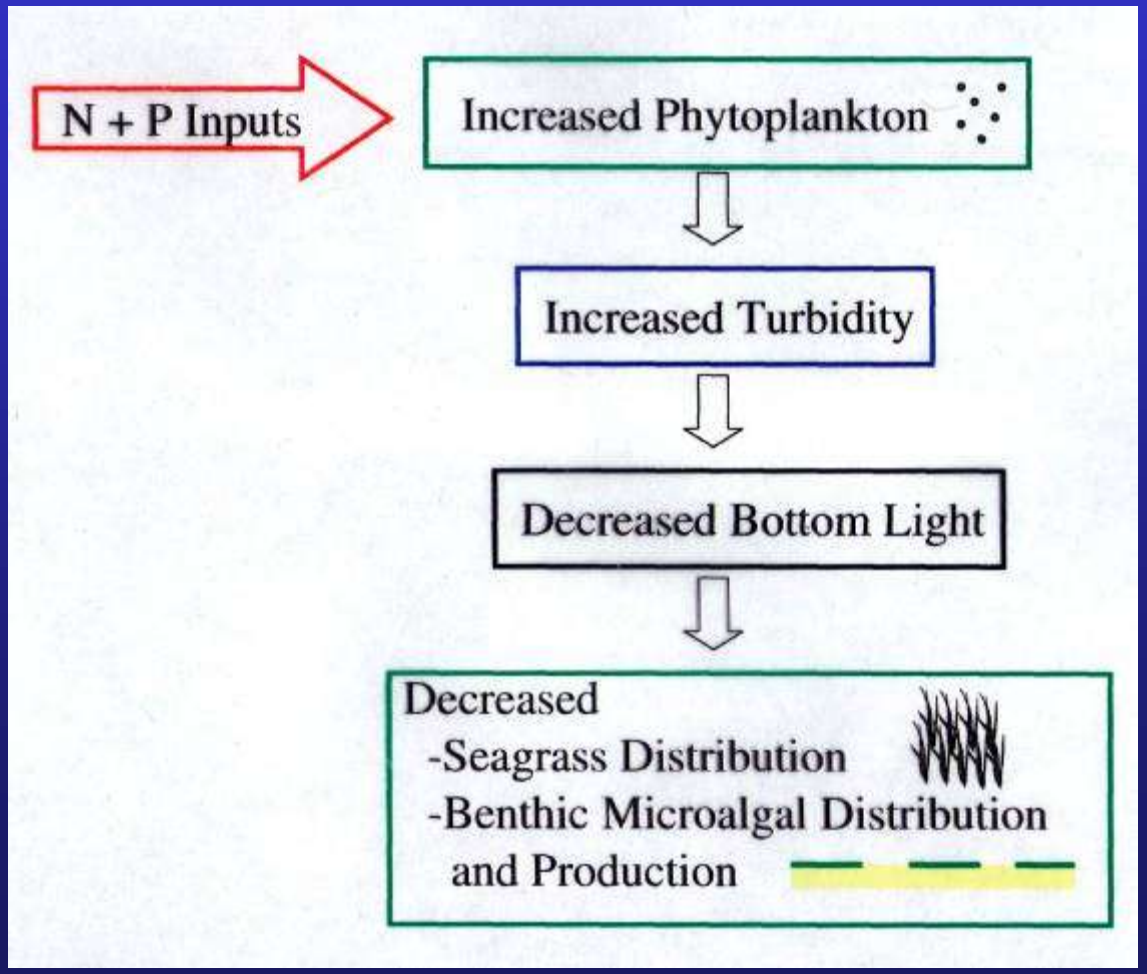
EFFECTS OF INCREASED NUTRIENT LOAD



NUTRIENT DELIVERY

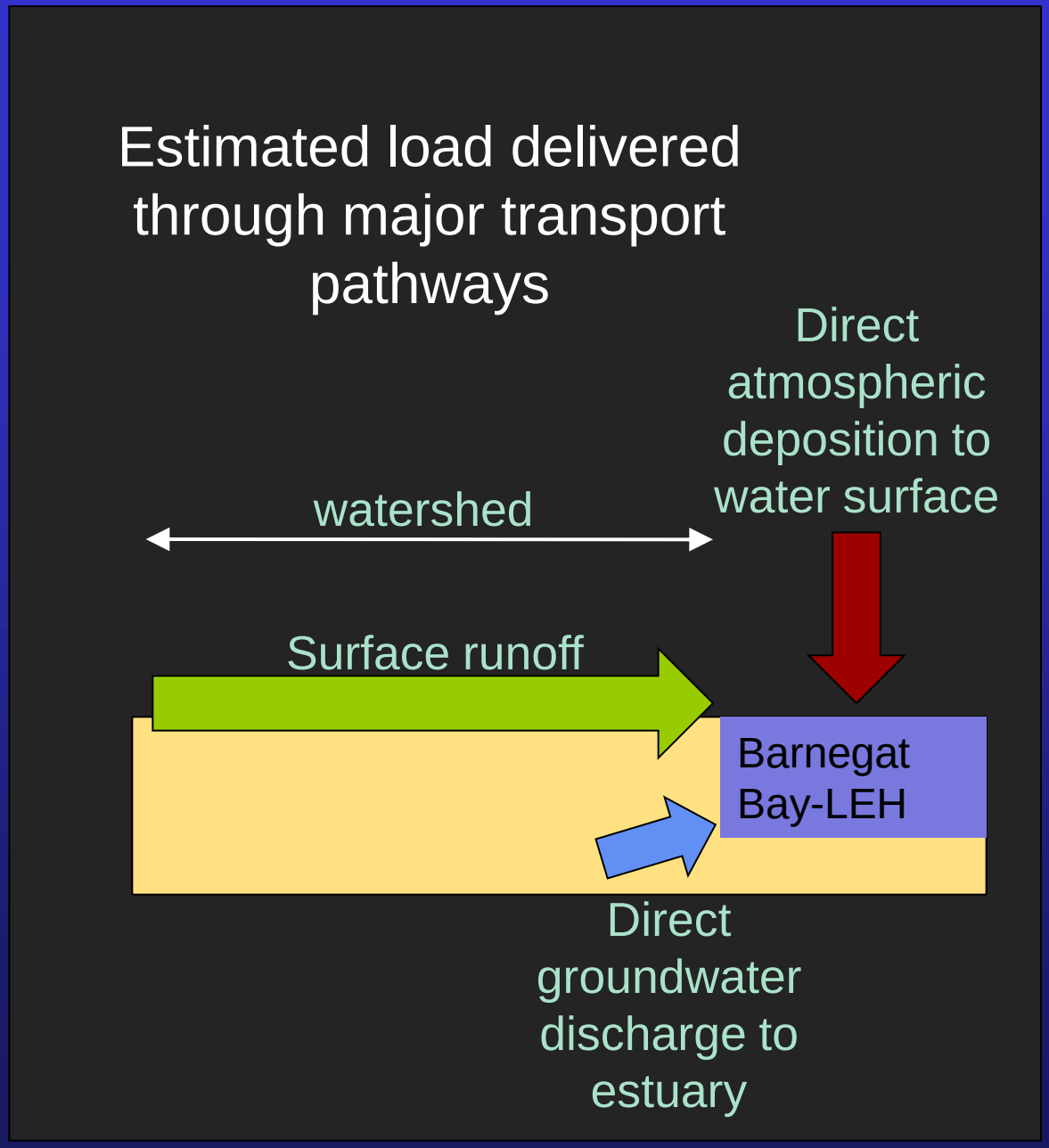
Nitrogen Load Assessment Update-2009

