Department of the Environment

Ground Water Protection Program
Fiscal Year 2011

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The Maryland General Assembly
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EXECUTIVE SUMMARY

Senate Joint Resolution No. 25 of 1985 requires the Maryland Department of the Environment (MDE) to provide an annual report on the implementation of a Comprehensive Groundwater Protection Strategy, and the coordinated efforts by State agencies to manage groundwater in the State. This document is the annual report of efforts to characterize, restore, allocate, conserve and protect groundwater through programs coordinated by MDE, the Maryland Department of Agriculture (MDA) and the Maryland Department of Natural Resources (MDNR) in fiscal year 2011. The report reflects the evolution of State programs in response to advancing science and increasing public interest in the quality and quantity of groundwater, and the State's continuing emphasis on citizen education and assistance to reinforce regulatory programs.

Groundwater is a finite natural resource that sustains Maryland's natural ecosystems in addition to supporting significant and growing human water supply demands. Approximately one third of Maryland's population currently depends on groundwater for drinking water. As the population in Maryland continues to grow, the demand for groundwater for drinking, irrigation, industry, and other uses is increasing, while threats to groundwater quality related to that development increase also. Programs to better understand and manage this critical resource must be strengthened to ensure that an adequate supply of groundwater is available for existing and future generations.

Highlights of groundwater management initiatives coordinated by the State during fiscal year 2011 (July 1, 2010 – June 30, 2011) include:

- In FY 2011 progress continued on the Regional Coastal Plain Assessment of the Maryland Coastal Plain. Phase I of the project is now complete, and work is ongoing for Phase II. Phase I work included revision of the hydrogeologic framework of the Maryland Coastal Plain and development of an Aquifer Information System, which is currently used by MDE staff to access information needed for water appropriation permitting decisions. Phase II includes development of a regional groundwater flow model.

- Work has also continued on the Fractured Rock Water Supply Study, which was initiated in 2009. Initial work focused on the development of a geospatially-referenced data base of stream flow, hydrogeology, water-use, and other appropriate information, and the determination of factors affecting groundwater availability in different hydrogeologic settings. An Aquifer Information System similar to that developed for the Coastal Plain study is also being developed for this region of the State.
- A stakeholder workgroup continued to meet during the year to develop regulations to implement SB 674 (2008), which authorizes the MDE to give priority to public water systems that provide water to a municipal corporation, when allocating groundwater in Carroll, Frederick, or Washington Counties. The group's work is nearing completion, and MDE expects to propose regulations during the next fiscal year.

- MDE continues to implement requirements that developers use environmental site design (ESD) to the maximum extent practicable to provide stormwater management. Counties and municipalities statewide are now implementing modifications to existing stormwater ordinances and plan review procedures to require better site planning, alternative surfaces, and small-scale runoff control practices on new development and redevelopment projects in an effort to replicate the runoff that would be expected from woods. Implementing ESD represents a significant change in the way development runoff is addressed in Maryland and marks another milestone in the evolution of a State program that has existed for nearly 30 years.

- MDE continues efforts to upgrade onsite sewage disposal systems through use of Bay Restoration Funds. Through April of 2011 septic systems serving 2,740 equivalent dwelling units have been upgraded to remove nitrogen with BRF grants.
- The Maryland Commission on Climate Change published its "Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change – Phase II: Building societal, economic, and ecological resilience" in January 2011. This report evaluates vulnerability and recommends adaptation strategies in six important areas, including water resources. MDE will be working in 2012 to implement the recommendations of the report.

INTRODUCTION AND BACKGROUND

The Maryland General Assembly passed Senate Joint Resolution No. 25 mandating the development of a Comprehensive Groundwater Protection Strategy for the State in 1985. The Assembly charged the Department of the Environment (MDE), the Department of Agriculture (MDA) and the Department of Natural Resources (MDNR) with responsibility for groundwater protection in Maryland, designated MDE as the lead agency, and required MDE to provide an annual report on the coordinated efforts by State agencies to protect and manage groundwater.

A steering committee formed by MDE, MDA and MDNR produced Maryland's Comprehensive Groundwater Protection Strategy in 1986. The Strategy described the State's existing groundwater protection programs, established groundwater protection goals and recommended ways to improve groundwater protection. The Maryland Groundwater Protection Strategy, originally developed in 1986, is guided by the following goal:

> *The State of Maryland is committed to protect the physical, chemical and biological integrity of the groundwater resource, in order to protect human health and the environment, to ensure that in the future an adequate supply of the resource is available, and in all situations, to manage that resource for the greatest beneficial use of the citizens of the State.*

State, federal and local agencies continue to work cooperatively to achieve this goal with programs that educate business, industry, and the public about the importance of water protection and conservation, in concurrence with programs that enforce federal and State water protection laws. Maryland has become a leader in the implementation of land use practices that minimize the impacts of development on surface and groundwater with best management practices, sensitive area protection (forests, wetlands, groundwater recharge areas, etc.) and Smart Growth that promotes development in regional growth centers where transportation and other public infrastructure are already in place.

This report provides an overview of the condition of Maryland's groundwater resources and a description of efforts in fiscal year 2011 to characterize, restore, allocate, conserve and protect groundwater through programs coordinated by MDE, MDA, and MDNR**.**

MARYLAND'S GROUNDWATER RESOURCES

Groundwater is an abundant, but finite natural resource that sustains Maryland's natural ecosystems and growing population. Groundwater is the source of crucial, continuous base flows to Maryland's rivers, streams and wetlands. It is also a large source of the freshwater that flows to the Chesapeake Bay and to coastal bays. At the same time, groundwater provides an increasing supply of freshwater for residential, agricultural, industrial, energy production and other uses in Maryland. About half of the Marylanders using groundwater for drinking water obtain water from a well that they own, while the other half obtain their drinking water from public water systems that use groundwater. In southern Maryland and the Eastern Shore, groundwater meets practically all water supply needs.

Geology/Natural Conditions

Geologic conditions vary widely across the State, and produce significant variations in the quantity and quality of groundwater. Aquifers in Maryland fall into two major types: unconsolidated Coastal Plain aquifers found east of the Fall Line (a geologic divide that generally coincides with the Interstate 95 corridor), and hard rock aquifers found in the western part of the State. Coastal Plain aquifers composed primarily of sand and gravel layers separated by layers of silt and clay, are productive and generally of good quality. Hard rock aquifers are composed of consolidated sedimentary and crystalline rock, and provide generally low to moderate water yields.

Unconfined aquifers are found throughout the State, and are the primary source of groundwater in the western part of the State. Water levels in these aquifers undergo seasonal fluctuation and are principally recharged by precipitation during the fall and winter months. Confined aquifers, in contrast, are not as directly influenced by precipitation and climate changes because they are separated from the ground surface by relatively impervious layers such as silt, clay or rock. Such aquifers are the primary source of drinking water in southern Maryland and the Eastern Shore. The water levels in certain confined aquifers in southern Maryland and in the Aquia aquifer in Queen Anne's County show long-term steady declines in areas of high use. Increased water demands from a growing population place new stresses on these aquifers. More detailed monitoring and analysis of the State's groundwater resources is needed to assess the long-term viability of many of the State's aquifers in the face of existing and increasing demands for water.

In the Piedmont region, where aquifers consist largely of fractured, consolidated bedrock, successful groundwater production depends on the size and number of water-bearing fractures encountered at a particular well site. Consequently, some fractured-rock aquifers have the lowest yields in the State. Consolidated rocks of sedimentary origin, which can be found in parts of the Piedmont, Valley and Ridge, and Appalachian Plateau regions, can yield higher amounts of water than fractured rock aquifers. Carbonate aquifers have some of the highest yields of consolidated aquifers in Maryland due to the presence of potentially large solution cavities, a factor that also renders them susceptible to contamination from surface sources.

Declining water level trends in some areas of southern Maryland have raised questions about the long-term sustainability of current groundwater withdrawals. On the Eastern Shore, increases in agricultural irrigation and urban growth continue to place greater demands on groundwater supplies. The uncertain degree to which groundwater moves between different aquifers in the Coastal Plain is a major obstacle to reliable predictions of sustained aquifer yields in both Southern Maryland and the Eastern Shore. In hard rock aquifers in the western part of Maryland, the availability of groundwater to meet the increasing demands of growing communities is also uncertain, particularly where growth is concentrated.

