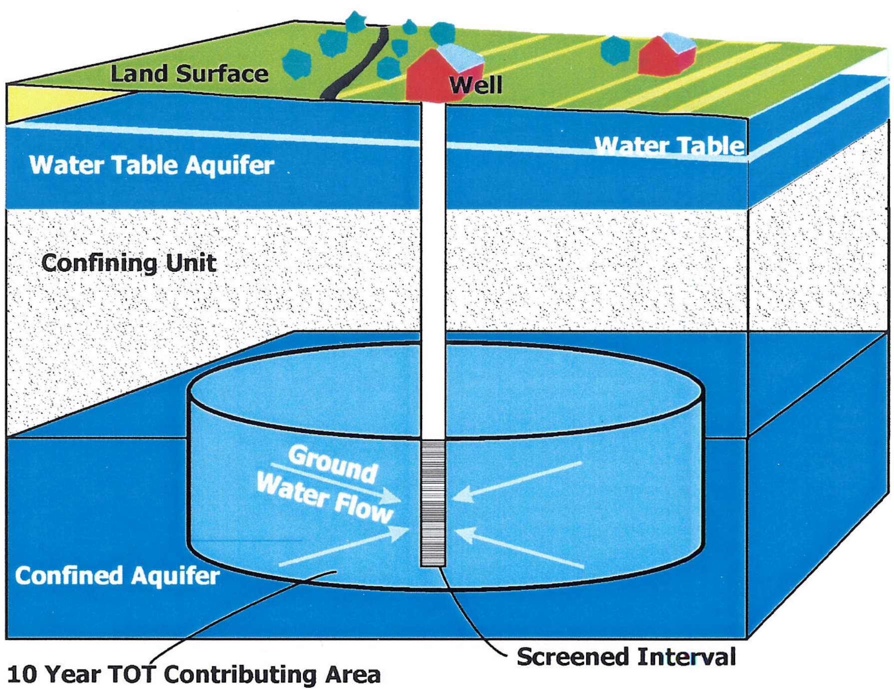
# Source Water Assessment

# for Community Water Systems

# in Queen Anne's County, MD

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MDE

**FINAL**

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## SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting drinking water supplies conclude this report.

The water supply sources of the community water systems in Queen Anne's County are naturally protected confined aquifers of the Atlantic Coastal Plain physiographic province. The fifteen community water systems included in this report are currently using thirty-two wells that draw from four different confined aquifer systems. The Source Water Assessment areas were delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment areas from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment areas are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. For the most part, the water supplies are not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers. However, one water system was determined to be susceptible to contamination by VOC's due to well integrity issues. Some naturally occurring contaminants do pose a risk to the water supply. It was determined that most water systems that draw water from the Aquia aquifer are susceptible to Arsenic. Some water systems may be susceptible to Radon depending upon the final adopted MCL.

# EXECUTIVE SUMMARY
# CENTREVILLE WATER SYSTEM

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Centreville Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Centreville's water supply is the Aquia aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Centreville water system currently has two wells in the Aquia aquifer providing water and has a third well in the development stages. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Centreville water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers. However, it was determined that Arsenic, a naturally occurring contaminant, does pose a risk to the water supply. The susceptibility of the water supply to Radon will depend upon the final MCL that is adopted for this contaminant.

## Executive Summary
## Queenstown Water System

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Queenstown Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Queenstown's water supply is the Aquia aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Queenstown water system currently has four wells in the Aquia aquifer, two of which are currently providing water. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Queenstown water supply is susceptible to volatile organic compounds, due to the condition of the Old Del Rhodes well and the risk it poses to the Aquia aquifer. In general, water supplies in confined aquifers are not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers. Therefore, the Old Del Rhodes well poses an unnecessary risk, and it should be abandoned and sealed. The water supply was also determined to be susceptible to Arsenic, a naturally occurring contaminant.

# EXECUTIVE SUMMARY
# BAYSIDE-QUEENS LANDING WATER SYSTEM


The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Bayside-Queens Landing Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The sources of Bayside-Queens Landing's water supply are the Aquia and Magothy aquifers; two naturally protected confined aquifers of the Atlantic Coastal Plain physiographic province. The Bayside-Queens Landing water system currently has two wells in the Aquia aquifer and two wells in the Magothy. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Bayside-Queens Landing water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers.

# EXECUTIVE SUMMARY
# PROSPECT BAY WATER SYSTEM

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Prospect Bay Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Prospect Bay's water supply is the Aquia aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Prospect Bay water system currently has two wells in the Aquia aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Prospect Bay water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers. However, it was determined that Arsenic, a naturally occurring contaminant, does pose a risk to the water supply. The susceptibility of the water supply to Radon will depend upon the final MCL that is adopted for this contaminant.

# EXECUTIVE SUMMARY
# FOX RUN CONDOMINIUMS WATER SYSTEM


The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Fox Run Condominiums Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Fox Run Condominiums' water supply is the Aquia aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Fox Run Condominiums water system currently has one well in the Aquia aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Fox Run Condominiums water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers. However, it was determined that the water supply is susceptible to Arsenic, a naturally occurring contaminant.

# EXECUTIVE SUMMARY
# OYSTER COVE WATER SYSTEM

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Oyster Cove Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Oyster Cove's water supply is the Aquia aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Oyster Cove water system currently has two wells in the Aquia aquifer providing water and two additional wells in the Magothy aquifer that are out of use. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Oyster Cove water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers. However, it was determined that the water supply is susceptible to Arsenic, a naturally occurring contaminant.

# EXECUTIVE SUMMARY
# BAYVIEW AT KENT NARROWS WATER SYSTEM

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Bayview at Kent Narrows Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Bayview at Kent Narrows' water supply is the Aquia aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Bayview at Kent Narrows water system currently has one well in the Aquia aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Bayview at Kent Narrows water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers. However, it was determined that the water supply is susceptible to Arsenic, a naturally occurring contaminant.

# Executive Summary
# Bridge Pointe Water System

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Bridge Pointe Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The sources of Bridge Pointe's water supply are the Aquia and Magothy aquifers; two naturally protected confined aquifers of the Atlantic Coastal Plain physiographic province. The Bridge Pointe water system currently has two wells in the Magothy aquifer and one well in the Aquia. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Bridge Pointe water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers.

# EXECUTIVE SUMMARY
# RIVERSIDE COMPLEX WATER SYSTEM

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Riverside Complex Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Riverside Complex's water supply is the Magothy aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Riverside Complex water system currently has one well in the Magothy aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Riverside Complex water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers.

# EXECUTIVE SUMMARY
# STEVENSVILLE WATER SYSTEM

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Stevensville Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The sources of Stevensville's water supply are the Patapsco, Monmouth, and Aquia aquifers, three naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Stevensville water system currently has one well in each of these aquifers providing drinking water and has a several other wells out of use or as backup supplies in the Magothy aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Stevensville water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers.

# EXECUTIVE SUMMARY
# GRASONVILLE WATER SYSTEM


The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Grasonville Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Grasonville's water supply is the Magothy aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Grasonville water system currently has two wells in the Magothy aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Grasonville water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers.

