Ground Water of the Raritan River Basin August 2001 Draft Technical Report

Presented by

Debbie Newcomb

NJ Water Supply Authority

Acknowledgements

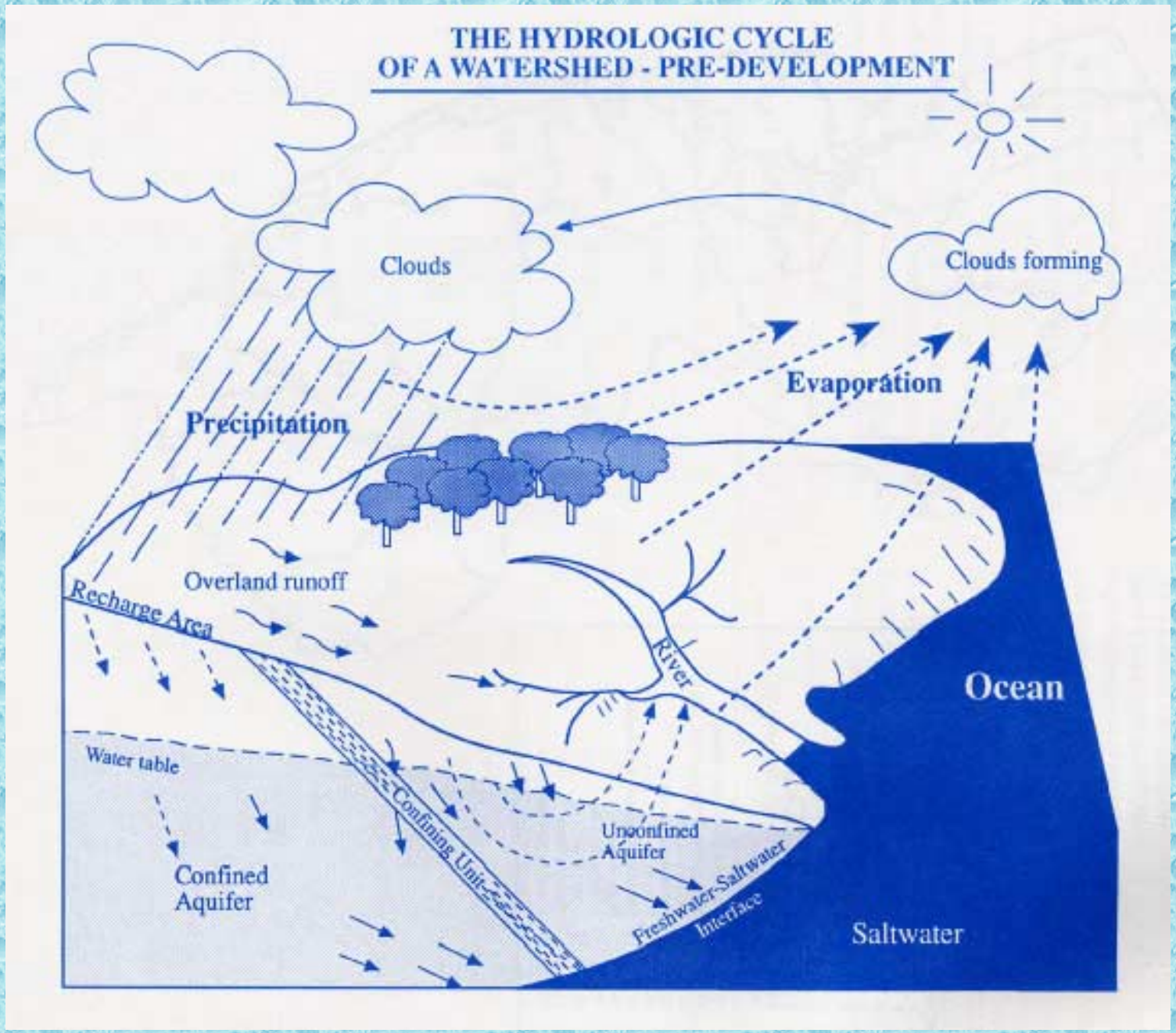
Caroline Phillipuk, GIS Specialist
Upper Raritan Watershed Association

Tom Stanuikynas, GIS Specialist
NJ Water Supply Authority

Dan Van Abs, Manager
NJ Water Supply Authority

Definition of Ground Water

- The fraction of precipitation on the land surface that has worked its way downward by gravity through the soil and into the underlying saturated zone (water table).
- Includes all water in the saturated zone; however, not all ground water is contained in aquifers.
- Aquifers are geologic formations that store, transmit and yield significant amounts of water for economic purposes.


THE HYDROLOGIC CYCLE
OF A WATERSHED - PRE-DEVELOPMENT
Clouds
Clouds forming
Evaporation
Precipitation
Overland runoff
Recharge Area
River
Ocean
Water table
Confining Unit
Unconfined
Aquifer
Confined
Aquifer
Freshwater-Saltwater
Interface
Saltwater

Definitions Cont'd

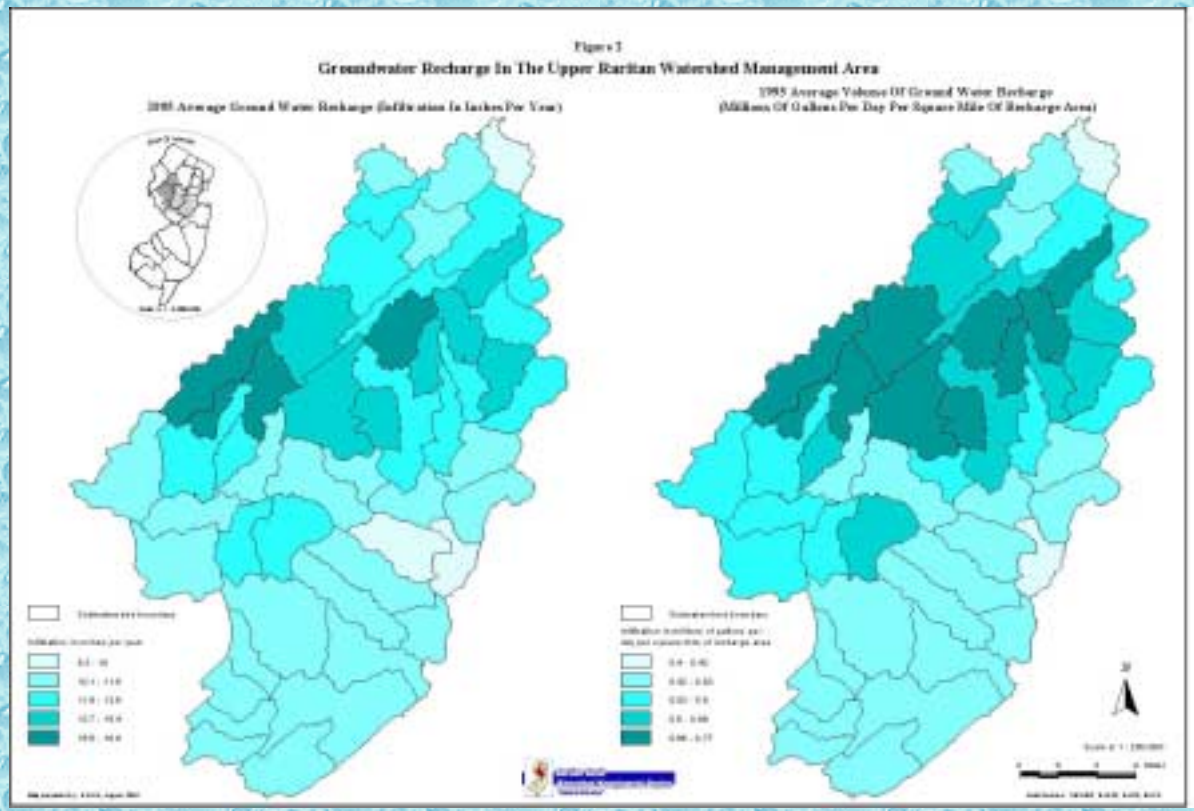
- Infiltration refers to all of the water that soaks into the ground.
- Ground water recharge occurs when water infiltrates beyond the root zone to the water table.
- Aquifer recharge refers specifically to the water that recharges an aquifer.

Ground Water Recharge Analysis

- Performed using NJGS GSR-32 Method:
  - Estimates ground water recharge using municipality-based rainfall & temperature, soil and land use/land cover factors.
- Aquifer recharge may be lower (but not higher), depending on local geology.
- Evaluates effects of present and future land uses on recharge areas.

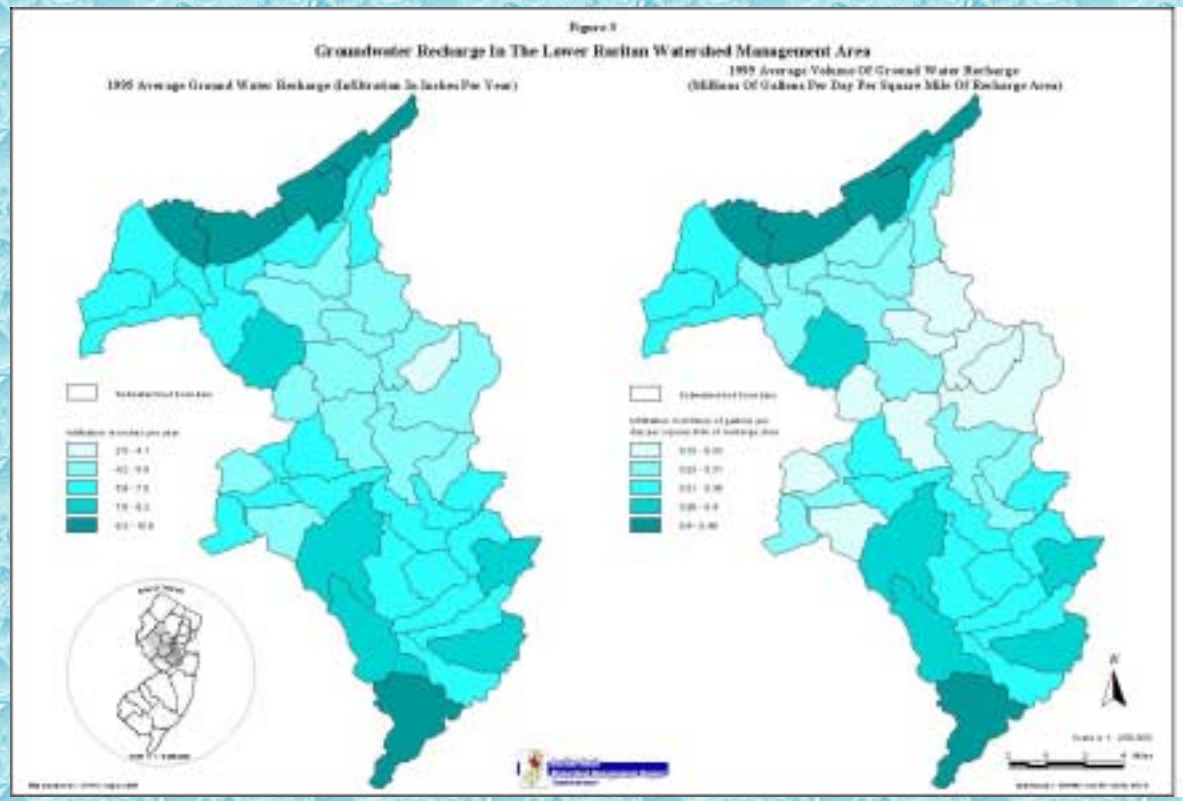
Ground Water Recharge in the Upper Raritan (N & S Branch) WMA

- Recharge range -- 8.3 to 16.8 in/yr
- Average 12.15 in/yr
- Average recharge for WMA ~ 0.58 mgd/mi^2
- Highest recharge occurs in SB Raritan River watersheds (above Spruce Run and Three Bridges to Spruce Run) and Lamington River



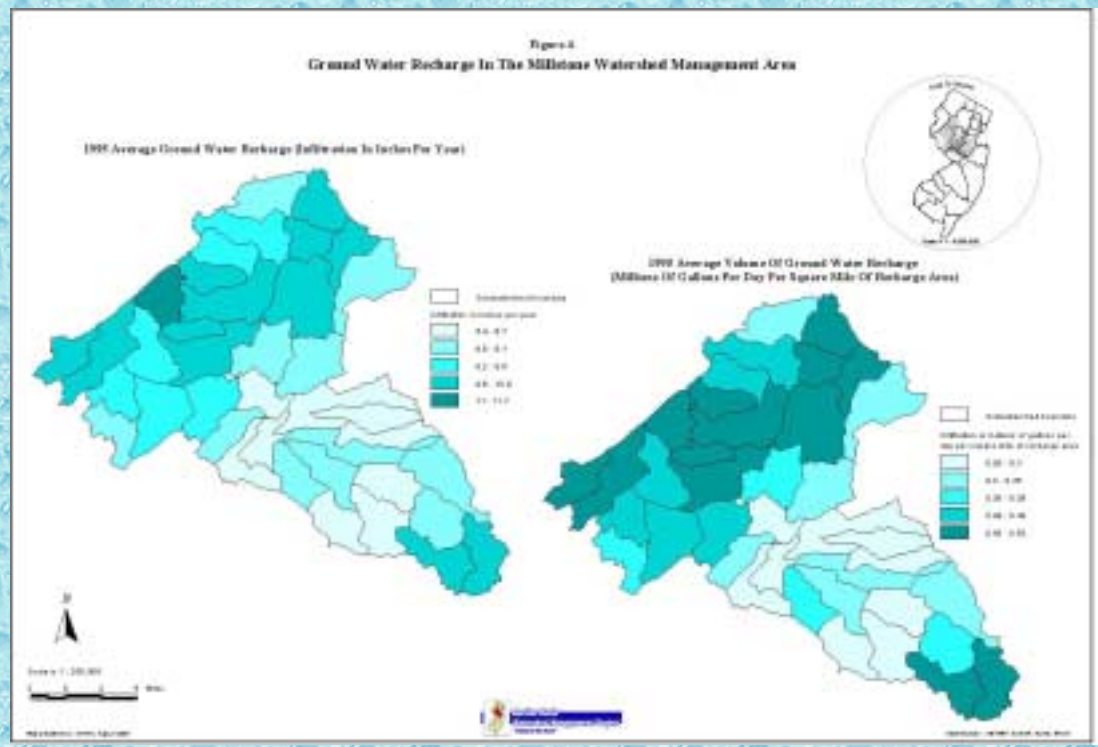
Ground Water Recharge in the Lower Raritan WMA

- Recharge range -- 2.5 to 10.6 in/yr
- Average ~ 6.68 in/yr
- Average recharge for WMA ~ 0.33 mgd/mi^2
- Highest recharge in northern (Lower Raritan River – Lawrence to Millstone watershed) and southern (Manalapan Brook watershed) portions of the WMA



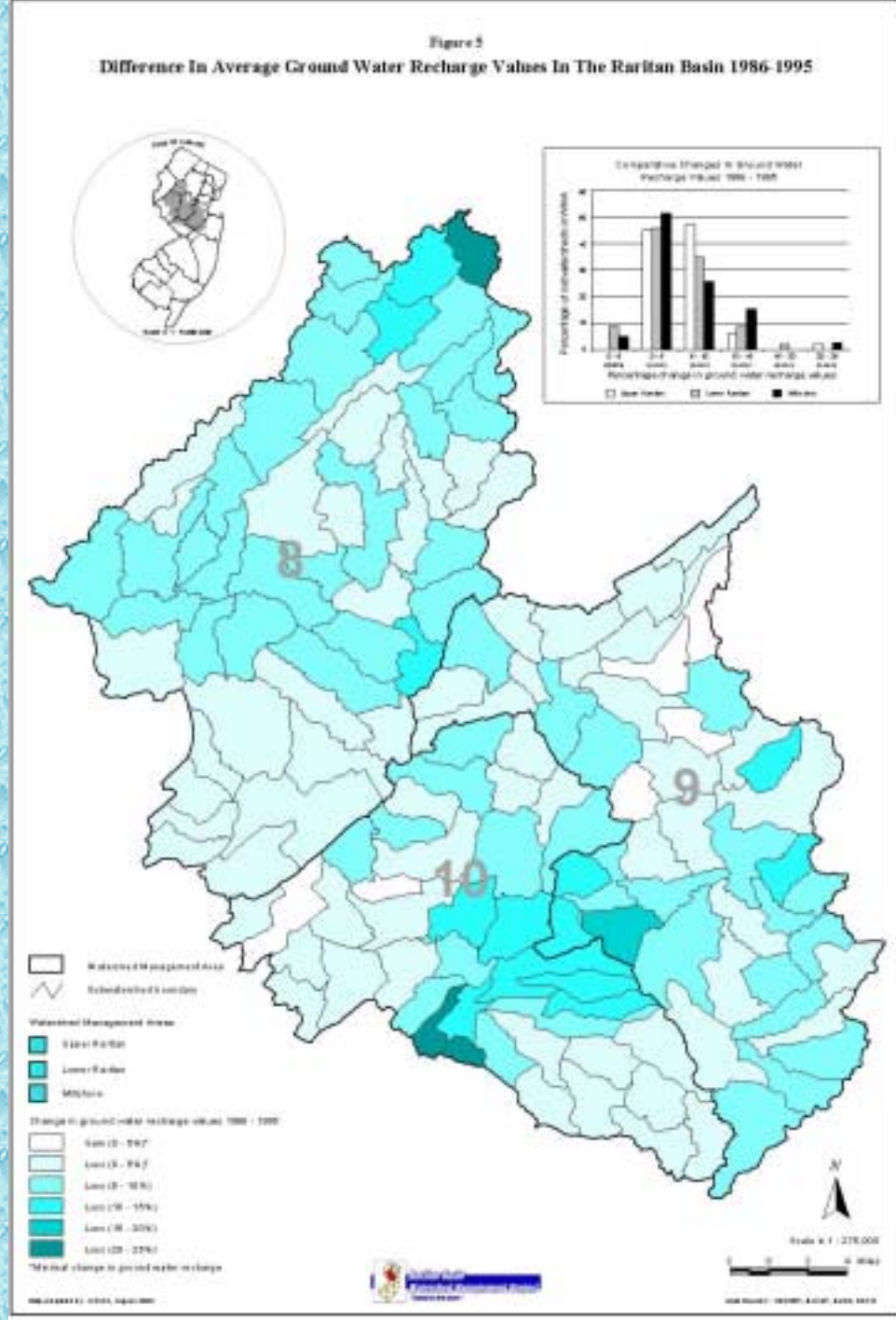
Ground Water Recharge in the Millstone WMA

- Recharge range -- 5.4 to 11.7 in/yr
- Average ~ 8.19 in/yr
- Average recharge for WMA ~ 0.40 mgd/mi^2
- Highest recharge in northern portion of WMA and in the Stony Brook watershed along the Sourland Mountains



Changes in Recharge Between 1986-1995

- 136 subwatersheds -- 130 experienced losses in GW recharge
- Majority of losses in 0-10% range
- Some losses in 10-25% range
- 6 subwatersheds show <u>minimal</u> gains (<3.5%)



Ground Water Recharge By WMA

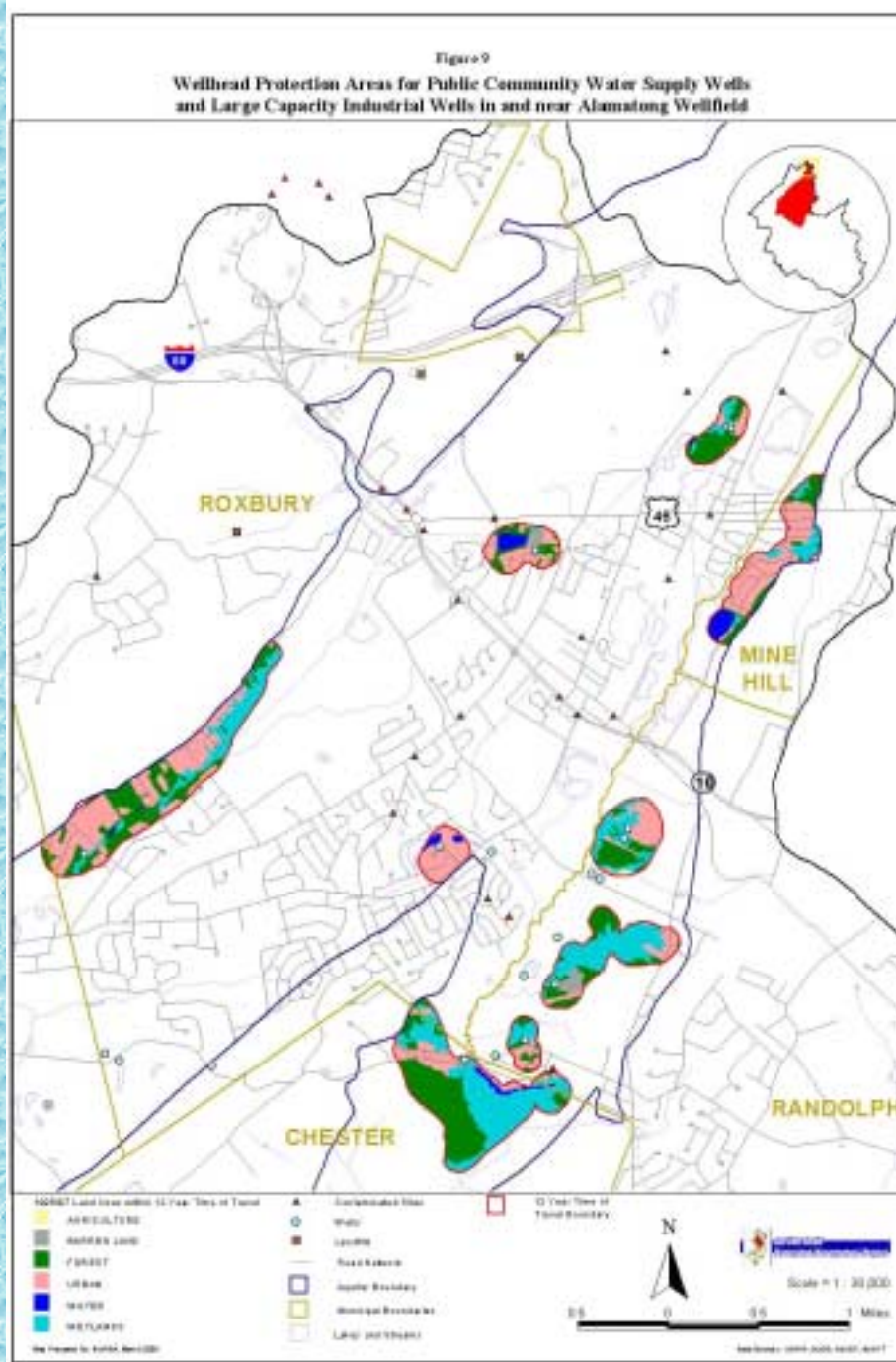
- **Upper Raritan (North & South Branch) WMA**:
  - All 51 subwatersheds showed losses (0.15 to 2.9 inches)
- **Lower Raritan WMA**:
  - 42 of 46 showed losses (0.04 to 1.06 inches)
  - 4 showed minimal gains (0.06 to 0.16 inches)
- **Millstone WMA**:
  - 27 of 39 showed losses (0.07 to 1.58 inches)
  - 2 showed minimal gains (0.001 to 0.04 inch)

Wells & Wellhead Protection Areas

- Basin contains approximately 350 public community water supply wells.
- NJDEP plans to delineate wellhead protection areas (WHPAs) for all public wells by September 2002 through Source Water Assessment Protection Program.
- This will provide a tool for determining the level and type of protection needed for wells.

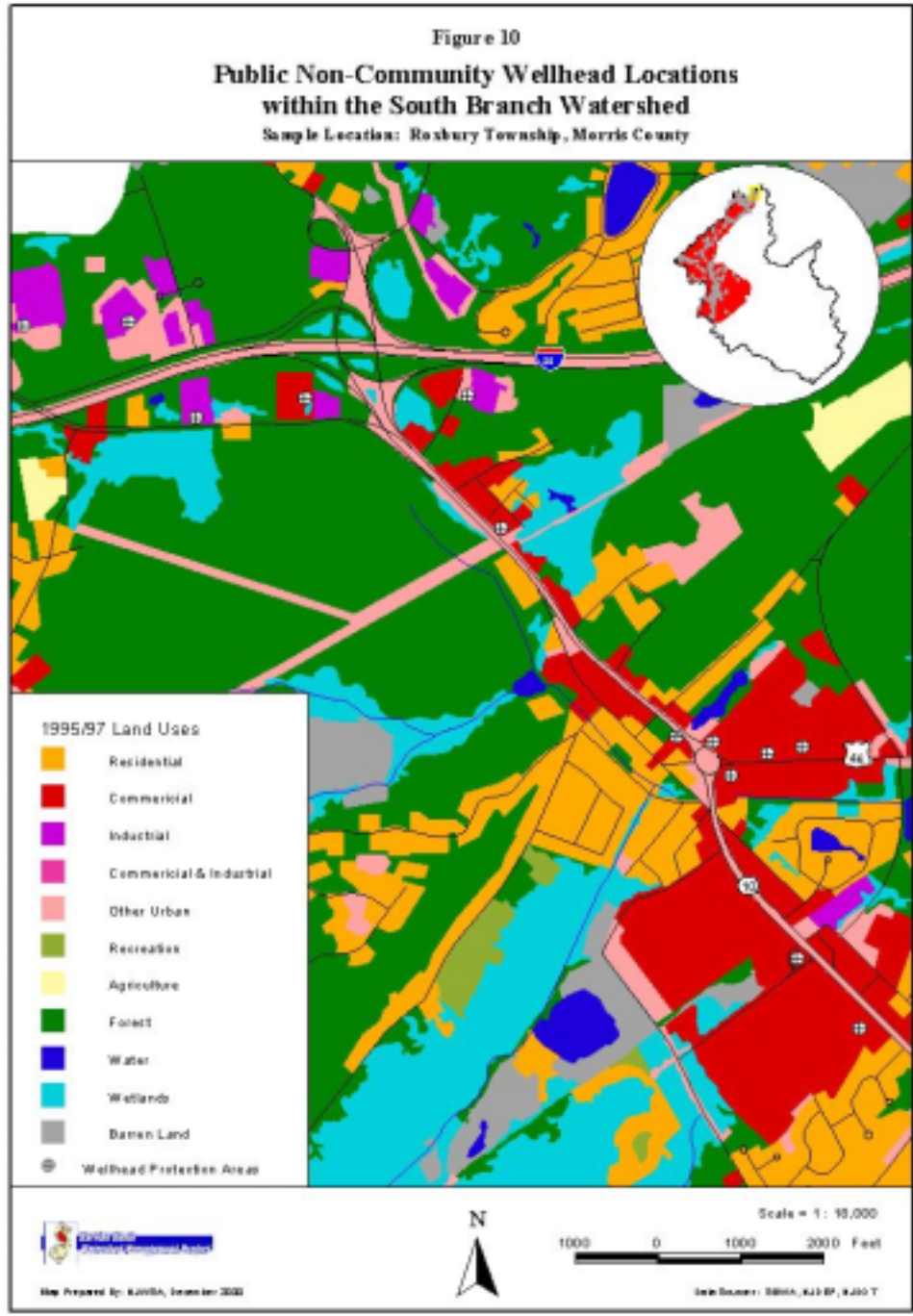
Alamatong Wellhead Protection Study

- Illustrates WHPAs for public community wells & industrial wells in Morris County
- Shows wells and surrounding land uses that contribute recharge to wells.
- Can determine which wells are at risk for contamination



NJ Highlands Wellhead Protection Program

- 430 public non-community wells mapped in 29 municipalities along SB Raritan River.
- This figure shows 13 wells in one area
- Demonstrates how WHPA data can be used to assess surrounding land uses and threats to wells.



Ground Water Quality

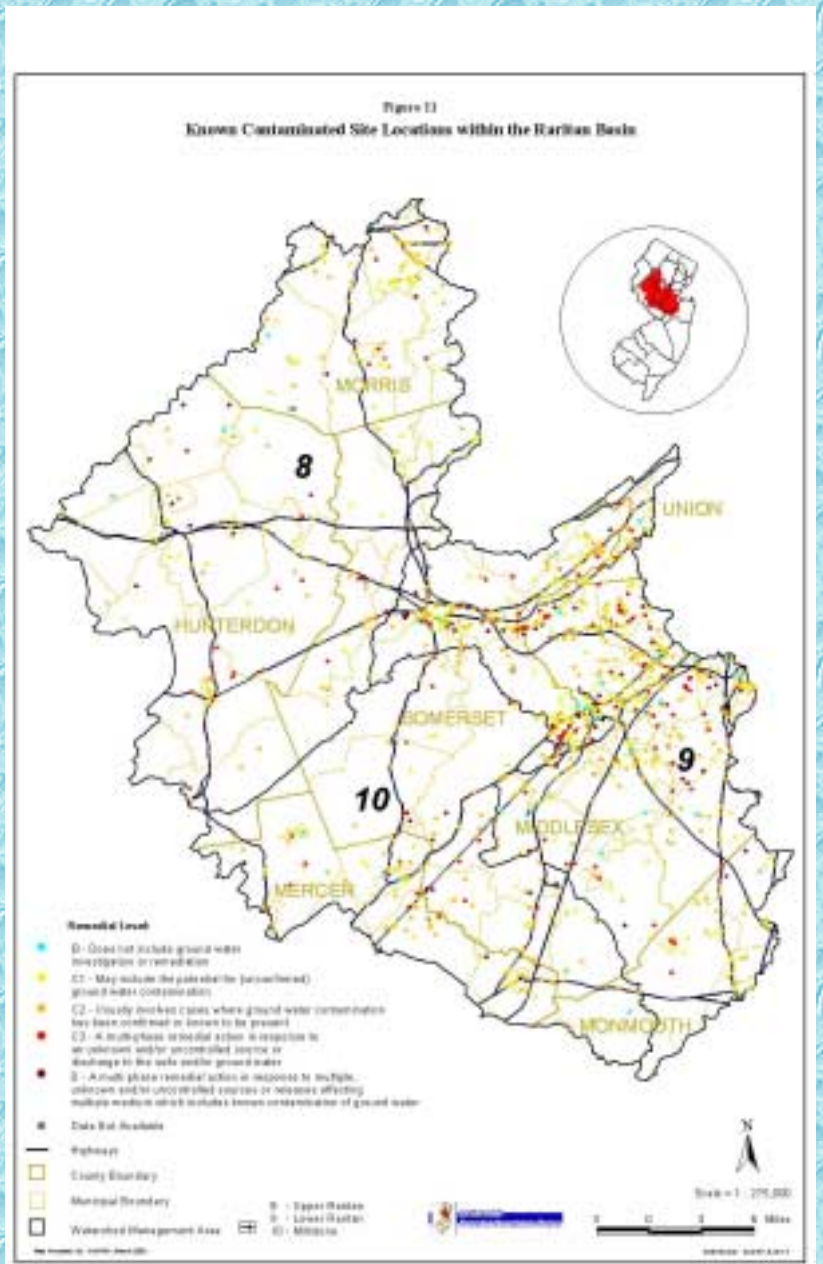
- **Saltwater intrusion**
  - Water Supply Critical Area #1 (partially in Basin -Middlesex & Monmouth Counties)
- **Arsenic**
  - Piedmont has higher arsenic concentrations than Highlands or Coastal Plain
  - 15% of the public community wells had concentrations over 5 ppb

Ground Water Quality Cont'd

- **Pesticides**
  - Detected most frequently in agricultural areas and less so in residential and undeveloped areas
  - Wells ranked by low, medium & high sensitivity to contamination
    - Highlands –medium
    - Piedmont – high
    - Coastal Plain – low

Known Contaminated Sites

- *"A site with contaminated soil or ground water where remediation is underway or pending."*
- **Approximately 1,270 known contaminated sites in Basin with confirmed ground water contamination.**
- **Most sites fall within transportation corridors of the Basin, and urban sections of Union, Middlesex and Mercer counties.**



Contaminated Wells

- 48% of PCWS wells in the Basin are within ½ Mile of a Known Contaminated Site
  - 43% of wells in the Upper Raritan WMA
  - 51% of wells in the Lower Raritan WMA
  - 52% of wells in the Millstone WMA
- Example – Of 67 E'town Water wells:
  - 23 are fully operable;
  - 23 are in service, but treated for VOC contamination;
  - 15 are out of service; and
  - 6 are out of service – naturally high radon levels.

Other Potential Sources of Contamination in the Basin

- 60 Landfills
- 500 NJPDES-permitted discharges to ground water
- 4,617 underground storage tanks
- 28 Superfund sites

Septic System Carrying Capacity Analysis

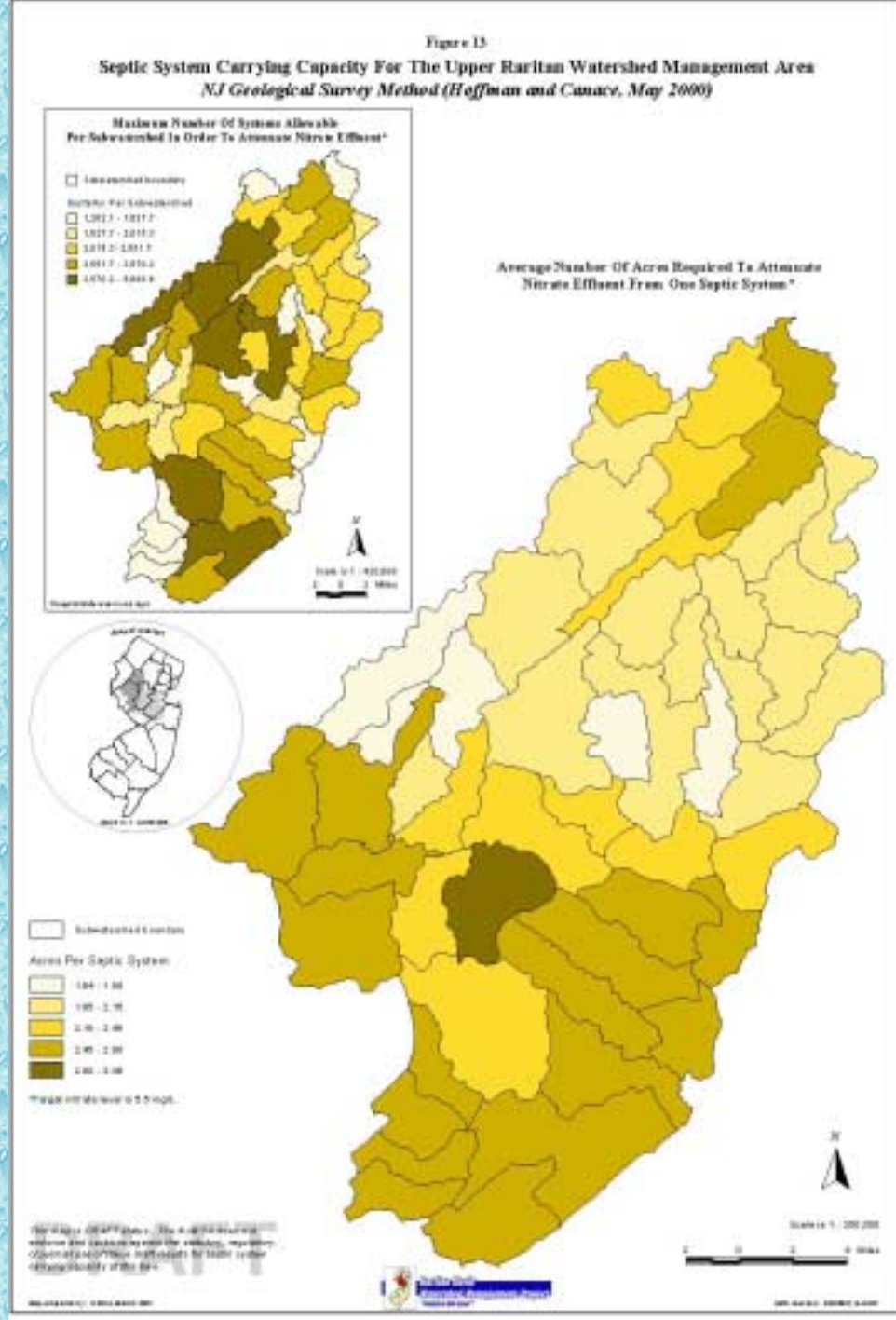
- **Used May 30, 2000 NJGS model**:
  - Estimates total # of septic systems that can be accommodated within a geographic area (carrying capacity).
- **Model uses**:
  - Average loadings of nitrate/septic system;
  - Estimates of ground water recharge from precipitation; and
  - Target concentration from the Ground Water Quality Standards (NJAC 7:9-6) of 5.5 mg/L.

Carrying Capacity Analysis Cont'd

- Estimates could be considered highest density (septic systems/mi^2) appropriate for septic systems. Results by subwatershed
- Other factors that justify larger average lot sizes (lower density) include:
  - local geology,
  - development patterns,
  - existing septic systems,
  - other existing pollutant sources

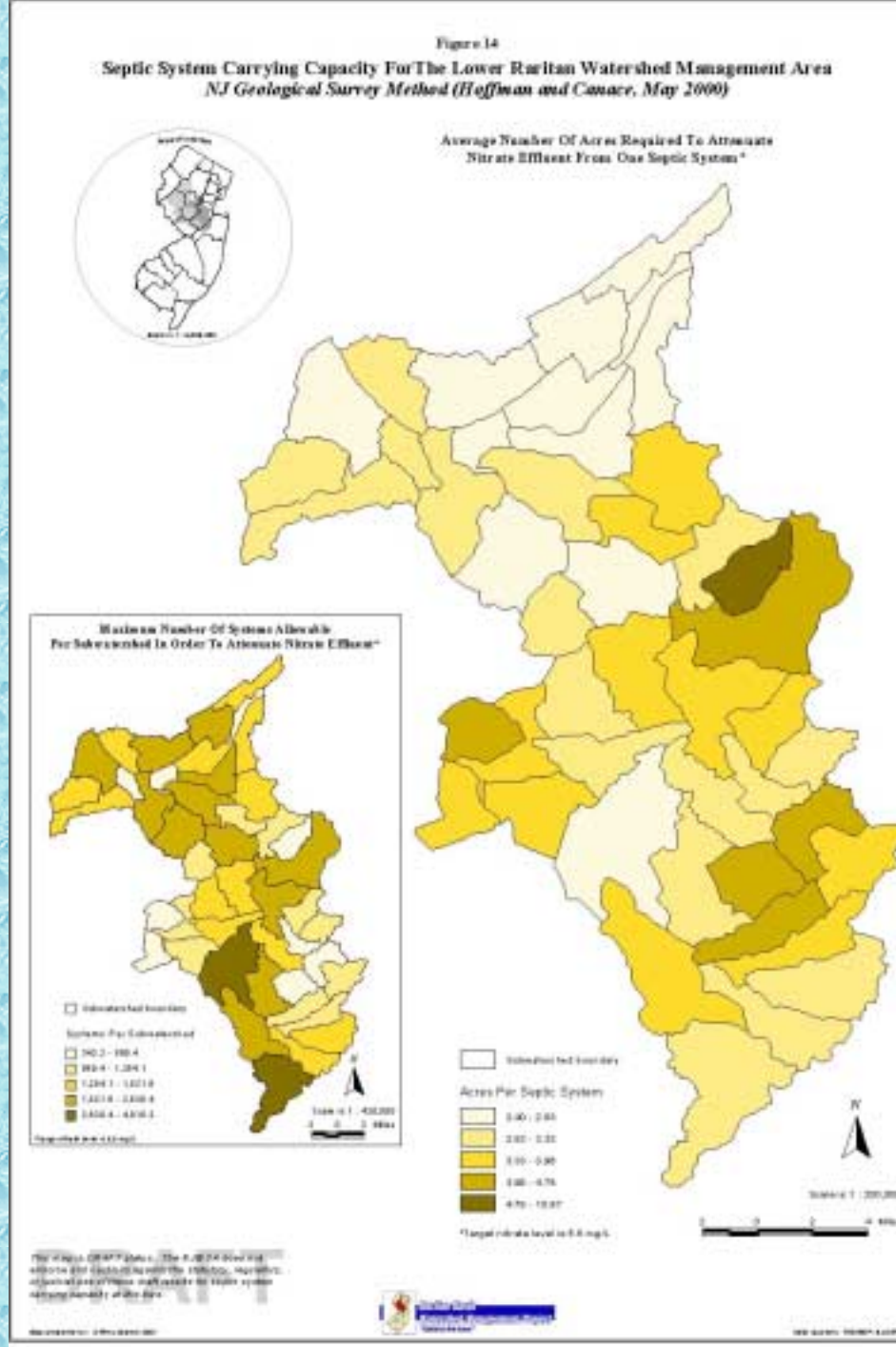
Carrying Capacity Upper Raritan WMA

- Highest carrying capacity (smallest avg. lot size) at 1.64 acres per septic system
- Lowest (largest avg. lot size) is 3.36 acres per septic system
- Highlands ~ 2 acres/ septic system, except in Upper Lamington River
- Piedmont sections such as Neshanic and South Branch River below Stanton - highest avg. lot sizes. No glacial soils or limestone valleys.



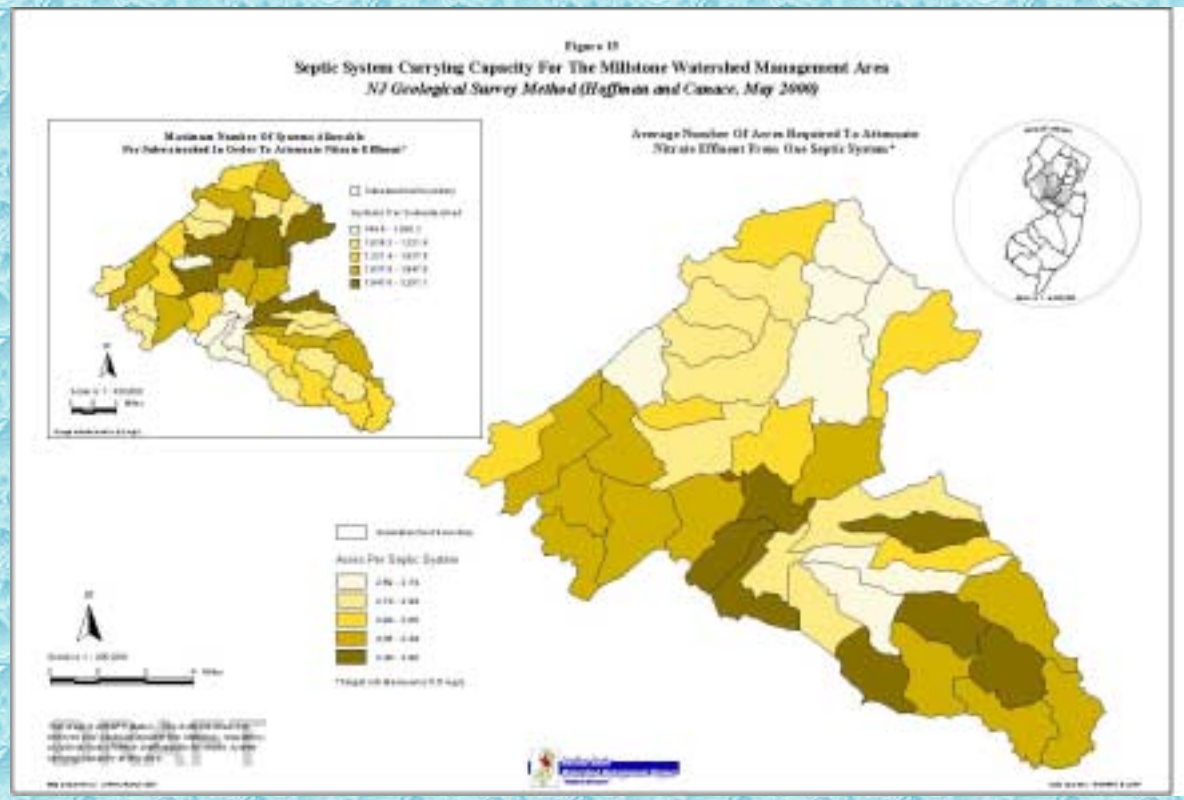
Carrying Capacity Lower Raritan WMA

- Smallest avg. lot size ~ 2.4 acres/septic system
- Largest ~ 10.97 ac/septic system
- Most subwatersheds show values of 3.0 - 5.0 ac/septic system
- Highest sustainable densities:
  - Bound Brook/Green Brook watershed,
  - Lawrence Brook and
  - Lower Raritan River (Piscataway/Franklin Townships)
- Most, if not all of these are already sewered.



Carrying Capacity – Millstone WMA

- Smallest avg. lot size is 2.59 ac/septic system
- Narrow range (from 2.6 to 3.9 ac/septic system)
- Upper Millstone River and Stony Brook watersheds, along w/ Route 1 corridor show higher avg. lot sizes
- Route 1 corridor is mostly sewered, Upper Millstone and much of the Stony Brook rely on septic systems



Results of Carrying Capacity Analysis

- No subwatershed can support septic systems on average lot sizes less than 1.64 acres.
- Most subwatersheds require average lot sizes of more than 2 acres, with many in excess of 3 and 4 acres.
- Regional analysis – local results will differ!

Results of Carrying Capacity Analysis Cont'd

- Upper Raritan WMA could support the most septic systems per area and Lower Raritan WMA could support the least.
- Results consistent with ground water recharge results and also reflect the impact of impervious surfaces.
- Lower Raritan WMA most developed, and Upper Raritan WMA is least developed and also has higher precipitation levels.

Conclusions

- Topography and geology are the primary factors affecting ground water availability and recharge.
- Losses in recharge attributed to conversion of areas of high recharge (including forested and agricultural lands) to urban land uses.
- Ground water contamination evident throughout Basin.
- Measures need to be taken to protect public water supply wells.

Conclusions Cont'd

- Much development is taking place in areas that lack public sanitary sewer systems.
- Development of too many septic systems would have the potential to contaminate ground water and surface water systems.
- Need proper planning to guide future growth patterns and to protect ground water supplies and recharge areas.