Groundwater Quality Issues

Except in some urban and industrial areas, Maryland's groundwaters are generally of good quality and meet drinking water standards. Incidents of serious contamination are usually localized near specific contamination sources. However, geologic conditions in some areas of the State make groundwater more vulnerable to anthropogenic influences. Areas most susceptible to groundwater contamination from local land use are the carbonate rock areas of Allegany, Washington, Fredrick, Carroll and Baltimore Counties; the unconfined Coastal Plain aquifers; the outcrop areas of major confined aquifers along the Baltimore-Washington corridor; and the hard rock aquifers of central and western Maryland. Potential contaminant sources include point sources such as landfills, underground storage tanks, spills, improper discharge of wastes containing solvents (such as dry cleaning fluids) and improper storage of salt or other materials on bare ground. Military installations often present unique risks such as contamination from perchlorate, an ingredient of solid rocket propellant.

Nonpoint sources of groundwater contamination include livestock waste, onsite sewage disposal, application of fertilizers and pesticides, infiltration of urban runoff and road salt application. Nonpoint sources usually do not cause excessive contamination at specific well locations but often represent the largest loadings of pollutants to groundwater over large areas. Because groundwater contributes a significant percentage of water to surface water flow, delivery and reduction of nutrients via groundwater is a significant issue for Maryland's streams and reservoirs, and has a major impact on water quality in the Chesapeake Bay.

Local natural conditions affect both the availability and the quality of groundwater. While natural groundwater quality is generally good, some areas may have hard water and locally high iron levels. Surveys of naturally occurring radionuclides in groundwater have shown that portions of the Magothy and Potomac Group aquifers in the Coastal Plain, primarily in Anne Arundel County, are subject to high levels of radium. The Piedmont Aquifers of central Maryland often have elevated radon levels. Levels of naturally occurring arsenic above the federal drinking water standard are not uncommon in the Aquia and Piney Point aquifers in southern Maryland and the central Eastern Shore, and in Garrett County. In portions of the carbonate rock aquifers of Central and Western Maryland, groundwater may be directly influenced by surface water, presenting the risk of pathogen contamination.

In the past, Maryland's water resources were generally sufficient to meet all needs. Drought related water restrictions in 2002 and increasing building moratoriums due to localized

water shortages however, provide evidence that water supplies are finite and are insufficient in some circumstances to meet current demands. Maryland's population is expected to increase by about 1.1 million over the next 25 years. The additional pressures of a growing population will further tax the State's water resources.

As water demand increases with population growth, communities find it increasingly difficult to find sufficient quantities of water without reaching beyond the boundary where they have a clear right to withdraw groundwater. The need to preserve some groundwater as base flow discharge to local streams and wetlands also affects its availability for withdrawals. In some areas, water quality concerns can limit the quantity of water available for withdrawal. For example, the threat of brackish water intrusion into the Aquia aquifer beneath Kent Island has precluded its full development as a drinking water supply source. In other instances, groundwater contamination due to a variety of human activities has affected water withdrawals at numerous sites.

Reliable assessments of water availability cannot be made without additional monitoring and modeling of groundwater movement within and between aquifers. Such information is needed to better predict the movement of groundwater contaminants as well. Estimating the sustainable yield of the State's aquifers will be an essential step in assessing the adequacy of Maryland's groundwater to meet the needs of current and future generations and their environment.

GROUNDWATER RESOURCES MANAGEMENT

The following summary of State groundwater protection programs and actions in FY 2011 reflects a response to increasing public interest in the quantity and quality of groundwater and advances in hydrogeology and other groundwater related sciences. These interrelated programs are presented in this report in the following categories: Coordination of Groundwater Protection; Demand Management, Water Conservation and Water Reuse; Drought Management; Monitoring and Assessment; Planning; Public Water System Oversight; and the Water Appropriation and Use Permit Program. Additional activities related directly to water quality are considered separately in the following chapter of this report.

Coordination of Groundwater Protection

The U.S. Environmental Protection Agency (EPA) provides funding through §106 of the Clean Water Act to assist in the coordination of groundwater protection activities. Maryland's annual funding for this program is approximately $385,000. These funds are used to support the coordination of activities around the State, including groundwater assessment projects, wellhead protection efforts and educational outreach activities.

Data Management

The Department currently uses an Enterprise System that incorporates and links information throughout the Department, allowing easy transfer of accurate, up-to-date information among various programs.

MDE's Water Supply Program has initiated development of a new data management system for managing water appropriation permits, to replace the existing legacy RAMS/WAN system. This new data management system will facilitate the issuance, management, and enforcement of water appropriation permits through a geographically-based system that is web-accessible. The system will allow permittees to report pumpage data electronically and will allow the Department to analyze usage patterns in order to better plan for and manage water withdrawals throughout the State.

MDE's Water Supply Program is also in the process of replacing its Public Drinking Water Information System (PDWIS) with the EPA's Safe Drinking Water Information System (SDWIS) database.

Maryland Groundwater Symposium

Each September, the Water Supply Program sponsors the Maryland Groundwater Symposium. This event has continued to evolve as a key source of topical information on the most current issues affecting groundwater management in the State. In September 2010, the nineteenth annual symposium attracted about 430 sanitarians and other groundwater professionals from local governments, State and federal agencies, and private sector

organizations. More than thirty presenters addressed a variety of topics related to groundwater, including, but not limited to, groundwater hydrogeology, water use, marcellus shale, implementation of requirements for onsite sewage disposal systems, and planning efforts related to water supply.

Demand Management, Water Conservation, and Water Reuse

As the need for increased water supply capacity intensifies, there has been a corresponding increase in the importance of managing demand as a means for extending water supplies and delaying or eliminating the need to develop new sources. Sound water use practices reduce the amount of stress that we place on our resources, both by limiting water withdrawals and by decreasing wastewater discharges. Managing demand is one important and relatively inexpensive alternative that water suppliers can use to meet their water supply needs.

Water efficiency technologies, water reuse, and behavioral changes can reduce water demand by at least ten to 20 percent, effectively extending existing water supplies. Demand management strategies can include a variety of options. Potential approaches include reducing losses from leakage, implementing rate structures or rate surcharges that encourage customers to conserve, providing incentives for customers to install low-flow fixtures or appliances, working individually with large-volume users to identify potential water savings, and using public outreach and education to encourage consumers to modify their behavior.

Demand Management

Use of demand management technologies is not widespread in Maryland. Guidance issued by MDE and the Maryland Department of Planning (MDP) to assist local governments with meeting the requirements of House Bill 1141 (2006) encourages local governments to undertake demand management as one aspect of their strategies to meet future water needs. Currently, however, there is not a well-developed State-level program to assist local governments to implement demand management programs.

The 2008 Report of the Governor's Advisory Committee on the Management and Protection of the State's Water Resources recommended that State water policies encourage water suppliers, commercial and residential users, and industries to utilize incentives, water conservation, and water reuse technologies in order to reduce water demand.

Water Conservation Act

The Maryland Water Conservation Act, passed during the 2002 legislative session, requires that as water appropriation permits for large water systems are renewed or expanded, that they be modified to require that these utilities consider certain conservation measures. The Maryland Water Conservation Act also required MDE to produce guidelines on water conservation best management practices for water utilities. This document was published in October 2003 and is available on MDE's website. For this reason, MDE requires water systems

applying for loans and grants to include a water audit with their application, and if funds are awarded, to develop water conservation plans.

Water Reuse

Revised guidelines for land treatment of municipal wastewater were finalized and adopted into regulation in April 2010. These new regulations allow high quality effluent to be used in public areas such as parks and athletic fields.

A stakeholder group is now working to develop comprehensive regulations for the use of highly treated wastewater treatment plant effluent in a variety of settings including "purple pipe" systems to deliver reclaimed water for nonpotable residential use. The stakeholder workgroup has reviewed similar regulations that have already been developed by other states, and is in the process of formulating new regulations. This has involved working with the Maryland Plumbing Board to ensure a coordinated approach.

Drought Management

In January 2001, MDE began evaluating hydrologic conditions using a plan developed by the Statewide Water Conservation Advisory Committee. Conditions are evaluated on a regional basis, and drought status is assessed monthly during normal conditions and more frequently when drought conditions exist. During a period of drought emergency, MDE coordinates with local governments through a network of local drought coordinators and maintains continual contact with water suppliers to ensure that the detrimental impacts of a drought emergency are minimized. During FY2011, MDE worked with the USGS to add "real-time" monitoring capability to eight network wells. This improves data availability and allows the State to better monitor drought conditions

MDE's website currently shows hydrologic conditions and drought assessment data and is available to the public on MDE's website. Regional assessments, however, may not be adequate to predict water shortages at specific localities and/or water systems. Some local governments have developed individualized drought response plans to meet their specific communities' needs. Drought assessments were "normal" for all of FY2011.

Monitoring and Assessment

Many of the initiatives described below are ongoing efforts that provide critical support to other State groundwater management programs. Although these programs provide crucial short term information, their primary value will be the comprehensive picture of groundwater resources that they will provide over time. It is essential that long range funding is provided to assure the maximum benefit of the groundwater assessment efforts.