# Executive Summary
# Phonecia Trailer Park Water System

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Phonecia Trailer Park Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Phonecia Trailer Park's water supply is the Aquia aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Phonecia Trailer Park water system currently has one production well and one backup well in the Aquia aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Phonecia Trailer Park water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers. However, it was determined that the water supply is susceptible to Arsenic, a naturally occurring contaminant.

# EXECUTIVE SUMMARY
# PINE SPRINGS WATER SYSTEM

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Pine Springs Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Pine Springs's water supply is the Aquia aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Pine Springs water system currently has one production well and one backup well in the Aquia aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Pine Springs water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers. However, the water supply may be susceptible to Radon, a naturally occurring contaminant, depending upon the final MCL that is adopted for this contaminant.

## EXECUTIVE SUMMARY
## BEACH HARBOR WATER SYSTEM

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted Source Water Assessments for fifteen community water systems in Queen Anne's County, including the Beach Harbor Water System. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Beach Harbor's water supply is the Aquia aquifer, a naturally protected confined aquifer of the Atlantic Coastal Plain physiographic province. The Beach Harbor water system currently has two wells in the Aquia aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for water supplies in confined aquifers.

Potential sources of contamination were researched and identified within the assessment area from field inspections, contaminant and well inventory databases, and land use maps. Well information and water quality data were also reviewed. Maps and aerial photography showing the Source Water Assessment area are included in this report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and aquifer characteristics. It was determined that the Beach Harbor water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifers.

## INTRODUCTION

The Water Supply Program has conducted Source Water Assessments for the fifteen community water systems in Queen Anne's County. Queen Anne's County is on the eastern shore of the State and its total population, reported in July 2001, is 42,600 (Md. Assoc. of Counties, 2000/2001). The fifteen community water systems serve a population of approximately 11,500 of the county residents, while the remaining residents in the county obtains their water supply from individual wells. The community water systems include the two incorporated municipalities of Centreville and Queenstown, seven unincorporated areas whose water systems are owned and operated by the County Sanitary District, five privately owned and operated water systems, and one State facility (Table 1). The community water systems included in this report are shown in Figure 1.

## WELL INFORMATION

Well information for each system was obtained from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports, and published reports. Amongst the 15 community water systems included in this report, a total of 32 wells are currently used or are backup wells, and one additional well is under construction for the Centreville water system. Twenty-seven of these wells were drilled after 1973 and should comply with Maryland's well construction regulations. The remaining six wells drilled prior to 1973, when regulations went into effect, and may not meet the current construction standards. In addition, there are ten other wells that are out of use for various reasons and are not considered in the source water assessment delineation, but warrant mention due to their existence and proximity to production wells. Table 2 contains a summary of well information for each of the community water systems.

Based on site visits, most wells were in good condition and appeared to be regularly maintained, sealed, and protected to insure integrity. Some of the older wells had a one-piece well cap, which may present a possible route of contamination (insects) through unscreened vents and electrical holes. This situation is easily remedied with the installation of a new two-piece sanitary well cap to prevent contamination. Another common threat to wells observed during field inspections are unused wells in the same aquifer. Several water systems have wells that are not in use due to high iron concentrations, or were drilled as test wells during new well construction. As long as these wells are sealed with a tight cap, and the pumps are exercised regularly they pose little threat to the production wells. However, unused wells with loose caps, no pumps, or with no potential for use in the future should be rectified or permanently abandoned and sealed by a licensed well driller because they represent a pathway for contamination to the deep aquifer.

## HYDROGEOLOGY

Ground water flows through pores between gravel, sand, and silt grains in unconsolidated sedimentary aquifers such as those used by the community water systems in Queen Anne's County. An aquifer is any formation that is capable of yielding a significant amount of water. The transmissivity is a measure of the amount of water an aquifer is capable of producing and is related to the hydraulic conductivity and the thickness of the aquifer. A confining unit is a layer generally composed of fine material such as clay and silt, which transmits relatively very little water. Confined aquifers are those formations that are overlain by a confining unit. Confined aquifers are recharged from the water stored in the confining unit above and from precipitation that infiltrates into the formation where it is exposed at the surface. Due to the depth and areal extent of the unconsolidated sediments on the Eastern Shore of Maryland, water stored in these aquifers is very old and the water pumped from wells in these aquifers has generally traveled great distances from its origin at the land surface.

Queen Anne's County lies within the Atlantic Coastal Plain physiographic province, which is characterized by low topography due to the underlying horizontal sedimentary layers. This province, which in Maryland includes roughly the area east of Interstate 95, is underlain by unconsolidated clastic sediments of Lower Cretaceous to recent age, which thicken to the southeast. In Queen Anne's County, the community water system wells draw water from four confined aquifer systems known as the Aquia, Monmouth, Magothy, and Patapsco formations (Appendix, Table 2). These aquifers have been studied considerably and hydrologic, lithologic, and geochemical data is available in several Maryland Geological Survey Reports (1977, 1983, 1984, 1987, 1988, 2001). The descriptive material below is summarized from these reports and the reader is referred to them for further information.

The Aquia aquifer represents the largest water use by community water systems in Queen Anne's County due to its accessibility as the shallowest of the aquifers, its generally high transmissivity, and its relatively good water quality. The top of the Aquia aquifer in Queen Anne's County ranges from 50 feet below sea level near the northern tip of Kent Island to approximately 300 feet below sea level in the southeastern most parts of the County (Appendix, Figs. 6, 7). The Aquia is overlain by the Nanjemoy formation, which acts as a leaky confining unit, and is between 200 and 300 feet thick depending on the geographic location. The Aquia aquifer consists of three distinct lithologic units, the Lower Eocene Sand, the Aquia formation, and the Hornerstown Sand, which hydraulically act as a single aquifer and are heretofore referred to as the Aquia formation. These three units are composed of fine to medium-grained sands, of varying composition but are generally quartz and glauconite rich with calcite cementation. Shell material differentiates the top two units from the lower unit, which has a clayey matrix. Transmissivity values, determined by aquifer tests on the Aquia in the Kent Island area of the county, ranged from 900 to 4800 feet$^2$/day. Brackish water intrusion is present in some areas of the Aquia closest to the Chesapeake Bay shoreline, which limits the use of this aquifer in the Kent Island area.

The Monmouth formation aquifer is used in the Stevensville area at the Business Park water treatment plant. This aquifer does not represent a significant source of water in the county because the areal extent of the sand is small. It is a good water supply source in some localities, and can be a good alternative in areas where the water in the Aquia is brackish. The Monmouth formation lies stratrigraphically below the Aquia and above the Magothy formations. The Business Park well draws water from this aquifer at a depth of 455 feet below ground surface. The reported thickness of this aquifer ranges from 29 to 85 feet. The Matawan formation lies directly above the Monmouth and acts as the upper confining unit for this aquifer. The Monmouth formation is characterized by a reddish brown color, a moderately high glauconite content and argillaceous sand or sandy clay. Transmissivity values are reported between 240 and 730 $feet^2$/day and were determined by aquifer tests on the Monmouth mostly in Kent County, where it represents a more significant water supply source.

