U.S. Department of the Interior
U.S. Geological Survey

Surficial Aquifer System of the New Jersey Coastal Plain -- Significance to Resource Management

Fact Sheet

SURFICIAL AQUIFERS

An understanding of the interaction between human activities and the Nation's surficial (water-table) aquifers is critical to maintaining the quantity and quality of our water resources and the health of the ecosystems they support. In recognition of the importance of these aquifers, the U.S. Geological Survey (USGS) is developing a program to study the surficial aquifers of the New Jersey Coastal Plain.

Virtually all ground water originates at the water table where infiltration of precipitation or leakage from surface-water bodies recharges surficial aquifers. As a result, surficial aquifers have the largest water budget, continually transmitting the greatest quantity of water. In fact, only a fraction of the water that flows in the surficial aquifers reaches regional confined aquifers.

Ground water in surficial aquifers is exchanged with surface water, maintains stream base flow, and supports sensitive wetland ecosystems. Because ground water and surface water interact where the water table is near or intersects the land surface, very small fluctuations in ground-water levels resulting from climatic variations and human activities can have a significant effect on that interaction.

Figure 1. New Jersey Coastal Plain.

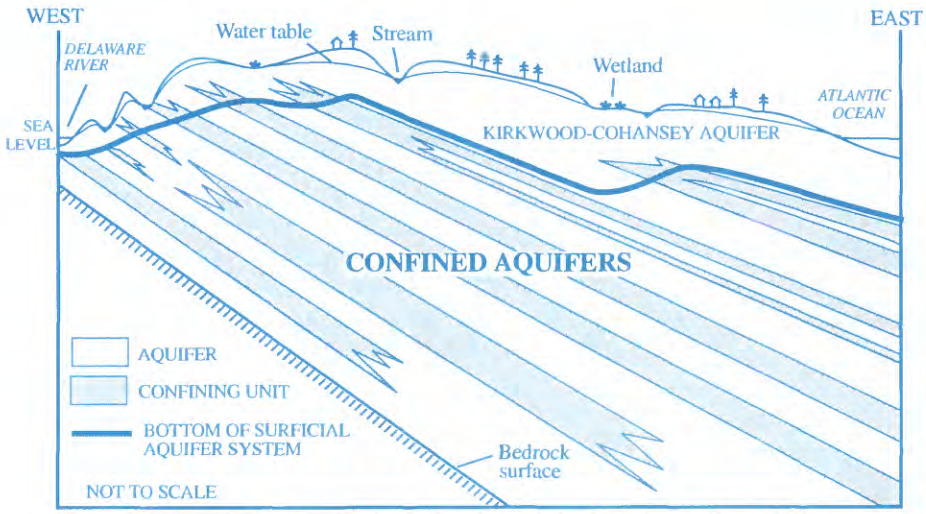

Figure 2. Schematic hydrogeologic section through the New Jersey Coastal Plain.

Contaminants from human activities typically enter ground-water systems in the surficial aquifer; they are transported along complex ground-water flow paths that result from the many flow subsystems developed in surficial aquifers. The contaminants may discharge after a few years at wells or surface-water bodies, affecting people and the environment, or they may flow to deeper aquifers and remain in the ground-water system for hundreds or thousands of years.

SURFICIAL AQUIFER SYSTEM -- NEW JERSEY COASTAL PLAIN

The New Jersey Coastal Plain covers an area of about 4,200 square miles (Fig. 1). Its aquifers supply water for more than 3 million residents and are designated by the U.S. Environmental Protection Agency as "sole-source" aquifers. The surficial aquifer system is characterized in the east by an extensive sand and gravel aquifer (the Kirkwood-Cohansey aquifer), and in the west by the outcrop of the deeper confined aquifers where they are unconfined (Fig.2).

Land uses in the New Jersey Coastal Plain vary from mixed urban, industrial, and residential (about 25 percent of the land area) to agricultural (25 percent) and undeveloped land (50 percent). Much of the undeveloped land lies within the Pinelands National Reserve, designated by Congress in 1978 to preserve a unique ecological habitat. Subsequent State legislation defines areas where no degradation of the natural environment is allowed and areas where development is permitted but is designed to minimize adverse environmental effects.

Contaminants have been introduced to and transported within the ground-water system for more than a century. Nutrients (mostly nitrogen compounds) are the most common contaminants because agricultural practices and on-site septic systems were the earliest sources of contamination. However, petroleum products, industrial organic compounds and pesticides, have been detected throughout much of the surficial aquifer and in parts of the confined aquifers.

Before development, about 3.5 billion gallons per day recharged this aquifer system. Virtually all of the water discharged to streams, lakes, wetlands, and tidal bays; less than 1.5 percent of recharge entered the confined aquifers. Today, about 450 Mgal/d (million gallons per day) is pumped from the aquifers in

the New Jersey Coastal Plain. Withdrawals from the surficial aquifer system total 220 Mgal/d -- 65 Mgal/d from shallow domestic wells and the remainder from larger capacity public supply, industrial, and irrigation wells. Withdrawals from confined aquifers, primarily from public supply wells, total 230 Mgal/d. As a result, flow from the surficial aquifer system downward to the confined aquifers has increased fivefold, and ground-water-level declines (drawdown) in the confined aquifers exceed 200 feet in places.

Historically, the vulnerability of shallow ground water to contamination encouraged pumping from the deeper, confined aquifers. However, limited yield and susceptibility to saltwater intrusion resulted in "Critical Area" legislation in the 1980's that restricted pumping from the confined aquifers. Today, surface and ground water associated with the surficial aquifer system are identified as likely sources for increased supply.

SIGNIFICANCE TO RESOURCE MANAGEMENT

The State of New Jersey, through the New Jersey Department of Environmental Protection (NJDEP), is custodian of the State's water resources and, as such, is responsible for ensuring that these resources are allocated equitably and are protected from excessive use or degradation. NJDEP administers many regulatory and resource-management programs related to --

- ground- and surface-water supplies,
- contamination of surface- and ground-water systems, and
- effects of ground-water withdrawals on streamflow, stream quality, and ecosystems that depend on ground water.

Implementation of these programs requires --

- knowledge of the processes that govern the exchange of water between ground-water and surface-water sources, and the related ground-water-level fluctuations, and
- ability to identify the source area of ground-water recharge, trace flowpaths from the water table through the ground-water system, and identify the ultimate points of discharge (such as wells and streams).

The following resource-management decisions are being made in New Jersey --

- NJDEP issues permits for all ground-water and surface-water withdrawals greater than 0.1 Mgal/d. These permits can include requirements that maintain minimum streamflows and minimize drawdown in wetland areas.

- NJDEP is reevaluating the sustained yield of surface reservoirs that were designed based on flow conditions during the 1960's. Ground-water withdrawals and urbanization since then may have changed streamflow and decreased the sustained yield.

- NJDEP, under mandate of the Federal Clean Water Act and the State Water Pollution Control Act, sets ground-water-quality standards and wasteload allocations to control the effects of ground-water contamination on surface-water quality. Some interpretations of these statutes require regulation of ground-water withdrawals that would reduce streamflow and thereby affect a stream's ability to meet water-quality standards.

- NJDEP, through its Safe Drinking Water Program, currently is developing criteria to determine which public supply wells may be threatened by bacteria or parasites from infiltrating surface water.

- Also as part of the Safe Drinking Water Program, NJDEP is establishing criteria for requiring routine monitoring of public supply wells for pesticides that will be based on the well's vulnerability to contamination. NJDEP may face similar decisions as new drinking-water standards are adopted.

- Although drinking-water standards apply to domestic wells, most monitoring programs are voluntary. NJDEP acknowledges that criteria for well placement and design are needed to minimize the potential for contamination.

- The Federal Coastal Zone Management Act requires enforceable State policies to minimize contamination of tidal water bodies. Virtually all of New Jersey's watersheds discharge to tidewater, and ground-water seepage can contribute significant amounts of some contaminants to coastal waters.

- Many Federal and State programs, including the Wellhead Protection, Aquifer Recharge Area Protection, Nonpoint Source, and Pesticide Programs, emphasize contamination prevention and management through identification of existing sources and mechanisms of contamination.

PROGRAM PLANS

The USGS program to study the surficial aquifers of the New Jersey Coastal Plain includes projects funded Federally and projects funded cooperatively by USGS and NJDEP. The program is designed to --

- provide knowledge required to implement State resource-management policies and programs,
- include long-term monitoring designed to analyze changes in hydrologic conditions,
- coordinate with the USGS National Water Quality Assessment (NAWQA) Program so that findings can be applied to analyze regional water quality, and
- include a research component to identify and explain relevant hydrologic processes.

Specific research issues include --

- seasonal interaction of streams and ground-water systems,
- ground-water-level fluctuations in areas where depth to water is shallow,
- patterns and rates of ground-water flow,
- ages of ground water within the surficial aquifer, and
- transport and fate of contaminants on a regional scale.

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