Coastal Plain Groundwater Study

In 2004, the Maryland Advisory Committee on the Management and Protection of the State's Water Resources identified the need for a comprehensive assessment of groundwater resources in the Maryland Coastal Plain, where the population is expected to grow by 44 percent between the years 2002 and 2030. Withdrawals from the confined aquifers of the Coastal Plain in southern Maryland and the Eastern Shore have caused water levels in some aquifers to decline by tens to hundreds of feet from their original levels, and the rate of decline is expected to increase as the population in these areas grows. A more comprehensive understanding of the confined aquifer systems and how much water is available in these systems is needed in order to make sound management decisions and appropriately evaluate water withdrawal requests. Through funding for MDE, the first phase of a three-phase Regional Coastal Plain Aquifer Assessment began in 2006.

In FY 2011 MDE provided funding for the U.S. Geological Survey (USGS) and Maryland Geological Survey (MGS) to complete work on Phase I of the Regional Coastal Plain Assessment of the Maryland Coastal Plain. Activities included development of an upgraded aquifer information system, compiling additional hydrologic and geologic data, reevaluation of groundwater monitoring needs, and further refinement of selected aquifer systems through the installation of 18 new observation wells and one continuous corehole. Model prototypes were developed for a regional groundwater model. Data were collected that will help to define the groundwater flow system, and will inform the design of the regional groundwater model. These data collection efforts included ages of selected groundwater samples, and water chemistry data related to the recharge and discharge rates of groundwater. All Phase I tasks were completed in SFY 2011, and workplans were written for Phase II and III tasks.

The funding that was provided in FY 2011 by MDE to USGS and MGS for Phase II activities included initial work on development of a regional groundwater flow model and preparation of reports documenting the hydrogeology of the Maryland Coastal Plain. Phase II activities will eventually include conducting detailed studies of the regional groundwater flow system and water budget, improving documentation of patterns of water quality in the aquifers, enhancing groundwater level, stream flow, and water quality monitoring networks, and developing tools to facilitate scientifically sound management of the groundwater resources in the Maryland Coastal Plain. Phase I and II activities have been jointly supported by funds from MDE and in-kind services from MDE, MGS, and USGS. Phases II and III will require significant additional investment from current and new funding partners from SFY 2012 to 2016.

Fractured-Rock Water Resources Study

The Final Report of the Maryland Advisory Committee on the Management and Protection of the State's Water Resources identified the need for a comprehensive assessment of water resources in the part of Maryland underlain by fractured-bedrock aquifers (which covers the area of the State north and west of Interstate 95). This part of Maryland is particularly susceptible to drought, because groundwater is mostly unconfined and responds directly to recharge (or the lack thereof). In FY 2011, the MGS and the USGS continued the first part of this evaluation that, if fully implemented, will take five years to complete. In FY 2011, work has

focused on Frederick County and selected adjacent areas as a pilot study for the larger fractured-rock project. Activities have included compiling hydrologic, geologic, and water-use data, which were incorporated into the beta version of a geospatially-referenced database. Two reports were published documenting work related to streamflow statistics, which will be used in later phases of the study on ecological flow needs and to develop groundwater budgets. Selected municipal water supply wells were logged with geophysical tools, which were used to evaluate flow rates and water-bearing characteristics of fractures in the aquifers. Work proceeded on other study tasks, including classification of areas with similar groundwater characteristics, an evaluation of factors affecting groundwater availability in different hydrogeologic settings, and preparation of a science plan that will guide study activities in subsequent years.

Evaluation of Salt-Water Intrusion into Maryland's Coastal Aquifers

Aquifers in several coastal areas of Maryland have experienced salt-water intrusion as a result of over-pumping of the aquifers. MGS has continued to monitor and assess the effects related to saltwater intrusion in FY 2011. Annual groundwater-quality monitoring continued on Kent Island, where salt water has intruded into the Aquia aquifer on the Eastern Shore of the Chesapeake Bay. In Ocean City, chloride concentrations from intruding seawater approach undesirable levels at some locations. USGS monitors groundwater levels and chloride levels in about 25 wells in the Ocean City area, and provides Ocean City with a summary report at the end of each year. The annual report also includes pumpage amounts from Ocean City's production wells.

Maryland Groundwater Quality Monitoring Network

The Maryland Groundwater Quality Monitoring Network is an ongoing monitoring effort intended to document the chemical quality of Maryland aquifers. In FY 2011, water samples were collected from wells in the Aquia and Piney Point Aquifers in southern Maryland and the Eastern Shore, where arsenic concentrations frequently exceed the Maximum Contaminant Level of ten (10) micrograms per liter. The purpose of these samples was to (1) determine the concentrations of the different forms of arsenic in these aquifers, which is critical to assessing water-treatment options, and (2) acquire additional geochemical data in order to provide a better understanding of arsenic mobilization in these aquifers.

Groundwater Level Monitoring

Water-level data are collected on an ongoing basis by MGS and USGS from several statewide, regional, and county networks. Statewide, Maryland's groundwater network consists of approximately 150 wells that are monitored at intervals ranging from continuous recording (mostly in the unconfined aquifers) to biannually (in confined aquifers). Additionally, about 270 wells in the Maryland Coastal Plain are measured once a year to monitor effects of groundwater withdrawals by power plants and other users; these data are used to publish potentiometric-surface maps for major aquifers. Several counties also support additional water-level groundwater monitoring by MGS and USGS. All data collected by MGS and USGS personnel are stored in the USGS-NWIS database and are published annually.

Planning

Climate Change

MDE's Water Supply Program has been closely involved with both State and federal efforts to develop recommendations for adaptation approaches to address potential water resources impacts from changing climate conditions. The Maryland Commission on Climate Change published its "Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change – Phase II: Building societal, economic, and ecological resilience" in January 2011. This report evaluates vulnerability and recommends adaptation strategies in six important areas, including water resources. MDE will be working in 2012 to implement the recommendations of the report. Water Supply Program staff were also involved in the development of the Environmental Protection Agency (EPA)'s new report "National Water Program Climate Change Strategy: Key Action Update for 2010-2011". The Water Supply Program is currently working with EPA to develop a brochure focused on educating water utilities in Maryland about the potential impacts of climate change and possible strategies utilities might use to reduce vulnerabilities.

Piedmont Water Supply and SB 674

Maryland follows the Reasonable Use Doctrine of water rights, which holds that every property owner has a right to make a reasonable use of the water associated with his or her property, as long as the use does not have unreasonable impacts on the water resource or other users of the resource. When evaluating available water supplies for a community using unconfined groundwater sources, the Water Supply Program uses a water balance criteria, which requires the community to own land with sufficient water resources to support the desired water use.

Smart Growth development concentrates water use in high-density population areas. These areas do not always have sufficient local water sources available to meet concentrated demand. In particular, the towns that rely on groundwater from hard rock aquifers may exceed the sustained yield of their water supply aquifers as high-density population growth occurs in the area. Only towns using groundwater as their sole source struggle with the problem of needing sufficient land area to meet their water supply needs, as the water balance criteria is not applied to surface water withdrawals when issuing water appropriation permits. Towns relying on water from Coastal Plain Aquifers, however, such as those in southern Maryland and the Eastern Shore, generally rely on deeper confined aquifers, which are not subject to the water balance criteria.

During the 2008 legislative session, the Maryland General Assembly passed SB 674, which authorizes MDE to give priority to public water systems that provide water to municipal corporations when allocating groundwater in Carroll, Frederick, or Washington counties. This legislation was developed collaboratively with the Maryland Municipal League, the affected counties, and MDE, with the goal of protecting the State's water resources and private property

interests while at the same time promoting Smart Growth. MDE has been meeting with a stakeholder's workgroup to develop regulations for implementing this law.

The stakeholder workgroup began meeting in February 2009 to develop appropriate policies and draft regulations to implement the intent of SB674. The stakeholder group has reached consensus on an approach for allocating water to municipalities in Carroll, Frederick, and Washington Counties, and regulations are expected to be finalized within the next year.

Water Resource Elements

During the 2006 legislative session, the Maryland General Assembly passed HB 1141, which was signed into law on May 2, 2006 and codified as Chapter 381. This law added new requirements for local governments to examine more thoroughly the effects of proposed land use on streams and wetlands, forest and agricultural conservation lands, water supplies and water quality to avoid negative impacts to the State's natural resources. In particular, the law requires local governments to include a Water Resources Element (WRE) in their Comprehensive Plans and requires MDE and the Maryland Department of Planning (MDP) to provide data and technical assistance and to review the plans.