The Magothy formation provides another significant water supply source in Queen Anne's County, although its depth and high iron content make it a less desirable aquifer in some areas of the county. The top of the Magothy formation has not been mapped in this area, but based on the well logs from the wells in this report the Magothy aquifer is intercepted between 550 and 900 feet below ground surface across the county. The clays of the Matawan and Monmouth formations form the upper confining unit for the Magothy aquifer and make it a uniformly distinct aquifer from the Aquia formation. The thickness of this formation is reported as 120 feet in the Kent Island area. The Magothy formation consists of white, lignitic sand interbedded with dark gray laminated silt and clay and this composition makes it readily distinguishable from the contiguous formations. Transmissivity values from aquifer tests in Queen Anne's County were reported at 8,800 and 10,000 $feet^2$/day.

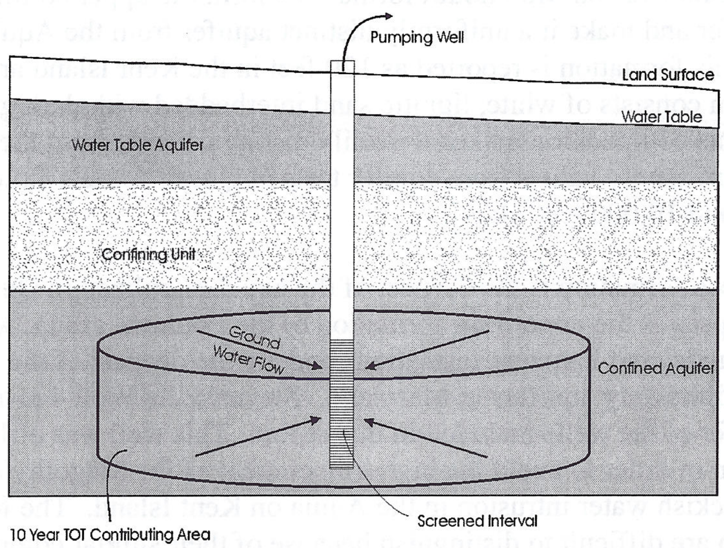
The Patapsco formation is the deepest of the aquifers utilized in Queen Anne's County. The Patapsco is the uppermost formation of the Potomac group, which also consists of the Arundel and Patuxent formations and are the deepest of the unconsolidated sedimentary aquifers in Maryland. Stevensville Well 4 is the only well utilizing this aquifer of the wells included in this report. This well was drilled into the Patapsco formation in order to avoid the high iron content of the Magothy and to prevent the increase of brackish water intrusion in the Aquia on Kent Island. The formations of the Potomac group are difficult to distinguish because of their similar composition and their lateral incontinuity. These formations consist of medium and fine sands and silts that were deposited in fluvial environments that shifted laterally, thus making the formations laterally inconsistent in lithology. This also makes it difficult to characterize the aquifer over a large area since sand content can vary considerably. In localized areas where the sand content is high, transmissivity of the aquifer was reported as high as 9,200 $feet^2$/day.

## SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered the source water assessment area for the system. The WHPA's were delineated using the methodology described in Maryland's Source Water Assessment Plan (MDE, 1999) for confined aquifers in the coastal plain, often referred to as the "Florida Method". The area is a radial zone of transport within the aquifer and is based on a 10-year time of travel (TOT), the pumping rate and the screened interval(s) of the well or wells included in the WHPA, and the porosity of the aquifer (see illustration below for conceptual model). The Florida Method is a modification of Darcy's law for radial flow to a well and the WHPA's were calculated using the following volumetric equation:

$$r = \sqrt{\frac{Qt}{\pi n H}}$$

where r = calculated fixed radius in feet (ft)
t = time of travel in years (yr)
Q = pumping rate of well ($ft^3$/yr)
n = aquifer porosity (dimensionless)
H = length of well screen (ft)




***Conceptual illustration of a zone of transport for a confined aquifer***

Table 3 gives the values used and the calculated radius for each water system's WHPA. The pumping rate (Q) used is generally the permitted daily average. If a water system has more than one well, the wells usually alternate pumpage. Therefore, the total appropriated amount was used in the calculation for each well, since, in theory each well is producing a zone of transport based on the average pumping rate. In some cases, the permitted amount was split between wells that do not alternate and are a significant distance apart, thus the permitted amount was divided amongst the wells based on pumping records for the last year.

A conservative estimate of porosity (n) of 25% was used for each of the aquifers based on published reports. The lengths of the well screens (H) were obtained from well completion reports. In the instance that there were multiples screens, the sum of the individual screen lengths was used. Using these parameters the radius was calculated with the above equation for the WHPA delineation (Table 3). Circles around each of the wells with the appropriate calculated radius represents the WHPA and are shown in Figure 2. The circles represent the aquifer zone of transport in the subsurface as illustrated above.

## Potential Sources of Contamination

In confined aquifer settings, sources of contamination at the land surface are generally not a threat unless there is a pathway for direct injection into the deeper aquifer such as through unused wells or along well casings that are not intact or have no grout seal.

Potential sources of contamination are classified as either point or non-point sources. Examples of point sources of contamination are leaking underground storage tanks, landfills, discharge permits, large-scale feeding operations, and CERCLA sites. These sites are generally associated with commercial or industrial facilities that use chemical substances that may, if inappropriately handled, contaminate ground water via a discrete point location. Non-point sources of contamination are associated with certain land use activities that may lead to ground water contamination over a larger area. All potential sources of contamination are identified at the land surface and therefore have the potential to impact the shallow water table aquifer. Therefore, as long as there is no potential for direct injection into the deeper confined aquifers, the water supply used by the community water systems should be well protected from ground water contamination.

Potential sources are identified if they fall within the WHPA for awareness and to ensure that the deep aquifer does not become affected by unused wells or poorly constructed wells in the water supply aquifer. Table 4 lists the facilities identified from MDE databases as potential sources of contamination and their locations are show in Figure 3. Underground storage tanks (UST's) sites are facilities that store petroleum on site in underground tanks registered with the MDE Waste Management Administration. Controlled Hazardous Substance generators (CHS) are facilities that may use or store any hazardous substance on site. Ground water discharge (GWDP) permits are issued by MDE's water management administration for discharge of wastewater to ground water.

The contaminants associated with the types of facilities are based on generalized categories and often the potential contaminant depends on the specific chemicals and processes being used at the individual facility. The potential contaminants for an activity may not be limited to those listed in Table 4. Potential contaminants are grouped as Volatile Organic Compounds (VOC), Synthetic Organic Compounds (SOC), Heavy Metals (HM), Metals (M), Nitrate/Nitrite (NN), and Microbiological Pathogens (MP).

## Water Quality Data

Water Quality data was reviewed from the Water Supply Program's database for Safe Drinking Water Act (SDWA) contaminants. The State's SWAP defines a threshold for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is greater than 50% of an MCL, this report will describe the sources of such a contaminant and, if possible, locate the specific sources that are the cause of the elevated contaminant level. All data reported is from the finished (treated) water unless otherwise noted. Table 5 summarizes the various treatment methods used at the water treatment plants for each of the fifteen community water systems.