C. Wieben
R. Baker

Barnegat Bay National Estuary Program

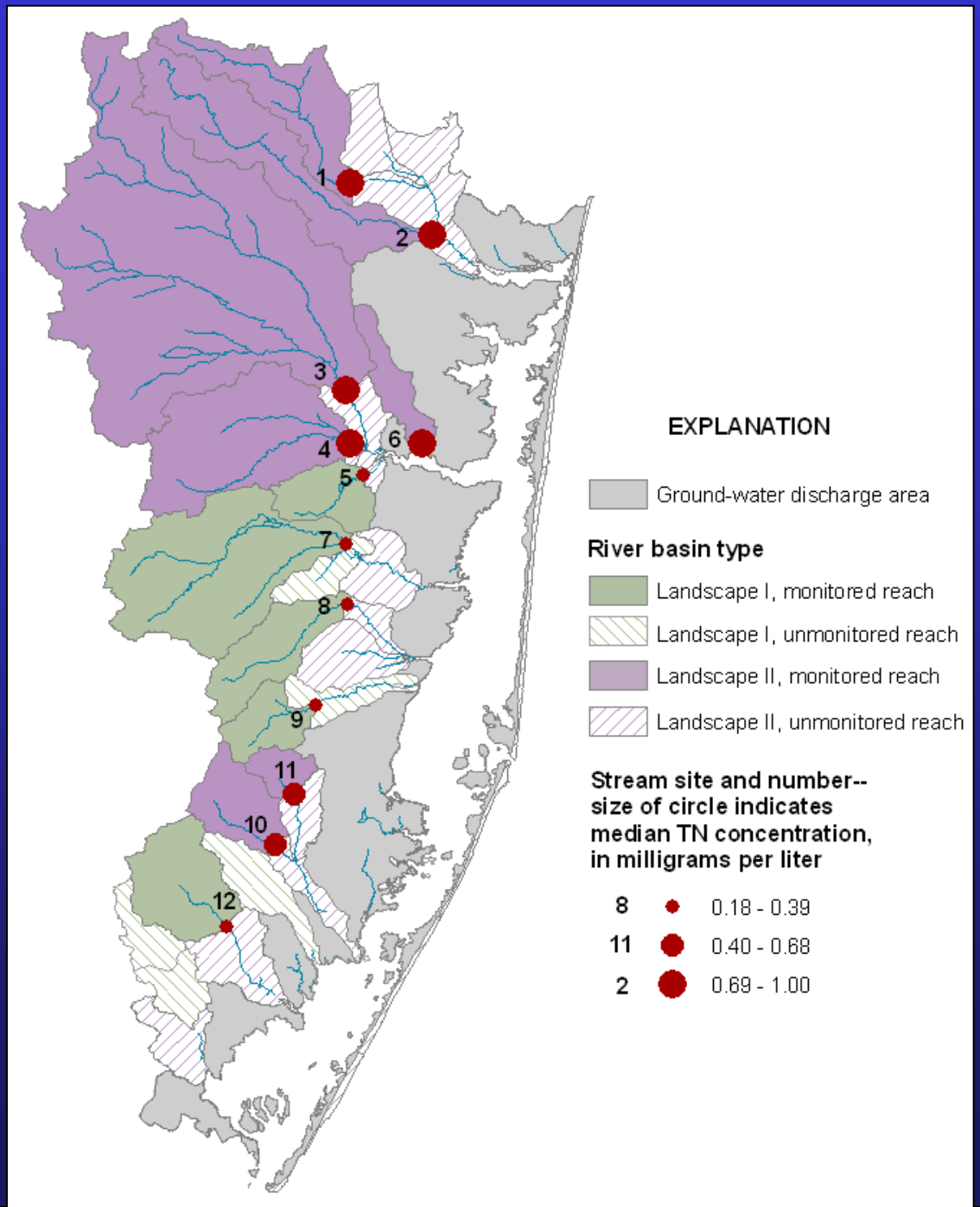
United States Environmental Protection Agency

USGS