Maryland's county and municipal governments have long had the primary responsibility for land use planning under existing State law. The provisions of HB 1141 will enhance local planning efforts by requiring comprehensive plans which include adequate water supply, acceptable wastewater treatment and assimilation, and water resource protection. MDE and MDP have assisted local governments in implementing the new requirements. Consideration of critical water resource needs early in the development planning process will result in more economical and effective development and resource protection.

MDE employees have worked closely with several multi-jurisdictional planning teams to assist them in developing their WREs. Jurisdictions were required to submit their plans by October 2009; however, many have applied for a six- or 12-month extension. To date, MDE has reviewed 123 county and municipal WREs.

Water and Sewerage Planning

Counties are required by law to develop and maintain water and sewerage plans to provide for the orderly development and extension of community water supply and sewerage systems. The Advisory Committee on the Management and Protection of Maryland's Water Resources identified a significant need for improvement in many of these plans in order to fulfill their potential as a water supply and resources planning tool. The Committee recommended more meaningful technical and financial support to county governments to assist them in preparing stronger and more comprehensive water and sewer plans. MDE routinely reviews county water and sewerage plans to identify and address issues that pertain to source water protection, water supply capacity, and Safe Drinking Water Act requirements.

Public Water System Oversight

Groundwater continues to be a reliable and safe source of drinking water for thousands of Maryland residents. MDE's Water Supply Program is responsible for ensuring that public drinking water in Maryland is safe and adequate. Statewide, there are about 474 community public drinking water systems, of which about 422 use groundwater as their only water source. These groundwater systems serve more than 600,000 residents. Additionally there are about 2,950 Maryland facilities defined by the Safe Drinking Water Act as non-community public water systems that rely on groundwater. These small facilities include schools, day care centers, office buildings, restaurants, churches, community centers, and campgrounds that use their own groundwater wells.

New Regulatory Initiatives

Although the Surface Water Treatment Rules are mainly focused on surface water systems, they also apply to groundwater systems where the source is under the direct influence of surface water. Two separate enhancements of the Surface Water Treatment Rule are currently being implemented for groundwater systems.

The Long Term I Enhanced Surface Water Treatment Rule was adopted in Maryland in April 2005. MDE implements the regulation, which requires water systems to employ certain treatment techniques, including maintaining appropriate turbidity levels, in order to reduce the risk of *Giardia* and *Cryptosporidium* contamination in the water supply. The Long Term II Enhanced Surface Water Treatment Rule was adopted in Maryland in December 2009. Under this regulation, surface water systems and groundwater systems under the influence of surface water are required to monitor for *Cryptosporidium* and *E. coli* in order to determine the vulnerability of the source water, and to determine what treatment improvements must be completed in the next ten years in order to provide up to 6.0 log removal of *Cryptosporidium*. The largest water systems that serve over 10,000 persons have completed their testing for *Escherichia coli* (E.coli) and *Cryptosporidium*; the smaller water systems that serve fewer than 10,000 persons will complete monitoring in the next year. Based on the initial testing, two water systems will be required to provide improved water treatment for *Cryptosporidium*.

On October 12, 2006, the EPA finalized the Groundwater Rule, which is intended to provide increased protection against microbial pathogens in public water systems that use groundwater sources. The new rule will apply to public drinking water systems that use groundwater. The rule also applies to any system that mixes surface and groundwater, if the groundwater is added directly to the distribution system, and provided to consumers without treatment. Beginning in December 2009, Maryland began early implementation activities for the Groundwater Rule based on the federal regulations. As of March 7, 2011, the Groundwater Rule regulations are effective in Maryland. The new rule provides the State additional authority for requiring water system improvement that will improve drinking water quality. Since its implementation, a few water systems with contaminated sources have been identified and corrective actions taken. This regulation will ensure that the drinking water sources are more closely evaluated on a regular basis.

Water Quality Monitoring

A significant amount of sampling occurs at public water systems to determine whether the water that is supplied to customers is in compliance with State and federal drinking water standards. Sampling requirements depend on the system's type, size, vulnerability, the source type, and the contaminant. Community groundwater systems are subject to monitoring requirements for more than 90 contaminants that have health-based standards or maximum contaminant levels. There are also 40 unregulated contaminants that some systems may also test. Small public drinking water systems often use groundwater with little or no treatment. The most common treatment objectives to improve groundwater quality, in descending order, are disinfection, pH adjustment, iron removal, corrosion control, inorganics removal, softening, particulate removal, organics removal, manganese removal and radionuclide removal.

Wellhead Protection

In order to protect public water supply wells from contamination the Water Supply Program implements the Wellhead Protection Program (WHPP) in wellhead protection areas (WHPA) around each well. Existing and potential sources of contamination are identified, and management plans are developed to identify the best means for protecting the water supply source. EPA approved Maryland's Wellhead Protection Program in June of 1991. MDE's Water Supply Program coordinates wellhead protection activities among State agencies, public water suppliers, local governments and the public, assists local governments in delineating WHPAs and in developing management programs to protect water supplies. Participation at the local level is voluntary.

In FY 2011, MDE's Water Supply Program finalized an Invitation for Bids (IFP) for implementing WHPPs for twenty vulnerable systems. Contractors have been selected, and the project is awaiting final approval from the Maryland Board of Public Works. Work is expected to begin in the Fall of 2011.

MDE's Water Supply Program staff works closely with the Maryland Rural Water Association's (MRWA) source water protection technician to promote wellhead protection for the small public water supplies in Maryland. The technician meets with water suppliers and community representatives throughout the State, and provides an important link between MDE and local water supply protection efforts. MDE has provided MRWA with funds to purchase and install Drinking Water Protection Area signs in wellhead protection areas for several systems interested in protecting their water supply. Signs have been installed at wellhead protection boundaries for about 15 systems, and additional installations are planned for other systems.

Well Siting

One priority for MDE's Water Supply Program is to ensure the safety of new public water supplies by reviewing and evaluating proposals for the siting of new wells. To ensure that wells are sited in the safest locations, staff review Departmental databases to identify existing or potential contamination sources, and use site investigations to verify this information and

evaluate any additional factors that might influence the safety of the water supply. In FY 2011, the Water Supply Program reviewed proposals for the siting of approximately 21 new public water supply wells.

Water Appropriation and Use Permit Program

Land development increases the demand for groundwater withdrawals. Groundwater is a major source of drinking water throughout the State, and the only feasible source on the Maryland Atlantic Coastal Plain. MDE's Water Supply Program has the responsibility of controlling the impacts of groundwater withdrawal through the water appropriation and use permit process.

Senate Bill (SB) 970 signed into law in May 2007, and codified at *Maryland Code Annotated*, Environment Article §5-502, exempts most groundwater withdrawals of 5,000 gallons per day (gpd) or less from the requirement to obtain a permit. Other exemptions include temporary construction dewatering (up to 30 days and 10,000 gallons per day), individual domestic use, agricultural use under 10,000 gallons per day and extinguishing a fire. Permits must still be obtained for public drinking water systems and withdrawals located in groundwater management strategy areas.

SB 970 (Environment Article §5-514-516) also enacted civil penalties for violations of appropriation regulations, or failing to comply with a water appropriation and use permit. These changes will allow MDE staff to focus on the larger, more complex permit applications and to enforce the permit requirements more effectively.

MDE evaluation of Water Appropriation and Use Permits includes aquifer testing, fracture trace analysis, water level monitoring, evaluation of water balance, and other similar investigations. MGS and USGS groundwater data and modeling are also used in the evaluation. Review criteria are applied to determine whether the amount of water requested is reasonable for the proposed use, and whether the proposed use will adversely impact the resource or other users. Through the permit review process, the Water Supply Program attempts to assure that groundwater withdrawals do not exceed the sustained yield of the State's aquifers.

In addition, MDE has delineated some areas for special groundwater management consideration. Management options include limiting withdrawals in a certain aquifer, directing withdrawals to a different aquifer, or additional scrutiny and/or water level monitoring when permits are requested for these areas. To prevent further degradation of the Aquia aquifer, new appropriations for Kent Island are directed to deeper aquifers. Special management considerations are taken into account when permitting withdrawals for the Aquia aquifer in the Annapolis Neck area of Anne Arundel County, the Magothy and upper and lower Patapsco aquifers in the Indian Head and Waldorf areas of Charles County, and the Columbia aquifer beneath the Ocean Pines area in Worcester County.

Waters that are considered Tier II are streams that have water quality that is higher than the existing water quality standards, or that have a high index of biological integrity. State law

requires that these special waters be protected from degradation. Regulations governing discharges include special requirements for Tier II waters. MDE requires applicants in Tier II watershed to conduct more detailed analysis of withdrawals to protect the stream segments.

MGS and USGS maintain monitoring wells to measure chloride levels at Kent Island and Ocean City. These data networks are continuously maintained to characterize trends caused by long-term changes in natural and anthropogenic conditions. This data is used to determine the success or failure of best management practices and regulatory policies, and provide a historical record to calibrate computer models of future conditions.

Steadily declining well water levels are a matter of concern to local residents in some areas of the State. Telescoping wells constructed with small diameter casings have resulted in the inability of homeowners to continue to withdraw water as the potentiometric surface declines. Usually, additional water is available but cannot be tapped because pumps cannot be lowered to reach new drawdown levels. The water level data that is obtained by MGS and USGS is used by MDE's Water Supply Program in evaluating water appropriation and use permit applications. Groundwater modeling helps project the impacts of comprehensive land use plans and provide guidance for future development.

Communities in the Piedmont region sometimes do not have sufficient water supplies to support projected growth. One problem can be that the available yield from wells often does not provide the amount of water that the system was permitted to withdraw, or that the original pump tests indicated that the wells would achieve. The economic downturn has resulted in less rapid growth in these areas, however it is anticipated that these communities could experience water supply deficiencies when economic conditions change. It is important that communities in this region of the State continue to develop plans to reduce demand, manage growth, and seek alternative water supplies.

Agricultural water use has been growing steadily in recent years, particularly for irrigation on Maryland's Eastern Shore. In general, MDE directs large irrigators to use the unconfined aquifers, reserving the more protected confined aquifers for individual potable and municipal uses. In some areas, however, the unconfined aquifer produces low yields, or is nonexistent, compelling an increasing number of farmers to seek water appropriation permits for confined aquifers.

WATER QUALITY PROTECTION AND RESTORATION

Groundwater supplies in Maryland are impacted by both natural influences and human-induced contamination. Population growth and development over the past 50 years has impacted water quality in both agricultural and urban areas in the State. Although Maryland has many programs in place to minimize and remediate existing groundwater contamination, threats to groundwater quality increase as new homes, new commercial development, and new roads are built to meet the needs of a growing population.

Drinking Water Quality Issues

A number of contaminants pose a concern for drinking water quality, both for public drinking water systems (facilities serving 25 or more people a day) and for individual wells. EPA establishes drinking water standards for more than 90 contaminants. Public drinking water systems are required by Federal law to monitor regularly to assure compliance with EPA standards, and in Maryland, these standards apply also to wells serving individual homes. However, individual wells are typically tested only for limited contaminants (bacteria and nitrates) when the well is first drilled; any subsequent testing is at the discretion of the homeowner.

Arsenic

MDE's Water Supply Program works closely with public water systems to ensure compliance with new federal and State regulations. Effective January 2006, the drinking water standard for arsenic was reduced from 50 parts per billion to 10 parts per billion. The lower arsenic standard will help to reduce the risk of cancer resulting from exposure to arsenic in drinking water. Sixty-five of the 69 public water systems in Maryland that had arsenic levels above the revised standard are now in compliance. Testing is still occurring at one of the 69 systems to evaluate their water supply, and the remaining three systems are in violation of the Arsenic maximum contaminant level. MDE continues to work with each of the water systems to help them to achieve compliance with the arsenic standards.

On the Eastern Shore and southern Maryland, arsenic in drinking water sources is from naturally occurring deposits in the underlying aquifers. Maryland has also identified arsenic contamination in western Maryland, but the source of the arsenic in the drinking water has not been specifically identified. Early evaluations of the groundwater in this part of the State indicate that Garrett County arsenic may be linked to coal in the hard rock aquifer, and that arsenic in the Carroll County aquifer may be linked to an external contamination source, such as pesticides.

In Maryland, any drinking water standard adopted for public water systems also applies to individual water supplies. Groundwater arsenic levels in some parts of southern Maryland and the Eastern Shore are known to exceed the EPA's Maximum Contaminant Level (MCL) of 10 parts per billion. Local health departments have sampled extensively in the counties throughout

southern Maryland and the Eastern Shore over the past four years to determine the extent and degree of arsenic contamination in these areas.

In FY 2010, the Maryland Geological Survey published *Report of Investigations No. 78* entitled "Arsenic in Groundwater in the Coastal Plain Aquifers of Maryland", which describes the distribution and possible chemical controls on arsenic occurrence in groundwater (primarily in the Aquia and Piney Point aquifers of Maryland's Eastern Shore and southern Maryland). MDE is working with these counties to implement programs to ensure that new wells are tested and appropriate treatment is employed, to educate owners of existing wells about the health risks associated with the elevated arsenic levels, and to provide information about appropriate treatment options. One component of the education process involves distribution of letters to parents and guardians at schools with public water systems that exceed a drinking water standard.

MTBE

During the summer of 2006, MTBE was removed from the gasoline that is supplied to the State of Maryland. This removal was a business decision by the gasoline suppliers, not a regulatory mandate. Soon after, MTBE was replaced with ethanol to meet EPA reformulated gasoline standards. Although removed from gasoline, MTBE still continues to be detected in groundwater. MDE predicts that there will be years of legacy cases related to MTBE. The number of public water systems with detectable MTBE (less than 0.5 parts per billion) continues to decline.

Perchlorate

Perchlorate is a substance that is used in fuel propellants for rockets, missiles, and fireworks. Although there is no federal drinking water standard for perchlorate, it has been shown to affect the thyroid by interfering with iodide uptake, and it may cause cancer, Graves' disease, and developmental problems in children. Water quality samples in Maryland indicate several areas of groundwater contamination from perchlorate, including the area west of Elkton in Cecil County and in the vicinity of the Aberdeen Proving Ground in Harford County.

Perchlorate contamination has been documented in three public water supply wells serving the City of Aberdeen - wells used by an industrial plant that manufactured rocket fuel and at two small community water systems in Cecil County. The City of Aberdeen has installed treatment to remove the perchlorate contamination and the water system is routinely monitoring water quality to maintain perchlorate levels below one part per billion as advised by MDE. In Cecil County, a treatment unit was installed which is currently serving both small, community water systems that are impacted by perchlorate. The State is supplying bottled water to residents where wells have shown perchlorate concentrations above one part per billion (ppb). A remedial investigation/feasibility study has been initiated at a former facility where fireworks were made, which was believed to be the source of the contamination. While the data does not suggest that perchlorate occurs at levels of public concern in the vast majority of public drinking water

supplies, a small sensitive subpopulation, which includes pregnant women and developing fetuses, is of significant concern.

MDE's Controlled Hazardous Waste Enforcement Division has conducted investigations at all known firework producers that have been known to manufacture or operate in the area. Based on the investigations, no definitive source for the presence of perchlorates could be identified. This information was presented to the Cecil County Health Department and Department of Public Works to assist them in future planning. MDE has been providing bottled water to homes that had a detection of perchlorate in excess of one ppb. A new survey in the area failed to identify any new affected residential wells. However, some wells that had low detections in the past were now found to be clean. MDE plans to reevaluate the need to provide drinking water based on EPA's interim health advisory.

In January 2009, the EPA issued an interim health advisory to assist state and local officials in addressing local perchlorate contamination in drinking water. The interim health advisory level is set at 15 ppb and is based on the reference dose recommended by the National Research Council of the National Academy of Sciences. In August 2009, the EPA published a Supplemental Request for Comments Federal Register notice seeking input on additional ways to analyze data related to the regulatory determination of perchlorate. The EPA is considering a broader range of alternatives for interpreting the available data on: the level of health concern, the frequency of occurrence of perchlorate in drinking water and the opportunity for health risk reduction through a national primary drinking water standard. A key focus is the re-evaluation of perchlorate exposure to sensitive life stages, including pregnant women and their developing fetuses, infants, and developing children. The EPA will make a final regulatory determination for perchlorate after considering comments provided on this and previous notices related to the perchlorate regulatory determination. The EPA's final decision may be a determination to establish a regulatory standard for perchlorate.

Radium and Gross Alpha Radiation

Radionuclides occur naturally in the northern-central portion of Anne Arundel County. Over the past several years, MDE has worked with Anne Arundel County to address elevated levels of radium in groundwater in the Magothy, Patapsco, and Patuxent aquifers of the northern central portion of that county. The Anne Arundel County Health Department currently requires new wells in the affected area to be sampled for gross alpha and radium. If test results indicate that the level of radionuclides is above the drinking water standard, the owners of the well(s) must employ treatment to remove the radium prior to obtaining a certificate of potability for the well(s). Sampling of groundwater in Baltimore and Howard Counties indicate that a small percentage (about ten percent) of wells in the formation known as Baltimore Gneiss also contain elevated levels of gross alpha.

Elevated gross alpha radiation levels have been identified in Carroll, Frederick, Charles and Cecil counties. In Charles County, polonium has been identified as the primary alpha emitter; however, in Carroll and Prince George's County, uranium is the primary alpha emitter and in Cecil County, radium is the primary alpha emitter.

Virus Studies

EPA finalized the Groundwater Rule in October 2006. This rule is aimed at protecting consumers from microbial pathogens in groundwater, particularly viruses. The regulation will require source water monitoring to identify vulnerable systems, and all treatment will be required to inactivate or remove all viruses. From 1998 to 2001, MDE worked with the United States Geological Survey to study virus occurrence in Maryland public drinking water systems, in both Coastal Plain and Piedmont geologic settings. The study found that viruses are not commonly found in groundwater systems in either setting.

In FY 2011, MDE completed sampling for a second study to evaluate unconfined aquifers in the Coastal Plain area for the groundwater indicators in the Groundwater Rule. The year-long study sampled 50 raw water sources on a quarterly basis. The sources are located in the Quaternary, Aquia, Patapsco, and Magothy aquifers. The raw water samples are analyzed for Escherichia coli (E. coli), Coliphage, Coliphage-Male, Enterococci, and nitrates as part of the study. The purpose of the study is to determine an appropriate indicator for vulnerability in the unconfined aquifers of the Coastal Plain. A final report is expected in FY 2012.

Emergency Response

MDE's Emergency Response conducts immediate removals of oil and hazardous materials that threaten both surface and groundwaters. Each year, Emergency Response responds to approximately 650 spills of hazardous materials and petroleum products on land and water. These spills are handled in a way to protect public health and safety and to minimize the contamination of water resources.

Groundwater Remediation and Restoration

Land Restoration

The federal "Superfund" program, authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), was established to identify, prioritize and cleanup hazardous waste sites. The Land Management Administration of MDE ensures that State requirements are met during investigation and cleanup of sites designated for the National Priority List (NPL) and federal facilities under the federal "Superfund" program. A key objective of the federal program is to obtain the data necessary to identify for cleanup the highest priority sites posing threats to human health and the environment.

A similar program under State law, the State Superfund Program, conducts investigations and oversees the remediation and cleanup of sites on the State Master List that are not included on the NPL or are not owned by the federal government. The State Master List contains 248 sites that have been identified statewide with known or potential contamination and another 187 sites that have been archived and transferred to the State Master List - Formerly Investigated Sites.

The Voluntary Cleanup Program provides a streamlined process for the remediation and redevelopment of former industrial or commercial properties that are contaminated or perceived to be contaminated with controlled hazardous substances. Upon successful completion of the program, participants are also provided limitations on liability for the eligible property. Since the inception of the Voluntary Cleanup Program in 1997, applications for 461 properties representing approximately 7,164 acres have been received and 251 properties, totaling about 4,207 acres, have each received either a certificate of completion or a no further requirements determination. The majority of these sites were issued a prohibition on the use of groundwater beneath these areas for any purpose.

Oil Control

Underground Storage Tanks (USTs) remain a major source of groundwater contamination. The Oil Control Program (OCP) within MDE has established stringent regulations and provides strict oversight of tank operations within Maryland. Releases from USTs are required to be investigated and those with groundwater impacts are required to define the vertical and horizontal extent of the contamination. Once defined, a Corrective Action Plan is implemented to mitigate the impact of the contamination. The effectiveness of remediation systems is normally evaluated through groundwater monitoring. The OCP has tracked reports of over 11,554 confirmed underground storage tank system releases from tanks other than heating oil tanks throughout Maryland. Of these releases, over 11,041 site cleanups have been completed. During FY 2011, OCP oversaw the investigation and cleanup of over 353 heating oil related cases. The OCP continues to provide oversight at both motor fuel and heating oil sites where cleanups have been initiated.

Onsite Sewage Disposal Systems

MDE has delegated the authority for administering on-site sewage disposal, land subdivision and well construction programs to either county health departments, which are part of the Maryland Department of Health and Mental Hygiene, or to a local county permitting agency. MDE personnel oversee the delegated programs, provide technical support, investigate potential public health threats and perform on-site evaluations of innovative and alternative sewage disposal system applications. A strong field presence and ongoing training are vital to the implementation of these important public health laws. Approximately 420,000 homes in Maryland use onsite sewage disposal systems.

MDE actively promotes the use of advanced onsite sewage disposal systems. As a rule, advanced onsite sewage disposal systems better protect groundwater resources than conventional systems. Advanced systems used in Maryland include: re-circulating sand filters, advanced waste treatment units, sand mounds, waterless toilets and at-grade systems. Research on emerging on-site sewage disposal technologies continues, with emphasis on those technologies that reduce discharges of nitrogen.

Bay Restoration Fund

The Bay Restoration Fund (BRF) was signed into law on May 26, 2004 because the Chesapeake Bay had been experiencing a decline in water quality due to over-enrichment of nutrients (mainly phosphorus and nitrogen). The law established a dedicated fund for improving the water quality of the Chesapeake Bay. In addition to financing wastewater treatment plant upgrades, the BRF finances onsite disposal system (septic system) upgrades and implements cover crop programs to reduce nitrogen loading to the Bay from runoff and groundwater. More than 7.5 million pounds of nitrogen and more than 260 thousand pounds of phosphorus will be reduced each year, which will meet over one-third of Maryland's nutrient reduction commitment under the Chesapeake Bay 2000 Agreement. Approximately 600 onsite sewage disposal systems per year are upgraded to remove nitrogen; totaling 9,000 pounds of nitrogen that are removed each year, which would have otherwise been discharged into the groundwater.

The goal of the Onsite Sewage Disposal System (OSDS) portion of the Bay Restoration Fund is to curtail the amount of nitrogen discharged from OSDS into the State's water This benefits the State by restoring the estuarine environment and by providing better protection of drinking water supplies. The BRF statute includes funding to provide grants for the incremental cost of upgrading OSDS to best available technology (BAT) for nitrogen removal. The BRF cannot provide funding for an entire OSDS replacement or repair, or any material (gravel, pipe, etc.) and labor costs not directly associated with the BAT unit installation.

MDE recognizes that operation and maintenance, design review, installation inspection, and project management are part of the costs of upgrading OSDS to BAT for nitrogen removal. The BRF grant funds will cover the initial cost of purchasing and installing the BAT unit. The cost for the initial five years of operation and maintenance is included in the cost of purchasing the BAT technology. Through April of 2011 septic systems serving 2,740 equivalent dwelling units have been upgraded to remove nitrogen with BRF grants.

In order to accomplish program objectives, it was necessary to develop a procedure for determining which technologies should be considered eligible for the BRF. The Governor's Advisory Committee on the Management and Protection of the State's Water Resources established a Best Available Technology Workgroup to develop specifications for OSDS technologies eligible for the BRF grant funds, which comprised of local health and public works agencies and industry representatives. The Workgroup reviewed available research, other states' programs, and third party verification programs. Current research indicates that nitrogen discharges from OSDS can be reduced by 50 to 60 percent.

The Workgroup adopted a protocol used by the Environmental Protection Agency/Environmental Technology Verification (EPA/ETV) to establish a procedure to verify the performance of nitrogen reducing OSDS. A review team, comprised of two engineers from MDE and one county environmental health director, is reviewing the applications to ensure that each technology has been third party evaluated to a standard at least as stringent as the

EPA/ETV's. To date, 16 proprietary technologies have been approved as grant eligible BATs for removing nitrogen. All technologies approved as grant eligible BATs for removing nitrogen must also undergo field verification of performance in Maryland. Twelve Maryland installations of each technology must be sampled on a quarterly basis for four quarters. The results of this sampling must indicate a minimum of 50 percent nitrogen removal to successfully complete field verification. To date, four technologies have completed field verification.

Permit Programs

MDE issues many types of permits for activities that can have a negative impact on groundwater quality. Permits can establish limits for specific chemicals or groups of pollutants, or can require best management practices that reduce releases to the environment.

Groundwater Discharge

Groundwater discharge permits are required for any discharges to groundwaters of the State. Sources of groundwater discharges include spray irrigation land treatment systems, overland flow systems, rapid infiltration systems (infiltration ponds), large on-site sewage disposal systems (greater than a daily average flow of 5,000 gpd), seepage pits, dry wells, septic systems, and injection wells. The Code of Maryland Regulations provides performance standards for location, design, installation, construction and maintenance of the permitted facilities. Issuing a permit involves the review of plans, specifications and hydrogeologic reports, and the evaluation of soil and site suitability. In many cases, groundwater monitoring is a condition of the permit, requiring that a facility maintain primary or secondary drinking water standards in the groundwater quality at the point of discharge or monitoring wells adjacent to the property boundary. In FY 2011, MDE issued twenty municipal groundwater discharge permits and seven industrial groundwater discharge permits.

Hazardous Waste

MDE's Land Management Administration (LMA) supervises hazardous waste generators and treatment, and storage and disposal facilities through both State regulations and a federally mandated permit program. LMA's Technical Services and Operations Program (TSOP) manages the hazardous waste permit program and implements the requirements of the federal Resource Conservation and Recovery Act (RCRA) as well as the requirements of State law. In Maryland, there are approximately 10,500 facilities registered as generators of hazardous waste. There are twenty facilities that have been issued permits allowing treatment of hazardous waste, storage of hazardous waste for longer than 90 days, acceptance of hazardous waste from off-site, and/or management of hazardous waste in land disposal units. The permitted hazardous waste land disposal units have all gone through closure and are subject to post-closure care requirements.

LMA's Waste Diversion Utilization Program relies on record-keeping to maintain a "cradle-to-grave" tracking system for all hazardous waste generated. Proper management and pollution prevention techniques ensure against contamination of groundwater. LMA's Hazardous Waste Program oversees the enforcement of hazardous waste requirements. If there

is improper management of hazardous waste, the program requires that actions be taken to remedy the situation and to restore, to the extent possible, the quality of the affected groundwater. A strong oversight and enforcement effort is maintained to provide high visibility as a deterrent against future violations.

Permitted hazardous waste treatment, storage, and disposal facilities whose operations would present a greater potential for groundwater contamination if an unforeseen incident occurs are placed under more stringent permit conditions. Permit conditions in this case would include the requirement that a groundwater monitoring system be deployed. The Hazardous Waste Program is charged with the responsibility of inspecting these systems and initiating enforcement action should the need arise. Permit requirements are tailored to address the potential for contamination presented by each facility using requirements for groundwater protection defined in State regulations. At a minimum, semi-annual reports are submitted by facilities required to monitor groundwater. Failure to meet permit requirements results in an enforcement action designed to both bring the facility into compliance and to remediate any contamination.

The Hazardous Waste Program also maintains the Federal Facilities Division that is responsible for supporting cleanup at Federal Facilities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or the federal "Superfund" program. MDE maintains a Department of Defense/State of Maryland Memorandum of Agreement, which provides federal funding to support the Division activities. The focus of the Federal Facilities Division activities at Department of Defense sites is on groundwater contamination. Evaluation of the extent of contamination, remedial alternatives, and ultimate cleanup criteria is conducted through the CERCLA process. The Division directly supports EPA Region III in the CERCLA cleanups.

Mining: Marcellus Shale

Natural Gas drilling could take place in the Marcellus shale in Garrett and Allegany counties within Maryland. The Department has received three applications for drilling and production, all within Garrett County. The permit process requires the applicant to identify the location from which they will obtain water for hydrofracturing as well as an approved disposal location. Chief has proposed to purchase water from a municipal water source in Preston County, West Virginia. The disposal facilities in Chief and Sampson's applications may not all be approved by PA DEP, since they recently told all wastewater treatment facilities, which are not up to the current effluent standards, to stop accepting frac fluid.

In June, 2001, a Governor's Executive Order in Maryland established a commission to study and make recommendations to assist State policy makers and regulators in determining whether or how drilling can occur without unacceptable risks of adverse reactions to public health, safety, the environment, or natural resources.

Oil Control

The Oil Control Program (OCP), within MDE's Land Management Administration, is the unit responsible for the implementation of the Underground Storage Tank (UST), Leaking Underground Storage Tank (LUST), and Aboveground Storage Tank (AST) programs. These programs provide for preventive actions to minimize ground and surface water pollution from the storage of petroleum products. The Program has increased regulatory oversight of USTs with improvements in release detection, secondary containment, and tank monitoring.

OCP has enacted a specialized tank inspection program to ensure the protection of groundwater resources and public health from the release of chemicals stored in underground storage systems. An owner of an underground motor fuel storage system in Maryland is required, upon notification from OCP, to have the system inspected by a certified private inspector. The inspector must visit the storage tank facility and complete a detailed site inspection form provided by OCP. The inspector evaluates tank and piping release detection, overfill/spill prevention, system corrosion protection, as well as facility housekeeping and other compliance concerns. After the initial inspection, follow-up inspections must occur every three years to confirm continued compliance with Maryland regulations.

The OCP requires additional release detection methods for motor fuel facilities operating within the High Risk Groundwater Use and Well Head Protection Areas of Baltimore, Carroll, Cecil, Frederick and Harford County. Facilities within this area must sample the groundwater through at least three onsite monitoring wells. This sampling must be performed yearly and the results reported to OCP. The facility must also sample the site's water supply well and perform special release detection tests on any operational underground storage tank systems. Facilities that fail to perform these tests face MDE enforcement actions and the loss of their fuel supply.

Solid Waste

Within MDE's Land Management Administration, the Solid Waste Program regulates the management and disposal of non-hazardous waste such as municipal solid waste, industrial waste, construction and demolition waste, land-clearing debris and natural wood waste, and performs enforcement activities for scrap tires, sewage sludge and Controlled Hazardous Substances. The program's comprehensive permitting requirements for facilities accepting waste are directed at protecting ground and surface water, while assuring the safe management and disposal of waste.

Program activities include significant enforcement efforts to stop and clean up illegal dumps before they can significantly impact groundwater resources. Permitting requirements include liners and leachate collection/treatment systems for landfills (except land clearing debris or "stump dump" landfills), groundwater monitoring systems, and other environmental protection systems that serve to protect groundwater. The program regulates 24 municipal solid waste landfills, three industrial waste landfills, three sewage sludge storage or treatment facilities, and six construction and demolition waste landfills, and evaluates environmental monitoring data for approximately 60 closed landfills. The Solid Waste Program is also tasked

with the permitting and enforcement of any new industrial landfill for the disposal of Coal Combustion Byproducts (CCB) such as coal flyash, and helps enforce MDE's CCB storage and transportation regulations.

The Solid Waste Program also oversees the utilization of sewage sludge that is applied as a soil amendment to farmland or used for the reclamation of land such as mined sites. Most of the sewage sludge generated in Maryland is applied to farmland here, or out of State. The beneficial use of this material is regulated by State statute and permit conditions that require buffers and nutrient management plans for farmland where sewage sludge is to be applied. By limiting the amount of nutrients applied to land to those actually required by crops, excess amounts of nutrients can be controlled and ground and surface water protected.

By eliminating unpermitted tire dumps and providing a regulatory program for the management, transportation, and recycling of scrap tires, the LMA's Waste Diversion Utilization Program prevents serious sources of pollution which are caused by "tire dump" fires, thus protecting both ground and surface water. See MDE's annual Scrap Tire Report for more information on these activities.

Stormwater Management

Urban development has a profound influence on the quality and quantity of Maryland waters by altering the hydrologic cycle. When vegetation is stripped, soil compacted and impervious surfaces added during the construction process, rain is deflected over these hard surfaces instead of filtering through the soil on site and recharging groundwater supplies. Stormwater from developed sites rushes overland, gaining volume, and picking up soil and its accumulated pollutants, which may include oil, grease, and fertilizer from streets, roofs, parking lots, lawns, and bare ground. This large quantity of contaminated water rushes into the closest surface water. This accumulated runoff causes flooding, stream channel erosion, sedimentation, wildlife habitat deterioration, water pollution, and lower stream base-flows.

The goal of MDE's Stormwater Management Program is to maintain pre-development runoff characteristics, during and after development. Currently, all new development projects are required to incorporate best management practices (BMP) to assist in achieving post development hydrology back to natural conditions, in which rainwater can filter into the ground on site, become cleansed by the soil, and recharge groundwater supplies.

MDE's "2000 Maryland Stormwater Design Manual" provides guidelines for designing structural and nonstructural BMPs. Examples of structural BMPs include ponds, artificial wetlands, filters, and infiltration practices to address water quality, water recharge, and stream channel protection. Many nonstructural practices mimic natural hydrology and minimize the generation of excess stormwater after development, including disconnecting roof top downspouts, conserving natural vegetation, and providing stream buffers to maximize filtration and groundwater recharge.

Requirements to use environmental site design (ESD) to the maximum extent practicable to provide stormwater management went into effect in May 2010. Counties and municipalities statewide are now working to modify existing stormwater ordinances and plans review procedures to require better site planning, alternative surfaces, and small-scale runoff control practices on new development and redevelopment projects in an effort to replicate the runoff that would be expected from woods. This completed the implementation mandate specified in the Stormwater Management Act of 2007 and includes Code of Maryland Regulations (COMAR) provisions passed by the Maryland legislature in the 2010 session to accommodate the final approval of large development projects that had been in the planning and review stages before passage of the Act. Implementing ESD represents a significant change in the way development runoff is addressed in Maryland and marks another milestone in the evolution of a State program that has existed for nearly 30 years.

Underground Injection Control

EPA delegated authority for the Underground Injection Control (UIC) program to Maryland in 1984. There are five classes of UIC wells, and Maryland has primacy for all five classes of wells. Maryland has primarily Class V wells, which are essentially shallow subsurface treatment and disposal systems, such as septic systems. On June 7, 2002, EPA published the *Underground Injection Control Program Notice of Final Determination for Class V Injection Wells*. This final determination covers all sub-classes of Class V wells not addressed in the Phase I Class V Rule.

These systems may receive treated industrial process wastewater or industrial wastewater commingled with domestic sewage. MDE's Groundwater Discharge Program issues permits for Class V wells. Large capacity septic systems, defined in the Code of Federal Regulations as serving greater than 20 persons, are also defined as Class V wells and are jointly permitted by the State's UIC Program and the county health departments. Disposal of hazardous waste by underground injection is not allowed in Maryland. Permitted Class V wells must meet primary and secondary drinking water standards.

The UIC Program maintains a data inventory of potential and known Class V wells. It also actively identifies unpermitted wells for regulation and inventory through unannounced site inspections by Program personnel that target un-permitted Class V wells. One inspector is dedicated to statewide inspections of facilities in unsewered areas, which may be using shallow disposal practices for industrial wastewater. A second inspector works in coordination with the Water Supply Program to investigate potential dischargers in wellhead protection areas (WHPAs). Notices of Violation are issued for facilities not in compliance with UIC Class V regulations. Corrective action is required for these facilities. Approximately 400 inspections are conducted each year. In addition, MDE compliance inspectors visit approximately 125 permitted facilities to monitor compliance with the conditions of groundwater discharge permits. In FY 2011, 699 UIC inspections were conducted by the two MDE inspectors. The inspectors issued 65 Notices of Violation. In FY 2011, 58 facilities were returned to compliance.

The UIC Program continues to provide information on best management practices and pollution prevention in all dealings with the regulated community, both during unannounced UIC, and permit related inspections. Outreach measures include distribution of brochures on *Management of Photochemical Waste*" and *A Dry Cleaner's Guide to Wastewater Management.*

The dry cleaner brochure provides information on percholoroethylene (PCE) and guidance on its disposal in septic and sewer systems.

The federal Phase I Class V Rule, which became effective April 5, 2000, bans new motor vehicle repair shop discharge wells and large capacity cesspools. There are no known large capacity cesspools in Maryland. Owner/operators of motor vehicle discharge Class V injection wells have the option to close their wells or to obtain a permit. This is consistent with Maryland's Plumbing Code regulations enacted October 20, 1997, via work by MDE's UIC Program. The Maryland Plumbing Code regulations, developed in coordination with the Department of Labor, Licensing, and Regulation (DLLR), allow automotive repair and related facilities to operate without a floor drain. If a floor drain is used to manage maintenance bay wastewater, it must be connected to a sanitary sewer, a holding tank or the facility must obtain a Class V injection well permit.

There is a developing interest in producing gas from the Devonian Marcellus shale in Western Maryland's Garrett County using the technology of hydro-fracing. This methodology uses tremendous quantities of fresh water for the fracturing process and then, as a byproduct of gas production, produces very large quantities of contaminated water for disposal. One disposal option is via a UIC Class II Well. Class II wells discharge wastewater beneath the lowermost underground source of drinking water. The UIC Program is working with MDE's Mining Program in the review of permit applications for hydro-fracing.

Inquiries have also been made to Maryland's UIC program regarding aquifer storage and recovery wells. ASR wells are being considered in several locations in Maryland to store treated drinking water in an aquifer, for later withdrawal and use during periods of peak demand. These types of wells are regulated differently across our country. Since it was not named as a high risk well in the Phase I Class V Rule, this category of Class V wells are Rule authorized. Therefore, some UIC regulating authorities do exercise the regulatory option of Rule authorization for ASR wells, and some require permits. In Maryland, we will require a UIC permit for ASR wells.

Water Well Construction

Responsibility for permitting well construction is delegated by MDE to local county health officers or other county environmental officials. MDE employees direct this delegated program and provide technical assistance to county personnel. Only drillers licensed by the Maryland Board of Well Drillers may drill wells in the State of Maryland. The driller must file a well completion report for each well; well completion reports are stored in a central computer database at MDE. The Department processes approximately 12,500 well permits each year. An estimated 400,000 households in Maryland rely on individual wells. MDE's On-Site Systems Division conducts well construction inspections in the field, trains well drillers and county personnel, and has been instrumental in developing enforcement cases for violations of well construction laws.

Maryland's Well Construction regulation, COMAR 26.04.04, is being updated, and changes proposed by MDE's Onsite Systems Division were reviewed by the Conference of Environmental Health Directors and the Maryland State Board of Well Drillers prior to their final promulgation in 2010. However, publication of the final regulation did not occur due to

MDE's withdrawing it concomitant with concerns expressed by the AELR committee. The regulations not promulgated included the requirement that potable wells have a minimum casing diameter of four inches. This was to address a problem in certain Coastal Plain counties where large withdrawals can cause the aquifer water levels in nearby wells to decline, was making it impractical for some well owners to procure water from their two-inch diameter well casings. A four-inch casing is necessary for installation of a submersible pump. This regulation will be included in the update of the Well Construction Regulation that is currently undergoing further stakeholder review.

Pesticides Management

The Maryland Department of Agriculture (MDA) Pesticide Regulation Section, the State's lead agency for implementing the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), continues to implement, maintain and update, as needed, its generic Pesticide Management Plan (PMP). As an addendum to the PMP, the United States Environmental Protection Agency (EPA), in cooperation with the states, has developed a *State Pesticides of Interest* list. Pesticides of interest (including their degradates) are pesticides that have been identified by the states as having the *potential* to occur in ground or surface water at concentrations approaching or exceeding human health or ecological reference points. These pesticides are to be periodically evaluated to determine whether a human health or environmental reference point is likely to be approached or exceeded. If an evaluated pesticide is found to pose a risk to water quality, then that pesticide must be actively managed. Management can include applicator training/public outreach, adoption of Best Management Practices (BMPs), targeted inspections and enforcement of existing water quality-related label restrictions, designation as a State "Restricted Use" pesticide due to water quality concerns, additional product label restrictions to reduce contamination or, ultimately, denial of state registration, of the pesticide, due to water quality concerns. As part of its continuing work with USGS, MDA contributed funds to a 5-year study within the Blackwater Wildlife National Refuge, to monitor and track groundwater quality in agricultural, suburban, and urban settings. This report is available on the USGS website.

This is the nineteenth year of MDA's recycling program for empty pesticide containers. MDA, which is in cooperation with local governments and private industries that, inspect, store, and clean empty pesticide containers that have been offered for recycling. Collection centers are maintained in seven counties (Frederick, Harford, Kent, Prince George's, Talbot, Washington and Wicomico) with the assistance of county government agencies. A total of 28 collection days are held during June through September. In addition, thirteen pesticide dealers/custom applicators are participating in inspection and collection of containers at their own facilities. The program has been well received by different interest groups, including the agricultural community, EPA's Chesapeake Bay Program and environmental organizations. Nearly 660,000 empty pesticide containers have been collected and recycled since 1993, taking more than 281 tons of plastic out of Maryland's waste stream.

CONCLUSION

State programs to protect groundwater must be strengthened to ensure that safe and adequate water supplies are available to meet growing human and environmental demands. Increased data collection and management for better decision making and planning related to groundwater use are among the top priorities for funding. Two examples of programs that develop and apply information for more effective and economical decision making to protect groundwater resources include comprehensive studies of Maryland water supply aquifers and water resource planning initiatives for the local level. However, these existing programs need increased funding to be successful.

Funding to support voluntary groundwater protection programs (e.g., wellhead protection, cover crop planting and voluntary cleanup programs) is having a positive impact. However, improvements are needed in the depth and scope of regulations to address more contaminants, and improve protection measures to meet legal requirements, which will require additional funding. The costs associated with addressing the legacy of past contamination remain high.

The challenges to groundwater protection are daunting: water demand and the threats to groundwater quality and quantity will continue to increase for the foreseeable future. Maryland's varied hydrologic terrain works against a "one size fits all" solution for managing, protecting and restoring groundwater. While some areas of the State experience issues of quantity limitations, other areas experience problems due to naturally occurring and/or human induced contamination. In FY 2012, MDE, MDA and MDNR will continue to coordinate the many activities to characterize, restore, allocate, conserve and protect the State's groundwater resources that are so crucial to public health and the environment.