A review of the monitoring data for the fifteen community water systems indicates that the water supplies meet drinking water standards with the exception of Arsenic for some systems. Table 6 summarizes the water quality results for each of the water systems by contaminant group.

***Inorganic Compounds (IOCs) except Arsenic***

A review of the data shows that three different inorganic compounds were detected above 50% of an MCL in three different water systems (Table 7a). In each incidence, the contaminant was not detected above the 50% threshold level in subsequent samples.

Fluoride is a naturally occurring element that is sometimes added to water for dental health benefits. The presence of fluoride in the water supply at Fox Run Condominiums is not due to addition, but due to the presence of Fluoride in minerals that make up the aquifer material. The value of 2.63 mg/L is considerably higher than the range of values (0 to 1.1 mg/L) reported for a number of wells in the Aquia formation on Kent Island (MGS R.I. 51, 1988). This result remains unexplained and it may possibly be due to increased concentration from improper sample preservation, handling, or other laboratory errors. In any case, the subsequent results are more typical of the Fluoride levels in the Aquia aquifer and are well below the MCL of 4.0 mg/L.

Nitrite was detected at 0.5 mg/L in one sample for Bridge Pointe's Kent Island Village well. Nitrites and Nitrates are nitrogen-oxygen chemical units, which combine with various organic and inorganic compounds. Primary sources of organic nitrogen include human sewage and livestock manure. The primary source of inorganic nitrogen compounds that may contaminate drinking water are potassium nitrate and ammonium nitrate both of which are widely used as fertilizers.

Nickel was detected at 0.08 mg/L in raw water from Grasonville's Well 1. The result collected on the same date for Well 2 was less than 0.02 mg/L. Subsequent results from the point of entry (a combination for the two wells), were less than 0.05 mg/L. An MCL had been established for Nickel at 0.1 mg/L, but has since been remanded and there is currently no MCL for this contaminant. Nickel comes from a variety of ores including sulfides, and many lithologic descriptions of the Magothy aquifer include pyrite. Therefore, it is possible that there is some naturally occurring Nickel in the Magothy aquifer, although published values are not available.

***Arsenic***

Arsenic is the contaminant most commonly detected above 50% of the MCL for the water systems assessed in this report. Eight of the fifteen water systems had one or more results above 50% of the MCL, and five had levels at or above the Arsenic standard of 0.010 mg/L (Table 7b). The Arsenic standard was recently lowered by the U.S. Environmental Protection Agency and therefore, these results were not considered violations at the time they were collected. However, for many of these systems, additional water treatment will be necessary to meet the new standard, which will be enforced starting January 23, 2006.

Arsenic is present in ground water in Maryland's Coastal Plain due to the natural presence of this contaminant in aquifer material. The eight water systems that reported Arsenic above 0.005 mg/L all draw water from the Aquia aquifer. A recent study of Arsenic concentrations in the major aquifers of the Coastal Plain indicates that Arsenic is present at the highest concentrations in the Aquia aquifer on the Eastern Shore of Maryland (MGS Draft Interim Report, 2003). It also appears that location in the aquifer affects Arsenic concentrations. Further study being planned will collect more data in order to better delineate if ground water Arsenic concentrations vary with stratigraphic levels in the Aquia aquifer.

***Radionuclides***

Gross-alpha radiation was reported above 50% of the MCL in the Prospect Bay water system (Table 7c). Gross-alpha is a measure of alpha radiation, which is emitted from certain radioactive elements such as Radium. The only other Gross-alpha result for this system was below the detection limit.

Radon-222 was reported above 150 pCi/L in three water systems (Table 7c). There is currently no MCL for Radon-222, however EPA has proposed an MCL of 300 pCi/L or an alternate of 4000 pCi/L for community water systems if the State has a program to address the more significant risk from radon in indoor air. The EPA received many comments in response to their proposed rule, and promulgation may be delayed. Radon-222 was reported above 50% of the lower proposed MCL of 300 pCi/L but well below the higher proposed MCL of 4000 pCi/L.

***Volatile Organic Compounds (VOCs)***

A review of the data shows that VOCs have not been detected above 50% of an MCL with two exceptions. Stevensville's Thompson Creek plant had two consecutive samples with Carbon Tetrachloride present (Table 7d). Five other sample results were below the detection limit. Carbon Tetrachloride is a solvent often used as a cleaning agent for machinery and electrical equipment.

Volatile organic compounds were detected in Queenstown's Wall Street Well in 1998, with some contaminants exceeding the MCL. VOC's were not present in samples collected from the other wells and from the distribution system (Table 7f). Results from soil samples and monitoring wells installed at the LUST sites in Queenstown are included in the Appendix.

***Synthetic Organic Compounds (SOCs)***

A review of the data shows that SOCs have not been detected above 50% of an MCL with the exception of Di(2-Ethylhexyl)Phthalate (Table 7e). However, the laboratory reported each sample result as being less than 10 times the amount found in laboratory blank samples and therefore are not considered valid.

***Microbiological Contaminants***

Routine bacteriological monitoring is conducted in the finished water for each water system on a monthly basis and measures Total Coliform bacteria. Since all water systems, except Phoenicia Trailer Park, disinfect their water at the treatment plant, the finished water data does not give much indication of the quality of raw water directly from the well. Total Coliform bacteria are not pathogenic, but are used as an indicator organism for other disease-causing microorganisms. A major breach of the system or the aquifer would likely cause a positive total coliform result despite disinfection and would require followup Total and Fecal Coliform analysis. Six water systems had positive Total Coliform in their routine bacteriological samples (Table 8), but in no instance were follow-up samples found to have positive Total or Fecal Coliform present.

## SUSCEPTIBILITY ANALYSIS

The wells serving the community water systems in Queen Anne's County draw water from confined aquifers. Confined aquifers are naturally well protected from activity on the land surface due to the confining layers that provide a barrier for water movement from the surface into the aquifer below. A properly constructed well with the casing extended to the confined aquifer and with sufficient grout should be well protected from contamination at the land surface. The only instance in which a contaminant at the surface could impact the water supply is through direct injection into the aquifer from within the WHPA. This could occur via poorly constructed wells, wells out of use that penetrate the aquifer, and underground injection wells. A pointed example of this was a petroleum contamination incident in the Queenstown water supply. In September 1998 the Wall Street well had been out of use for some time and when it was turned on the operator immediately noticed a gasoline-like odor. After some investigation, two leaking Underground Storage Tanks cases (LUST's.) were opened nearby and inspected as the source of contamination (Figure 3a). The LUST's should have only impacted the water table aquifer due to their depth, however because of many problems relating to the integrity of the Wall Street well, the contaminants reached the deeper aquifer. The age of this well and the poor condition of the casing in a corrosive environment was the likely cause of contaminant migration to the confined aquifer. Furthermore, the well represents a route for contamination of the aquifer since it is not regularly pumped. This example indicates the importance of proper well abandonment and maintenance of backup wells.

Some contaminants such as radionuclides and other chemical elements are naturally occurring in the aquifer and in some instances can reach concentrations that pose a risk to the water supply. In the case of confined aquifers, this is generally more problematic than contaminants at the land surface. The Aquia aquifer is highly susceptible to Arsenic. The Magothy tends to have elevated Radionuclides, although less significant in Queen Anne's County than other parts of the State. Also, their high iron content has precluded the use of the Magothy and deeper aquifers. Iron does not pose a health risk, but is considered a "Taste and Odor" nuisance and requires treatment.

The susceptibility of the source water to contamination is determined for each group of contaminants based on the following criteria: 1) the presence of natural and anthropogenic contaminant sources within the WHPA, 2) water quality data, 3) well integrity, and 4) the aquifer conditions. The susceptibility analysis is summarized for each water system in Table 9.

***Inorganic Compounds (except Arsenic)***

Inorganic compounds were present at significant levels in three water systems as described above. However, the presence of these contaminants was not consistent and the cause of their elevated levels was unclear. The source of inorganic compounds can be either the aquifer material or from human activity. In the case of nitrite, potential sources could be fertilizer or human or mammalian waste, but these sources are not likely to impact the water supply since they are activities at the land surface and the aquifers are naturally protected. Sources of fluoride and nickel could be naturally occurring or from human activity. Since the levels of these contaminants were not significant on a consistent basis, they are unlikely to be naturally occurring. In addition, potential sources were not identified within the WHPA's of the systems with the positive results. The only significant source of inorganic contaminants identified within a WHPA was the ground water discharge at the Kent Narrows waterfowl pond (Fig. 3b). The discharge is treated wastewater to the water table aquifer. The point of discharge is within the zone of transport for the Monmouth aquifer of Stevensville's Business Park well. As long as there is no direct route from the water table aquifer to the deeper aquifer, the water supply should not be impacted by the ground water discharge.

Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination, the water supplies are considered **not susceptible** to inorganic compounds.

***Arsenic***

Arsenic is present in significant concentrations in eight of the fifteen community water systems. The source of Arsenic in these water supplies is the natural occurrence and mobility of this contaminant in the aquifer material. A recent study of the occurrence of Arsenic in Coastal Plain aquifers indicates that the highest concentrations are found in the Aquia aquifer on the Eastern Shore. The data has not been fully interpreted, but it is does not seem to be related to any geochemical indices such as pH or specific conductance. The concentration of Arsenic in ground water of these aquifers may simply be dependent on the amount of Arsenic in the aquifer at certain locations. Due to the presence and levels of Arsenic in the Aquia aquifer, most wells drawing from this aquifer **are susceptible** to this contaminant.

The Bridge Pointe Kent Island Village well, the Queens Landing wells, and Beach Harbor wells are all drawing water from the Aquia, but each had Arsenic levels less than 0.002 mg/L, and are therefore **not susceptible** to Arsenic. These wells are located in an area that has been shown to have lower ground water Arsenic. In addition, these wells draw water from the top unit of the Aquia only, and there is speculation that Arsenic levels vary among the three units of this aquifer. This hypothesis will be investigated further in future study of Arsenic levels in the Aquia.

The Pine Springs water system has Arsenic results reported as non-detected, however the detection limit used for these samples was 0.010 mg/L. This was sufficient at the time of collection, however due to the new standard this method does not provide enough information to determine the susceptibility of this system to Arsenic. Pine Springs is in an area that has lower reported Arsenic concentrations in the Aquia (MGS Interim Draft Report, 2003), and therefore it is likely that this system will not be susceptible to Arsenic.

The Arsenic levels in the other aquifers used by the community water systems are not as significant, and there were no detects above 0.005 mg/L. Therefore wells drawing from aquifers other than the Aquia are **not susceptible** to Arsenic.

***Radionuclides***

The source of radionuclides in ground water can be traced back to the natural occurrence of uranium in rocks. Radionuclides are present in ground water due to radioactive decay of uranium bearing minerals in the sediment that makes up the aquifer material.

There is currently no MCL for Radon-222, however EPA has proposed an MCL of 300 pCi/L or an alternate of 4000 pCi/L if the State has a program to address the more significant risk from radon in indoor air. Radon is present in three water systems at a level that is greater than 50% of the lower proposed MCL of 300 pCi/L. The EPA has information on proposed regulations for radon in indoor air and drinking water on their web site (http://www.epa.gov/OGWDW/radon.html). Currently, it appears that these three water systems may be susceptible to radon if the lower standard is adopted.

Gross-alpha radiation was detected in the water supply above 50% of the MCL in one sample from one water system. The result was not repeated. Based on the water quality data, the community water systems are **not susceptible** to radiological contaminants other than Radon-222.

### *Volatile Organic Compounds*

Volatile organic compounds have not been detected in the routine samples collected for the water systems with the exception of the Stevensville water system, but the contaminant was not consistently present. Several potential sources for these types of contaminants were identified in the Stevensville WHPA's. However, as long as there is no potential for direct injection into the aquifer, the water supply should not be susceptible to VOC contamination.

The Queenstown water system has not abandoned the Wall Street well, which represents a potential pathway for contamination to the other wells since it lies within their zones of transport. The Queenstown Bank LUST case was closed after tanks were removed from the site and samples from the monitoring wells were shown to be free of contamination (See Appendix). The Queenstown VFD case has not yet been closed because the last samples collected still showed contaminant present in the ground water, although the monitoring well closest to the Wall Street Well was free of contaminants. In addition to these LUST sites, there are several additional potential sources of VOCs present within the Queenstown WHPA (Fig. 3a). Therefore, the Queenstown water system **is susceptible** to these contaminants as long as the Wall Street well exists in its current condition.

The remaining water systems did not have potential sources of VOCs identified within their WHPAs and did not have contaminants detected in the water supply and are therefore considered **not susceptible** to contamination by VOCs.

### *Synthetic Organic Compounds*

Synthetic organic compounds have not been detected in the water supplies and a confined aquifer waiver has been issued for each water system for monitoring for these contaminants. SOC sources are generally pesticides and herbicides application and due to the confined nature of the aquifer, do not pose a threat to the water supply. Therefore based on lack of contaminant sources and water quality data, the water supplies are considered **not** susceptible to SOCs.

### *Microbiological Contaminants*

Raw water microbiological monitoring is not required of water systems in confined aquifers because they are considered naturally protected from sources of pathogens at the land surface. Therefore, the water supplies are considered **not** susceptible to microbiological contaminants.

## Management of the Source Water Assessment Area

With the information contained in this report the community water systems in Queen Anne's County are in a position to protect their water supplies by staying aware of the area delineated for source water protection. Specific management recommendations for consideration are listed below:

***Form a Local Planning Team***

- The team should represent all the interests in the community, such as the water suppliers, home association officers, the County Health Department, local planning agencies, local business, developers, and property owners, and residents within and near the WHPA. The team should work to reach a consensus on how to protect the water supply.

***Public Awareness and Outreach***

- The Consumer Confidence Report should list that this report is available to the general public through their county library, by contacting the operator or MDE.
- Conduct educational outreach to businesses and residents within the WHPA focusing on potential contaminant sources. Important topics include: (a) compliance with MDE and federal guidelines for gasoline and heating oil UST's, (c) hazardous material disposal and storage, (d) well abandonment regulations and procedures.

***Monitoring***

- Continue to monitor for all required Safe Drinking Water Act contaminants.
- Annual raw water bacteriological testing is a good test for well integrity.

***Contingency Plan***

- COMAR 26.04.01.22 requires all community water systems to prepare and submit for approval a plan for providing a safe and adequate drinking water supply under emergency conditions.

***Contaminant Source Inventory Updates/ Inspections/Maintenance***

- Conduct a survey of the WHPA and inventory any potential sources of contamination, including unused wells, that may have not been included in this report. Keep records of new development within the WHPA and new potential sources of contamination that may be associated with the new use.
- Work with the County Health Department to ensure that there are no unused wells within the WHPA. An improperly abandoned well can be a potential source of contamination to the aquifer.
- Water operation personnel should have a program for periodic inspections and maintenance of the supply wells and backup wells to ensure their integrity and protect the aquifer from contamination.

***Changes in Use***

- An increase in use or the addition of new wells may require revisions to the WHPA. The water system is required to notify MDE if such changes are proposed.

# References

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MDE, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 pp.

U.S. Environmental Protection Agency, 1991, Wellhead Protection Strategies for Confined-Aquifer Settings: Office of Ground Water and Drinking Water, EPA/570/9-91-008, 168 pp.

## OTHER SOURCES OF DATA

Water Appropriation and Use Permits
Public Water Supply Sanitary Survey Inspection Reports
MDE Water Supply Program Oracle® Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles in Queen Anne's County
USGS Topographic 7.5 Minute Quadrangles in Queen Anne's County
Maryland Office of Planning 2000 Queen Anne's County Digital Land Use Map
Maryland Office of Planning 1996 Queen Anne's County Digital Sewer Map

# TABLES

| PUBLIC WATER SYSTEM ID (PWSID) | SYSTEM NAME | POPULATION SERVED | OWNER/OPERATOR TYPE |
|---|---|---|---|
| 0170001 | CENTREVILLE | 2600 | LOCAL GOVERNMENT |
| 0170003 | QUEENSTOWN | 530 | LOCAL GOVERNMENT |
| 0170006 | EASTERN PRE-RELEASE UNIT | 130 | STATE GOVERNMENT |
| 0170007 | BAYSIDE-QUEENSLANDING | 1030 | LOCAL GOVERNMENT |
| 0170009 | PROSPECT BAY | 913 | LOCAL GOVERNMENT |
| 0170010 | FOX RUN CONDOMINIUMS, INC. | 85 | INVESTOR/TRUST/WATER ASSOCIATION |
| 0170011 | OYSTER COVE | 400 | LOCAL GOVERNMENT |
| 0170013 | BAYVIEW AT KENT NARROWS | 75 | INVESTOR/TRUST/WATER ASSOCIATION |
| 0170017 | BRIDGE POINTE | 600 | LOCAL GOVERNMENT |
| 0170018 | RIVERSIDE COMPLEX | 60 | LOCAL GOVERNMENT |
| 0170019 | STEVENSVILLE | 3950 | LOCAL GOVERNMENT |
| 0170020 | GRASONVILLE | 450 | LOCAL GOVERNMENT |
| 0170203 | PHONECIA TRAILER PARK | 40 | INVESTOR/TRUST/WATER ASSOCIATION |
| 0170207 | PINE SPRINGS | 160 | INVESTOR/TRUST/WATER ASSOCIATION |
| 1170001 | BEACH HARBOR | 481 | INVESTOR/TRUST/WATER ASSOCIATION |

***Table 1. Community Water Systems in Queen Anne's County***

| PWSID | SYSTEM NAME | PLANT ID | SOURCE ID | USE CODE | WELL NAME | WELL PERMIT NO. | WELL DEPTH | CASING DEPTH | SCREENED DEPTH(S) | YEAR DRILLED | AQUIFER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0170001 | CENTREVILLE | 02 | 03 | P | CENTREVILLE WELL 4 | QA670030 | 448 | 272 | 272-448 | 1966 | AQUIA FORMATION |
| | | 03 | 04 | P | CENTREVILLE WELL 5 | QA941390 | 385 | 250 | 228-385 | 1998 | AQUIA FORMATION |
| | | 04 | 05 | F | PROPOSED WELL 6 | | ~ 400 | | | | AQUIA FORMATION |
| | | 01 | 02 | U | CENTREVILLE WELL 3 | QA044935 | 264 | 170 | 170-263 | 1959 | AQUIA FORMATION |
| 0170003 | QUEENSTOWN | 01 | 04 | S | DEL RHODES (STANDBY WELL) | QA049856 | 290 | 200 | 200-290 | 1962 | AQUIA FORMATION |
| | | | 01 | U | WALL STREET WELL | NOT KNOWN | ~ 320 | NOT KNOWN | NOT KNOWN | NOT KNOWN | AQUIA FORMATION |
| | | 02 | 02 | P | CHESAPEAKE VILLAGE 1 | QA730387 | 343 | 338 | 338-343 | 1973 | AQUIA FORMATION |
| | | | 03 | P | CHESAPEAKE VILLAGE 2 | QA881726 | 296 | 260 | 260-275 | 1993 | AQUIA FORMATION |
| 0170006 | EASTERN PRE-RELEASE UNIT | 01 | 01 | P | ECI WELL 1 | QA881623 | 250 | 179 | 226-251 | 1992 | AQUIA FORMATION |
| | | | 02 | P | ECI WELL 2 | QA881622 | 250 | 180 | 220-245 | 1992 | AQUIA FORMATION |
| | | | 03 | U | ORIGINAL WELL (IRRIGATION) | QA050363 | 195 | 194 | NOT KNOWN | 1963 | AQUIA FORMATION |
| 0170007 | BAYSIDE-QUEENSLANDING | 01 | 01 | P | QUEENS LANDING WELL 1 | QA810152 | 282 | 182 | 180-280 | 1983 | AQUIA FORMATION |
| | | | 02 | P | QUEENS LANDING WELL 2 | QA810540 | 300 | 182 | 182-282 | 1984 | AQUIA FORMATION |
| | | 02 | 03 | P | BAYSIDE 1 | QA811753 | 684 | 450 | 652-684 | 1986 | MAGOTHY FORMATION |
| | | | 04 | P | BAYSIDE 2 | QA811778 | 666 | 450 | 639-666 | 1986 | MAGOTHY FORMATION |
| 0170009 | PROSPECT BAY | 01 | 01 | P | PROSPECT BAY 1 - GRNWOOD SHOAL | QA732192 | 356 | 336 | 336-356 | 1978 | AQUIA FORMATION |
| | | 02 | 02 | P | PROSPECT BAY 2 - P B DR. WEST | QA732193 | 329 | 309 | 309-329 | 1978 | AQUIA FORMATION |
| 0170010 | FOX RUN CONDOMINIUMS, INC. | 01 | 01 | P | FOX RUN | QA810779 | 313 | 214 | 214-313 | 1984 | AQUIA FORMATION |