Nitrogen Load Assessment Update-2009

Surface Load Determination



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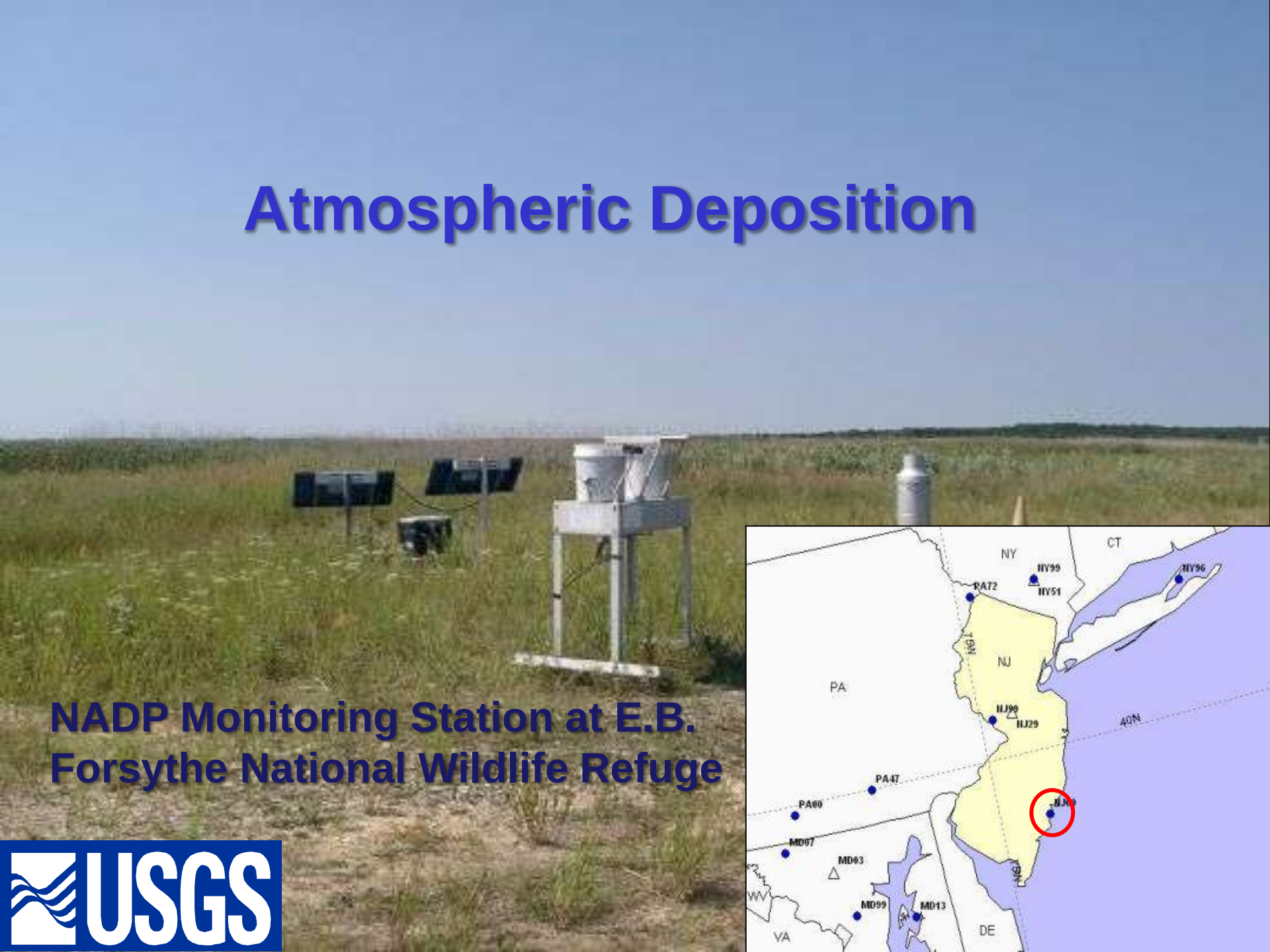
Atmospheric Deposition

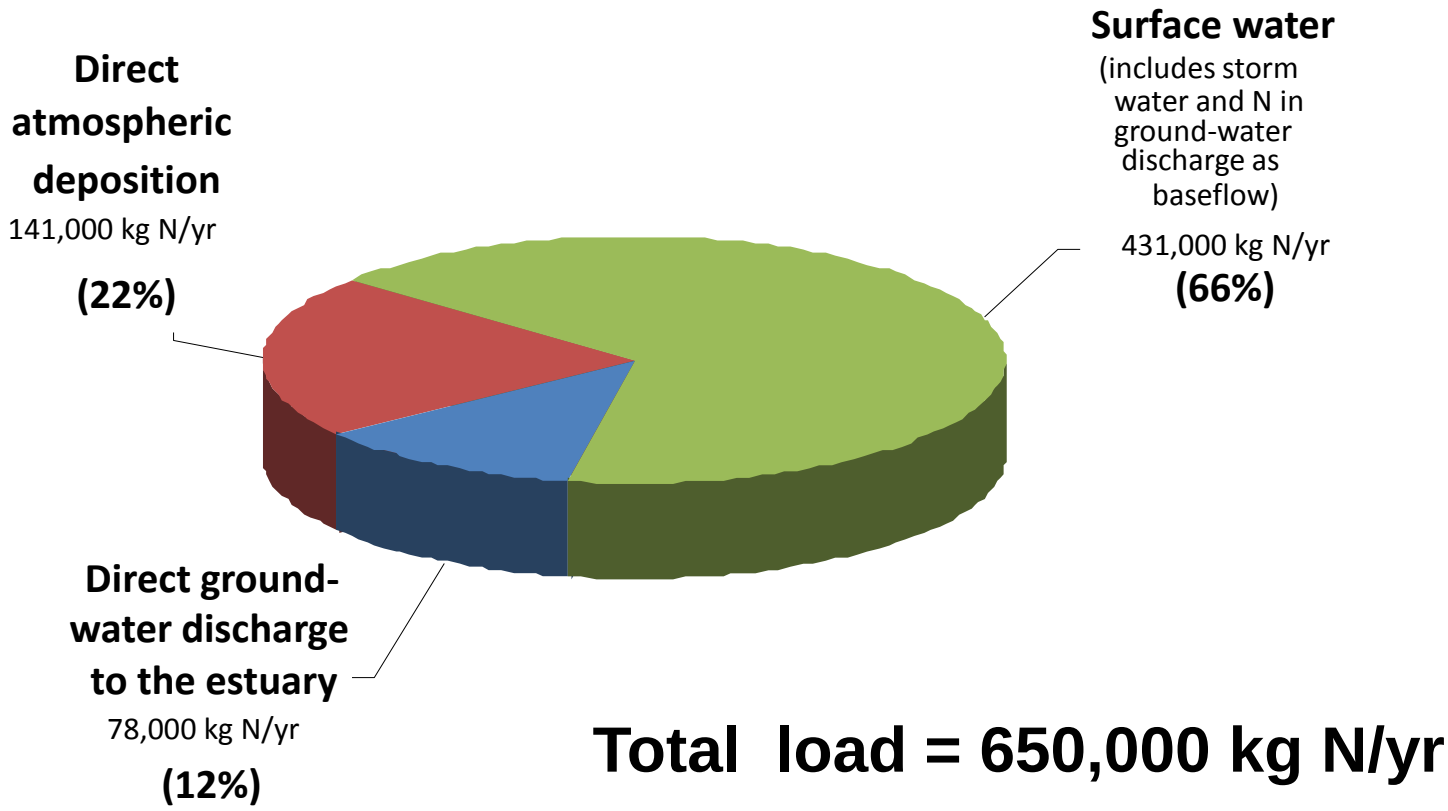


NADP Monitoring Station at E.B. Forsythe National Wildlife Refuge

USGS

NUTRIENT DELIVERY

2009 Updated Estimate of Delivered Load



Wieben and Baker (In press)

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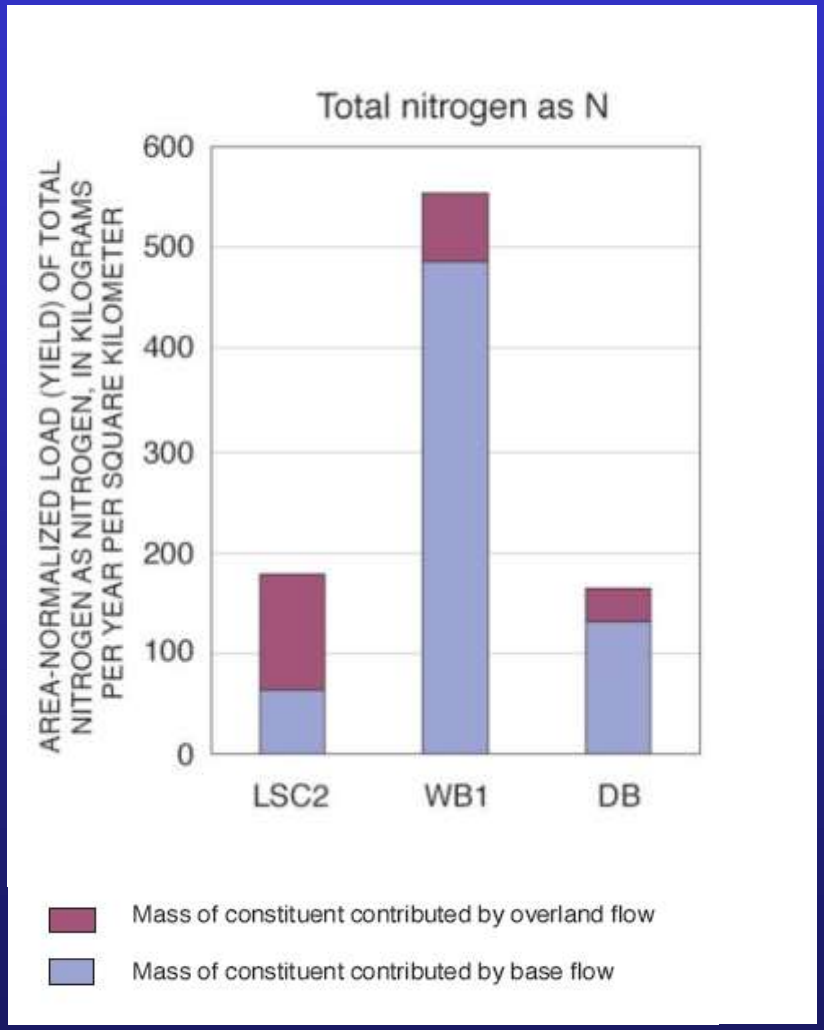
Relative Loads from Stormwater and Baseflow

USGS/NJDEP Toms River study (2006)

R. Baker and K. Hunchak-Kariouk (2006, USGS)

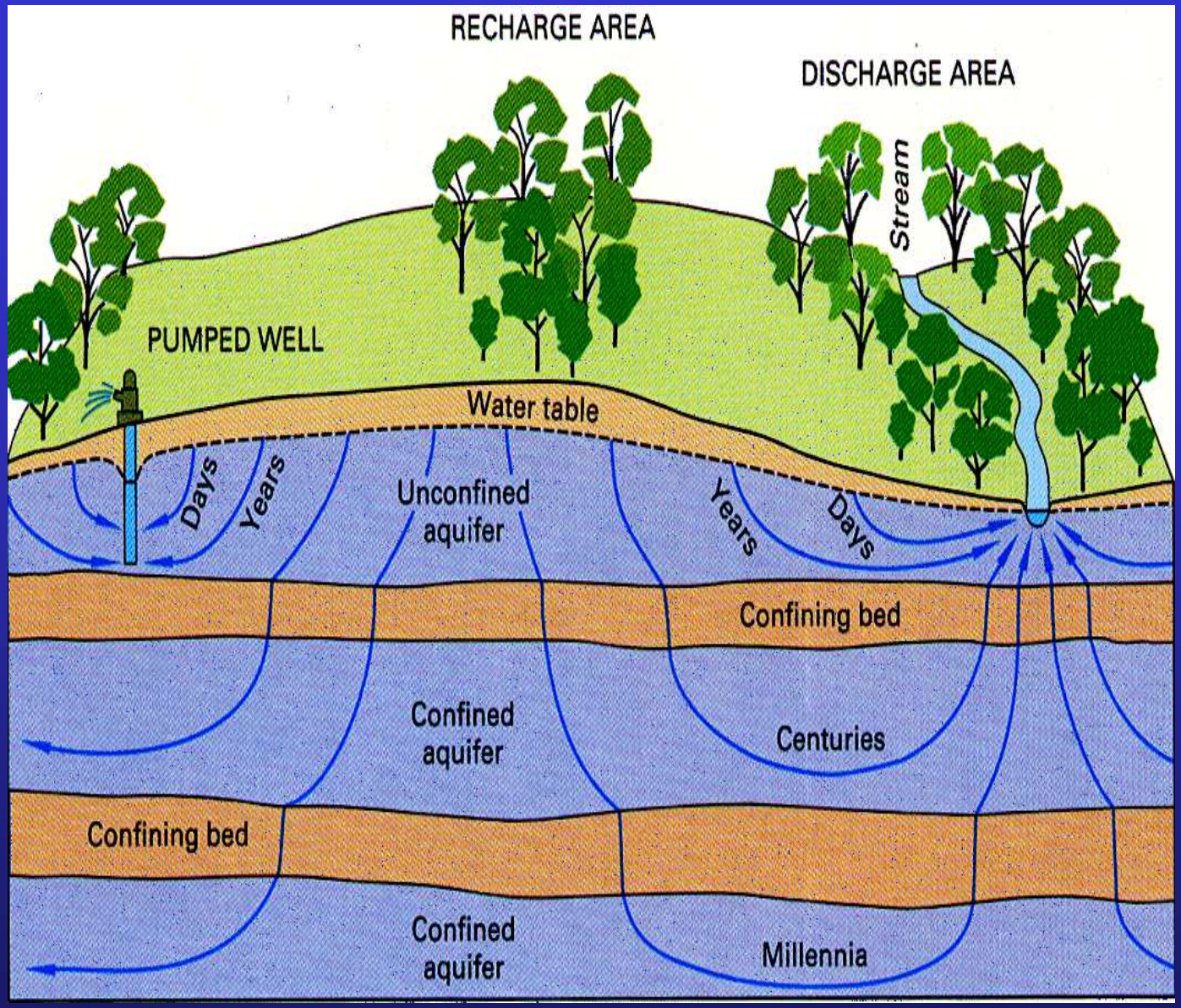
Connell and Schuster (NJDEP, 1999)

- Baseflow contributed more of the N load than overland flow in 2 of 3 tributaries
- Storm-water loading was more closely related to recent land use



Source: Baker and Hunchak-Kariouk, 2006

Groundwater flow concepts



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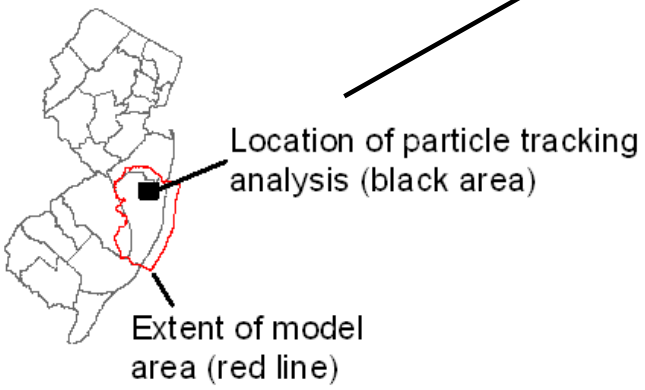
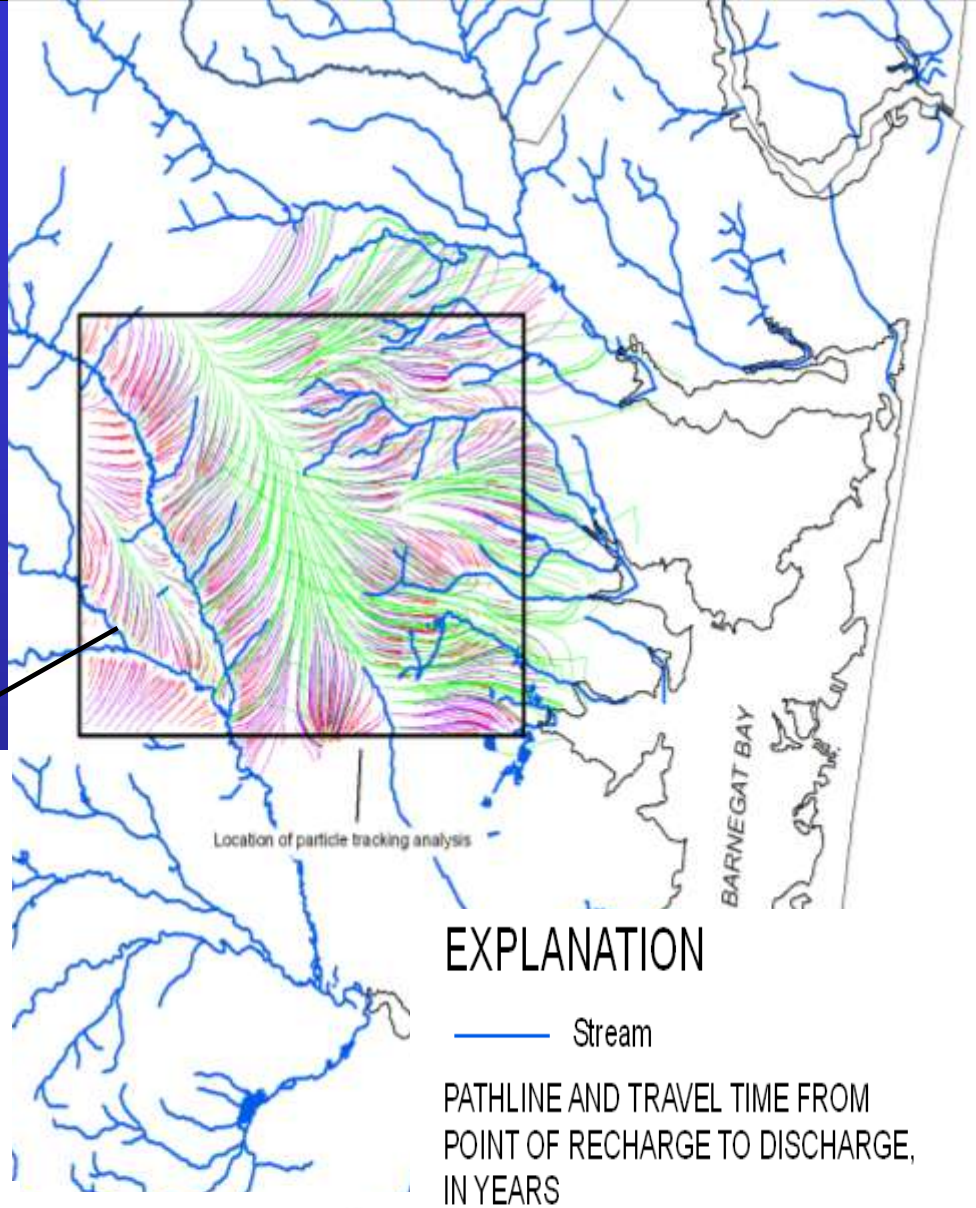
Pathline analysis: a useful tool for evaluating N transport in groundwater

Simulated flow paths in Kettle Creek area





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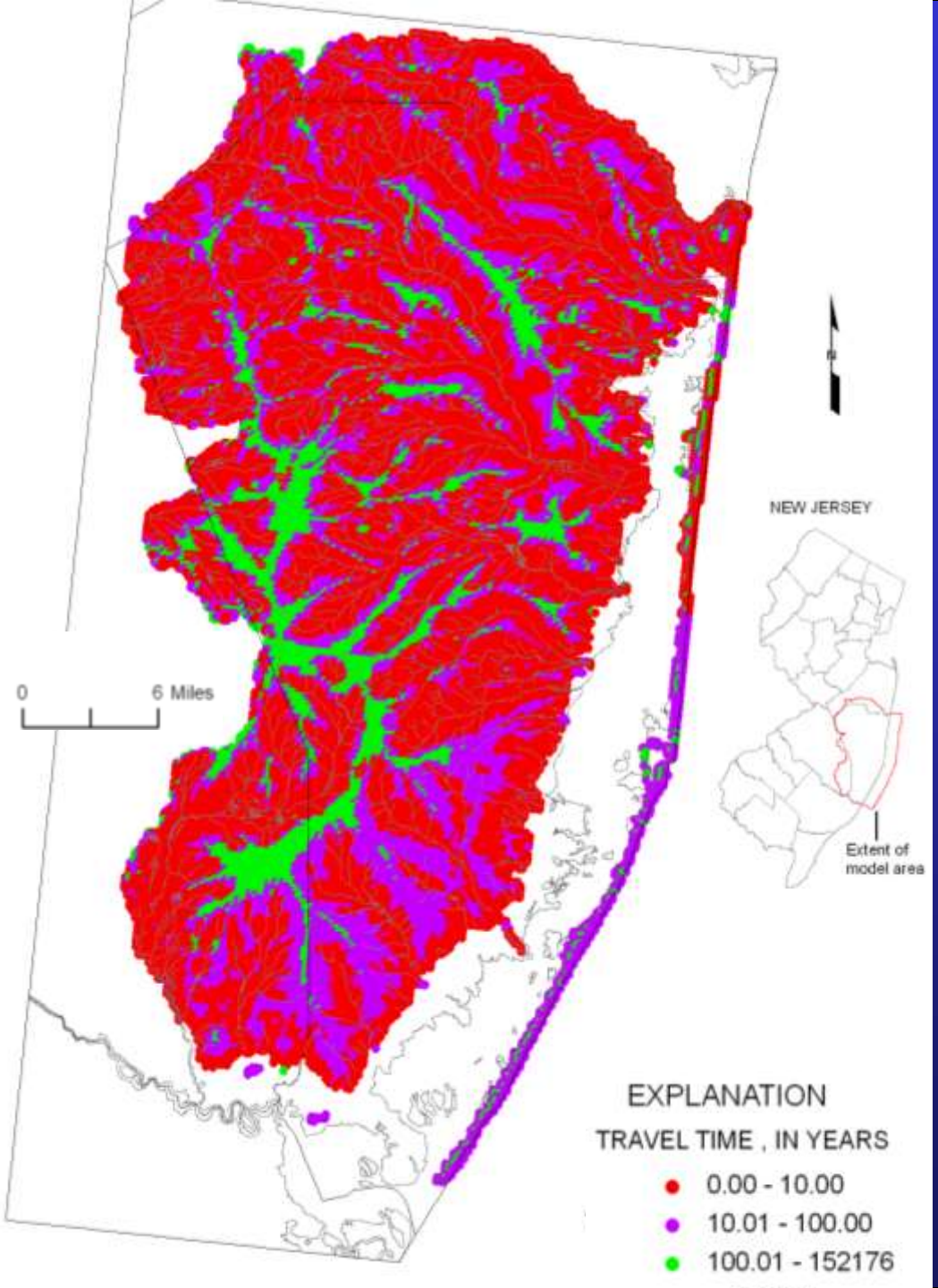
Preliminary simulated groundwater travel time from recharge to discharge area



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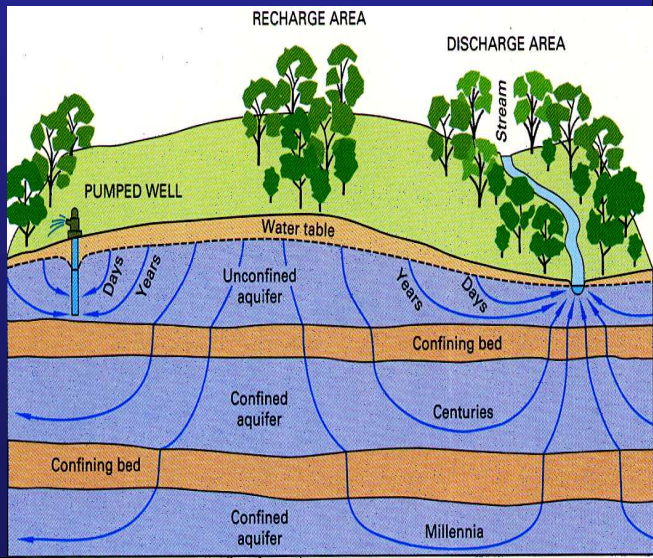
Consequence of slow groundwater transport:

Effects of changes in groundwater nitrogen loads may be delayed by long periods of time.

Examples:

- *New commercial/residential developments*
- *Implemented BMPs*
- *Fertilizer ordinances*



SUMMARY

- Barnegat Bay is a valuable resource that is vulnerable and threatened
- Groundwater recharge and discharge help maintain freshwater inflows
- Soil disturbance during construction impairs soil function; can reduce recharge and stream baseflow
- Nutrient loads are delivered by surface water, groundwater, and atmospheric deposition
- Groundwater transports much of the nitrogen load
- Groundwater transport can continue for long periods of time

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in cooperation with…

US EPA

New Jersey DEP

Barnegat Bay National Estuary Program

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