

# Appraisal of the Northern Shenandoah Valley Carbonate Aquifer System, Frederick County, Virginia

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## Project Description

The carbonate aquifer system of the Northern Shenandoah Valley provides an important water supply to local communities. This is an area with an expanding economy and a growing population, and this aquifer is likely to be further developed to meet future water needs. An improved understanding of this complex aquifer system is required to effectively develop and manage it as a sustainable water supply. Hydrogeologic information provided by a detailed aquifer appraisal will provide useful information to better address questions about (1) the quantity of water available for use, (2) the effects of increased pumpage on ground-water levels and instream flows, (3) the relation between karst features and the hydrology and geochemistry of the surface- and ground-water flow systems, and (4) the quality of the ground-water supply and its vulnerability to current and potential future sources of contamination. The area to be considered in this study encompasses the carbonate formations in Frederick County, Virginia bounded on the east by the Martinsburg Formation, and on the west by Little North Mountain.



## Objective

The objective of this study is to better characterize the carbonate aquifer system in the Northern Shenandoah Valley and provide relevant hydrogeologic information that can be used to guide the development and management of this important water resource.



## Approach

This 3 1/2-year study began in October 2000 and will include 4 major work elements: (1) **Hydrogeologic Framework**, (2) **Ground-Water Flow System**, (3) **Water Balance**, and (4) **Water Quality**. A field reconnaissance will be completed, existing geologic, hydrologic, and associated information will be collected, organized, and evaluated, and limited field data collection activities will be conducted in Federal Fiscal Year 2001. Based on an evaluation of this information, field investigations will be expanded in Fiscal Year 2002 and 2003. Data analyses will be completed in 2003, and a final report will be produced in Fiscal Year 2004. Continued monitoring and further investigation of specific water management issues will likely be carried out thereafter.

This proposal describes the project scope and funding for Fiscal Year 2001 activities. An annual work plan describing proposed work elements and funding estimates will be produced in each of the following years.



Water supply well

## Hydrogeologic Framework

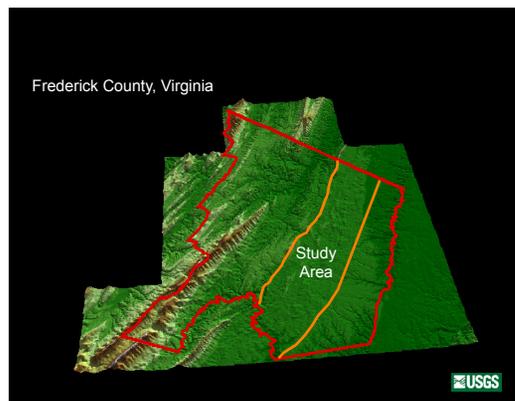
- Conduct a field reconnaissance of the study area to identify the major physical features and land use characteristics.
- Collect and evaluate published and unpublished geologic maps, and interview geologists who have conducted geologic mapping activities within the study area.
- Establish a preliminary subdivision of major formations, with descriptions of folds, faults, and prominent jointing (*finalize in 2002*).
- Field locate sinkholes and springs with GPS, enter into a geospatial data base, and describe their position and relation to geologic and hydrologic features.
- Interview local well drillers and geotechnical professionals, and collect, inventory, and evaluate selected well logs and geophysical logs (*if available*).
- Draft a preliminary description of the hydrogeologic framework (*revise and finalize in 2003*).



Domestic spring

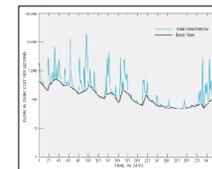
## Ground-Water Flow System

- Inventory existing wells and evaluate completion reports, water-level measurements, and well yield information.
- Establish a provisional water level monitoring network, survey wellhead elevations, and initiate periodic water-level measurements.
- Conduct synoptic water level measurements during high and low water conditions and provide a generalized water-table map (*expand synoptic network in 2002 and produce detailed water-table map in 2003*).
- Re-evaluate and revise observation well network at the end of the year and identify selected wells for ground-water age dating analyses (2002).



## Water Balance

- Identify sources of existing information and evaluate appropriate methods for measuring or estimating components of the water balance.
- Collect and evaluate appropriate data and identify additional data needs.
- Conduct field reconnaissance to identify locations for spring discharge and stream seepage measurements (*to be completed in 2002*).



## Water Quality

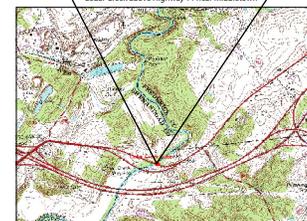
- Collect and organize existing surface- and ground-water quality information from the Frederick County Health Department, the Virginia Department of Environmental Quality, and other sources.
- Evaluate the data with respect to its suitability for geochemical analyses such as calculating saturation indices and reaction path modeling, and evaluate the data with respect to public health criteria for nitrates, bacteria, and toxics.
- Identify areas that require additional water-quality sampling and design a preliminary long-term water-quality monitoring network.

## Stream Gaging

One stream gage was constructed on each of **Cedar** and **Opequon Creeks** in the vicinity of where they enter the Martinsburg Formation. The gages were constructed in November 2000 and will be operated for the remainder of the study. The gages are equipped to record stream stage at 15-minute intervals and report stream discharge in near real time on the USGS web page. Discharge data will be archived and published in the USGS annual data report.



USGS Station No: 01635090  
Cedar Creek above Highway 11 near Middletown



USGS Station No: 01614830  
Opequon Creek near Stephens City