***Table 2. Well Information for Community Water Systems in Queen Anne's County***

| PWSID | SYSTEM NAME | PLANT ID | SOURCE ID | USE CODE | WELL NAME | WELL PERMIT NO. | WELL DEPTH | CASING DEPTH | SCREENED DEPTH(S) | YEAR DRILLED | AQUIFER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0170011 | OYSTER COVE | 01 | 01 | U | OYSTER COVE 1 | QA810873 | 782 | 729 | 750-780 | 1984 | MAGOTHY FORMATION |
| | | | 02 | U | OYSTER COVE 2 | QA811493 | 793 | 743 | 753-793 | 1986 | MAGOTHY FORMATION |
| | | | 03 | P | OYSTER COVE 3 | QA882093 | 250 | 140 | 220-250 | 1994 | AQUIA FORMATION |
| | | | 04 | P | OYSTER COVE 4 | QA942417 | 230 | 200 | 200-230 | 2001 | AQUIA FORMATION |
| 0170013 | BAYVIEW AT KENT NARROWS | 01 | 01 | P | BAYVIEW | QA732433 | 215 | 80 | 195-215 | 1978 | AQUIA FORMATION |
| 0170017 | BRIDGE POINTE | 01 | 01 | P | WELL 1 | QA811232 | 712 | 401 | 682-692, 692-712 | 1985 | MAGOTHY FORMATION |
| | | | 02 | P | WELL 2 | QA881490 | 718 | 400 | 688-718 | 1992 | MAGOTHY FORMATION |
| | | 02 | 03 | P | KENT ISLAND VILLAGE | QA810446 | 340 | 188 | 188-288 | 1984 | AQUIA FORMATION |
| 0170018 | RIVERSIDE COMPLEX | 01 | 01 | P | RIVERSIDE PRODUCTION | QA812673 | 740 | 720 | 720-740 | 1988 | MAGOTHY FORMATION |
| 0170019 | STEVENSVILLE | 01 | 03 | U | STEVENSVILLE WELL 2 | QA940318 | 765 | 500 | 606-688 | 1996 | MAGOTHY FORMATION |
| | | | 05 | U | STEVENSVILLE WELL 1 | QA880686 | 783 | 596 | 596-767 | 1990 | MAGOTHY FORMATION |
| | | | 06 | P | STEVENSVILLE WELL 4 (PATAPSCO) | QA941702 | 1590 | 503 | 1463-1478, 1520-1535, 1550-1580 | 1999 | PATAPSCO FORMATION |
| | | | 08 | T | PATAPSCO TEST WELL | QA941444 | 1580 | 280 | 1460-1480, 1520-1530, 1550-1580 | 1999 | PATAPSCO FORMATION |
| | | 02 | 04 | P | BUSINESS PARK WELL 1 | QA811494 | 488 | 451 | 455-485 | 1986 | MONMOUTH FORMATION |
| | | 03 | 01 | U | THOMPSON CREEK WELL 1 | QA730215 | 197 | 166 | 166-197 | 1973 | AQUIA FORMATION |
| | | | 02 | U | THOMPSON CREEK WELL 2 | QA810893 | 693 | 399 | 658-693 | 1985 | MAGOTHY FORMATION |
| | | | 09 | P | THOMPSON CREEK WELL 3 | QA700021 | 220 | 210 | 205-210, 210-220 | 1969 | AQUIA FORMATION |

***Table 2. Well Information for Community Water Systems in Queen Anne's County (cont.)***

| PWSID | SYSTEM NAME | PLANT ID | SOURCE ID | USE CODE | WELL NAME | WELL PERMIT NO. | WELL DEPTH | CASING DEPTH | SCREENED DEPTH(S) | YEAR DRILLED | AQUIFER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0170020 | GRASONVILLE | 01 | 01 | P | GRASONVILLE 1 | QA920457 | 955 | 500 | 826-836, 842-872, 880-900 | 1995 | MAGOTHY FORMATION |
| | | | 02 | P | GRASONVILLE 2 | QA920465 | 933 | 500 | 824-834, 840-885, 900-930 | 1995 | MAGOTHY FORMATION |
| 0170203 | PHONECIA TRAILER PARK | 01 | 01 | S | EMERGENCY BKUP | QA001310 | 241 | 205 | 205 | 1947 | AQUIA FORMATION |
| | | 01 | 02 | P | PHOENICIA - PRODUCTION | QA942005 | 230 | 200 | 200 | 2000 | AQUIA FORMATION |
| 0170207 | PINE SPRINGS | 01 | 01 | S | PINE SPRINGS 1 | QA731489 | 215 | 215 | 195 | 1977 | AQUIA FORMATION |
| | | 01 | 03 | P | PINE SPRINGS 3 | QA920309 | 300 | 120 | 260 | 1994 | AQUIA FORMATION |
| 1170001 | BEACH HARBOR | 01 | 01 | P | BEACH HARBOR CLUBHOUSE | QA710195 | 230 | 205 | 205 | 1971 | AQUIA FORMATION |
| | | 02 | 02 | P | BEACH HARBOR TENNIS COURTS | QA810643 | 241 | 211 | 211 | 1984 | AQUIA FORMATION |

***Table 2. Well Information for Community Water Systems in Queen Anne's County (cont.)***

**WATER SUPPLY PROGRAM DATABASE FIELD NAMES:**

PWSID = Public Water System ID Number
PLANT ID = Water Treatment Plant ID Number
SOURCE ID = Unique Identifier Number for Well
USE CODE: P = Production, S = Standby, F = Future, T* = Test, U* = Unused. (* Wells not included in assessment delineation)

| PWSID | System Name | Wells included in WHPA | Aquifer | Discharge (Q) in gal/day | Screened Interval (H) in feet | Calculated Radius for WHPA in feet | Acreage of WHPA | Comment |
|---|---|---|---|---|---|---|---|---|
| 017-0001 | Centreville | Well 4 | Aquia | 405000 | 176 | 1200 | 103 | |
| | | Well 5 | Aquia | 120000 | 157 | 700 | 35 | |
| | | Proposed Well 6 | Aquia | 120000 | 100 | 900 | 58 | Screen length estimated |
| 017-0003 | Queenstown | Ches Village 1 and 2, Del Rhodes Well | Aquia | 120000 | 5 | 3900 | 1091 | Well 1 area encompasses others |
| 017-0006 | Eastern Pre-Release Unit | Wells 1 and 2 | Aquia | 35000 | 25 | 1000 | 77 | Two circles merged |
| 017-0007 | Bayside-Queens Landing | Queens Landing Wells 1 and 2 | Aquia | 35000 | 100 | 500 | 20 | Two circles merged |
| | | Bayside Wells 1 and 2 | Magothy | 35000 | 27 | 900 | 61 | Two circles merged |
| 017-0009 | Prospect Bay | Well 1 | Aquia | 125000 | 20 | 2000 | 287 | |
| | | Well 2 | Aquia | 125000 | 20 | 2000 | 287 | |
| 017-0010 | Fox Run | Well | Aquia | 5600 | 99 | 200 | 3 | |
| 017-0011 | Oyster Cove | Wells 3 and 4 | Aquia | 88000 | 30 | 1400 | 141 | |
| 017-0013 | Bayview at Kent Narrows | Well | Aquia | 6000 | 20 | 500 | 18 | |
| 017-0017 | Bridge Pointe | Wells 1 and 2 | Magothy | 46100 | 30 | 1000 | 79 | Two circles merged |
| | | Kent Isle Village Well | Aquia | 15000 | 100 | 400 | 11 | |
| 017-0018 | Riverside Complex | Well | Magothy | 5100 | 20 | 400 | 11 | |
| 017-0019 | Stevensville | Thompson Creek Well 3 | Aquia | 92200 | 15 | 2000 | 287 | |
| | | Business Park Well | Monmouth | 170000 | 30 | 1900 | 259 | |
| | | Well 4 | Patapsco | 750000 | 60 | 2800 | 563 | |
| 017-0020 | Grasonville | Wells 1 and 2 | Magothy | 342000 | 60 | 1900 | 259 | Two circles merged |
| 017-0203 | Phoenicia Trailer Park | Production and Emergency Backup Wells | Aquia | 4300 | 36 | 300 | 7 | |
| 017-0207 | Pine Springs | Wells 1 and 3 | Aquia | 14000 | 20 | 700 | 56 | Two circles merged |
| 117-0001 | Beach Harbor | Clubhouse and Tennis Cts. Wells | Aquia | 7000 | 25 | 500 | 29 | Two circles merged |

***Table 3. Parameters used for WHPA delineations.***

| ID* | Type | Facility Name | Address | *Reference Location | WHPA System Name | No. of UST's/ Capacity/Substance/ Other Comments | Potential Contaminants |
|---|---|---|---|---|---|---|---|
| 1 | UST | Queenstown Xtra Mart | 4638 Ocean Gtwy | Figure 3a | Queenstown | 3 - 10,000 gal. Gasoline, 1 -10,000 gal. Kerosene, 1-10,000 gal. Diesel | VOC |
| 2 | UST | Queen Anne SOC(GLC-37650) | 653 Del Rhodes Ave | Figure 3a | Queenstown | 1 - 600 gal. Used Oil | VOC |
| 3 | UST | Queenstown Service Center | 500 Del Rhodes Ave | Figure 3a | Queenstown | 15,000 gal. Gasoline | VOC |
| 4 | UST | Harned's Food Inc. T/A Bobs Mini Mart | 102 Clay Dr | Figure 3a | Queenstown | 3 - 6,000 gal. Gasoline | VOC |
| 5 | UST | Shore Stop #63 | 100 Main St | Figure 3b | Stevensville | 2- 12,000 gal. Gasoline, 1 - 8,000 gal. Gasoline, 1 - 8,000 gal. Kerosene | VOC |
| 6 | UST | Kent Island Citgo | 101 Duke St | Figure 3b | Stevensville | 1- 6000 Kersone, 1-10,000 and 1-12,000 gal. Gasoline | VOC |
| 7 | UST | KNSG Fuel Depot | 310 Bateau Dr | Figure 3b | Stevensville | 1 - 10,000 - gas. Gasoline, 1 - 10,000 gal Diesel | VOC |
| 8 | UST | State Highway Administration Stevensvil | 334 State St | Figure 3b | Stevensville | 1 - 2,000 gal. Gasoline, 1-6,000 gal. Diesel | VOC |
| 9 | CHS | Friel's Lumber Co. | Friel's Place | Figure 3a | Queenstown | | VOC |
| 10 | CHS | Thompson Creek Cleaners | Thompson Creek Mall | Figure 3b | Stevensville | | VOC |
| 11 | GWD | Kent Narrows Water Fowl Ponds | Chesapeake Bay Business Park | Figure 3a | Stevensville | Discharges to water table aquifer | MP, NN, VOC, SOC, M |
| 12 | LUST | Queenstown V.F.D. | 7110 Main St | Figure 3a | Queenstown | 1 - 500 gal. Gasoline, 1-550 gal. Heating Oil Both permanently out of use | VOC |
| 13 | LUST | Queestown Bank of Maryland | 7101 Main St | Figure 3a | Queenstown | unknown | VOC |

***Table 4. Potential Contaminant Point Sources Within WHPA's.***

*See referenced figure for location

| PWSID | PWS NAME | PLANT ID | TREATMENT METHOD | PURPOSE |
|---|---|---|---|---|
| 0170001 | Centreville | 02 | Gaseous Chlorination, Pre | Disinfection |
| | | 03 | Gaseous Chlorination, Pre | Disinfection |
| 0170003 | Queenstown | 01 | Hypochlorination, Pre | Disinfection |
| | | 02 | Gaseous Chlorination, Pre | Disinfection |
| 0170006 | Eastern Pre-Release Unit | 01 | Gaseous Chlorination, Post | Disinfection |
| | | | Ion Exchange -Iron (Non-Sdwis Code) | Iron Removal |
| 0170007 | Bayside-Queenslanding | 01 | Gaseous Chlorination, Pre | Disinfection |
| | | | Filtration, Pressure Sand | Iron Removal |
| | | 02 | Gaseous Chlorination, Pre | Disinfection |
| | | | Coagulation (Non-Sdwis Code) | Iron Removal |
| | | | Filtration, Rapid Sand | Iron Removal |
| | | | Flocculation (Non-Sdwis Code) | Iron Removal |
| | | | Gaseous Chlorination, Pre | Iron Removal |
| | | | Sedimentation | Iron Removal |
| | | | Sequestration | Iron Removal |
| | | | Ph Adjustment | Iron Removal |
| 0170009 | Prospect Bay | 01 | Gaseous Chlorination, Post | Disinfection |
| | | | Sequestration | Iron Removal |
| | | 02 | Gaseous Chlorination, Post | Disinfection |
| | | | Sequestration | Iron Removal |
| 0170010 | Fox Run Condominiums, Inc. | 01 | Gaseous Chlorination, Post | Disinfection |
| 0170011 | Oyster Cove | 01 | Gaseous Chlorination, Pre | Disinfection |
| | | | Filtration, Pressure Sand | Iron Removal |
| | | | Gaseous Chlorination, Pre | Iron Removal |
| 0170013 | Bayview At Kent Narrows | 01 | Hypochlorination, Post | Disinfection |
| | | | Filtration, Greensand | Iron Removal |
| | | | Permanganate | Iron Removal |
| | | | Ph Adjustment, Pre | Iron Removal |
| 0170017 | Bridge Pointe | 01 | Gaseous Chlorination, Pre | Disinfection |
| | | | Coagulation (Non-Sdwis Code) | Iron Removal |
| | | | Filtration, Greensand | Iron Removal |
| | | | Filtration, Pressure Sand | Iron Removal |
| | | | Gaseous Chlorination, Pre | Iron Removal |
| | | | Permanganate | Iron Removal |
| | | | Ph Adjustment, