Sustainability of the Ground-Water Resources in the Atlantic Coastal Plain of Maryland

A 2004 report by the Advisory Committee on the Management and Protection of the State's Water Resources identified the need for a comprehensive assessment of ground-water resources of the Maryland Coastal Plain, where the population is expected to grow by 37 percent between the years 2000 and 2030. Accordingly, the Maryland Geological Survey (MGS) and the U.S. Geological Survey (USGS) have begun the first phase of a three-phase assessment of Maryland's Coastal Plain aquifer system. This Fact Sheet describes this assessment and the current and planned activities necessary for its implementation.

Importance of Ground Water in the Atlantic Coastal Plain of Maryland

Ground water is the primary source of water supply in most areas of Maryland within the Atlantic Coastal Plain (fig. 1), and is pumped from sand and gravel layers underlying the Coastal Plain. These sand and gravel layers alternate with layers of silt and clay to form a wedge-shaped system of sediments that begins at the Fall Line (the boundary between the Atlantic Coastal Plain and the Piedmont Physiographic Provinces) and gently tilts and thickens to the southeast toward the Atlantic Ocean (fig. 2). The buried sands and gravels form a sequence of confined aquifers that is overlain by sandy deposits that form a surficial aquifer. These aquifers are the primary water supply for southern Maryland and the Eastern Shore.

Why is this Assessment Necessary?

1) Water Levels in the Aquifers are Declining at a Significant Rate

Withdrawals from Maryland Coastal Plain aquifers have caused ground-water levels in confined aquifers to decline by tens to hundreds of feet from their original levels (fig. 3). The current rate of decline in many of the confined aquifers is about 2 feet per year. The declines are especially large in southern Maryland and parts of the Eastern Shore, where ground-water pumpage is projected to increase by more than 20 percent between the years 2000 and 2030, with some regions experiencing significantly greater increases. Continued water-level declines at current rates could affect the long-term sustainability of ground-water resources in Maryland's heavily populated Coastal Plain communities and the agricultural areas of the Eastern Shore.

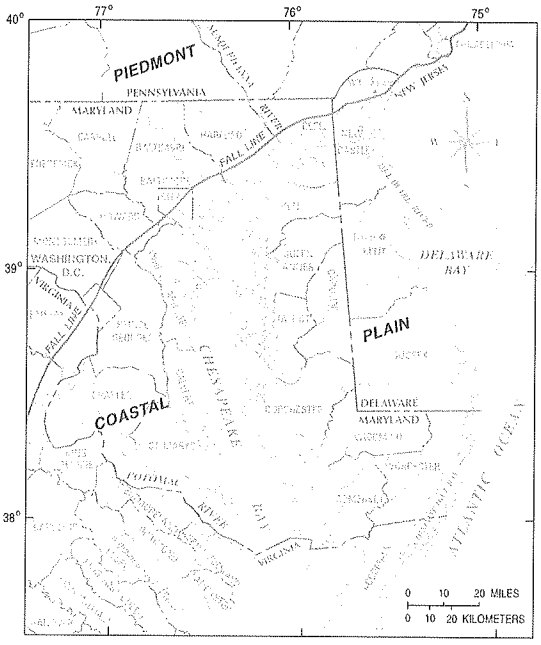

Figure 1. Extent of the Atlantic Coastal Plain in Maryland and adjacent states.

2) Water Quality in Some Areas is Significantly Compromised

Water quality in the Coastal Plain aquifers is a concern for several reasons. Contamination by saltwater intrusion is a significant water-quality issue for the confined aquifers, and has been documented in several of Maryland's waterfront communities. However, the potential for saltwater intrusion is not well known in the deeper parts of the aquifer system because few data are available. Some areas have problems with naturally high concentrations of trace-element contaminants (including arsenic and radium), and further evaluation of these public health issues is warranted. Elevated concentrations of nutrients and agricultural chemicals in the surficial aquifer is a significant concern, especially on the Eastern Shore, where shallow ground water is the water-supply source for many homeowners and provides much of the base flow to streams.

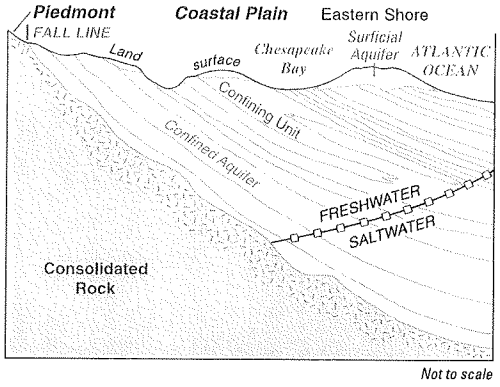

Figure 2. Schematic of the Atlantic Coastal Plain aquifer system in southern Maryland.

3) Ground-Water Resource Managers Need Better Tools

Water managers, policymakers, planners, and developers need to know how much ground water is available in the different areas of the Maryland Coastal Plain for public and domestic water supply, agriculture, industry, and electric power generation. Ground-water withdrawals in Maryland are managed by the Maryland Department of the Environment (MDE) through the Water Appropriations Permit Program. While studies of individual aquifers or multi-aquifer subregions are available, MDE needs more comprehensive

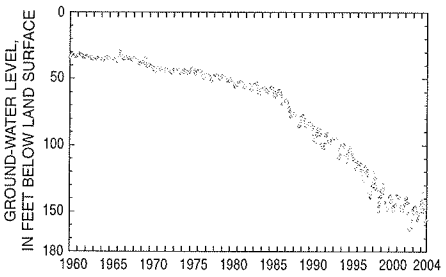

Figure 3. Hydrograph showing declining water levels in a well in the Aquia aquifer in southern Maryland.

and interactive tools for making management and permitting decisions. Specifically, MDE needs information systems and simulation tools to evaluate the effects of increased withdrawals on the entire aquifer system in important subregions and throughout the Maryland Coastal Plain. These tools need to take into account that some of the aquifers are units of a regional system that extends into and is used for water supply in adjacent states.

Evaluation of alternative water-management strategies requires enhancements in the monitoring networks for ground-water levels and streamflow throughout the Coastal Plain. Water managers and planners need to understand where and when continued withdrawal of ground water may reduce streamflow and/or induce changes in water quality that would require additional treatment or limit uses of the water resource.

Plans for the Comprehensive Assessment of the Coastal Plain Aquifer System in Maryland

In response to the Advisory Committee's 2004 report recommendations, MGS and USGS are preparing a science plan and implementation plans for conducting a comprehensive regional assessment of the Coastal Plain aquifers in Maryland and appropriate areas of surrounding states.

Comprehensive Assessment is Underway

MGS and USGS started Phase I of the Comprehensive Assessment in January 2006. Phase I activities are being jointly supported by funds and services from MDE, MGS, and USGS. Phases II and III of the assessment will require significant additional investment from current and new funding partners from 2008 to 2013.

Goals of the Assessment

- Document the geologic and hydrologic characteristics of the aquifer system in the Maryland Coastal Plain and appropriate areas of neighboring states.
- Conduct detailed studies of the regional ground-water-flow system and water budget for the Coastal Plain aquifer system in Maryland.
- Improve documentation of patterns of water quality in all Coastal Plain aquifers, including the distribution of saltwater.
- Enhance ground-water-level, streamflow, and water-quality monitoring networks in the Maryland Coastal Plain.
- Develop tools to facilitate scientifically sound management of the ground-water resources in the Maryland Coastal Plain.

Implementation Plans

PHASE I (2006-2008) *Getting Started and Building Partnerships*	PHASE II (2008-2012) *Filling in the Gaps and Building the Resource Management Tools*	PHASE III (2010-2013) *Using the Tools to Manage and Optimize the Resource*
• Develop an aquifer information system. • Refine the aquifer framework. • Determine management criteria. • Identify information gaps. • Develop plans for addressing gaps. • Build partnerships and inform the public.	• Develop and test ground-water-flow model. • Simulate flow system and conduct field studies of recharge and leakage. • Enhance ground-water-level and streamflow-monitoring networks. • Conduct water-quality studies.	• Develop optimization model. • Link flow and optimization models to create interactive management model. • Test water-management scenarios. • Inform partners and stakeholders.

For Additional Information, please contact:

Robert J. Shedlock
U.S. Geological Survey
Water Science Center
8987 Yellow Brick Road
Baltimore, MD 21237
(rjshedlo@usgs.gov)

David W. Bolton
Maryland Geological Survey
Maryland Department of
Natural Resources
2300 St. Paul Street
Baltimore, MD 21218
(dbolton@dnr.state.md.us)

Matthew Pajerowski
Maryland Department
of the Environment
1800 Washington Boulevard
Baltimore, MD 21230
(mpajerowski@mde.state.md.us)

USGS science for a changing world

MARYLAND DEPARTMENT OF NATURAL RESOURCES

MDE

Fractured Rock Water Supply Study

In the region of the State west of the Fall Line, ground water is obtained from fractured rock aquifers. Watershed based, water balance methods are used to determine if sufficient ground and surface water is available to supply the requested need without unreasonable adverse impact on the streams in the watershed. The evaluations are conducted by WSP staff using land use information and hydrologic data from a variety of databases. Increasing development pressures are expected to greatly increase the demand for water over the next 20 years. There is concern that some of the assumptions and limitations of the current water balance methods may result in unacceptable impacts on streams, particularly in heavily developed watersheds or watersheds where seasonal low flows are substantially lower than annual average flows. For example, the methodology may not fully account for the cumulative impacts of ground water and surface water withdrawals in the same watershed, may not be sufficiently protective during severe droughts, or may not account for the full impacts of water withdrawals concentrated in one part of a watershed. Information on the relationship between water quantity and stream ecology is limited, and thus it is difficult to predict the potential impacts of withdrawals on aquatic biota.

Some watersheds in the fractured bedrock areas of Maryland have already shown signs of reaching the limits of their ability to provide water without adverse impacts on ground water and streams. This is expected to occur more frequently as Maryland's population continues to grow. As the requests for new water withdrawals increase, it is critical that the Maryland water managers have a set of tools to assist in evaluating new requests for water.

MDE has proposed, with cooperation from the U.S. Geological Survey and the Maryland Geological Survey, a study of water supply in the fractured rock region of the State, with special emphasis on the Piedmont aquifers. The project would provide MDE with a set of improved tools with which to plan the development and management of ground and surface water in that part of Maryland underlain by fractured bedrock. These new tools will utilize the same watershed based, water balance concepts as the current methods, but they will allow decisions about future water withdrawals to be made more reliably and efficiently. These tools will also be user friendly, and make efficient use of staff time needed to evaluate permit applications.

The completed project will provide a set of tools that can be used by MDE staff to evaluate water availability and new permit applications in that part of Maryland north and west of the Fall Line, particularly in the Piedmont and Blue Ridge provinces. An Aquifer Information System, similar in concept to one developed for the Coastal Plain Aquifer Study, will be developed. This tool will include water use data, stream information, hydrogeologic information, well data, and precipitation data, and will present data in a geographical context. This tool will be linked with a second application that will allow users to estimate natural stream flows as well as the potential impacts of surface water or ground water withdrawals on stream flows.

The project will also correlate data from the Maryland Biological Stream Survey with the water availability and use data in an attempt to establish relations between stream flow, water withdrawals, and the diversity and/or abundance of riverine species or communities in Maryland. The results of this task will provide additional guidance for determining appropriate stream flows needed to protect aquatic resources.

Understanding the factors related to ground water availability in central and western Maryland is an important component of water resources management. Because stream base flow is derived entirely from ground water discharge, factors affecting ground water availability will have a direct bearing on stream flow. In addition, a number of communities in Maryland have experienced situations where numerous wells have been drilled in an attempt to locate wells with sufficient yield. This study will attempt to determine factors that influence ground water availability in various hydrogeologic settings.

Finally, two research watersheds will be established in the Piedmont/Blue Ridge province to address water resource issues that are not readily answered at a larger scale, and to establish sites for long term hydrologic monitoring. Issues that may be addressed include but are not limited to the relation between ground water withdrawals and stream flow, the effects of seasonal variability in recharge and withdrawals, the sensitivity of aquatic organisms to variations in stream flow, water availability in headwaters versus downstream areas of the watershed, and the effects of changing land use on surface and ground water availability and quality. Long term monitoring of biological and water resources at the watershed scale would enable researchers to identify cause-and-effect relationships as land use and other changes occur through time within the watershed.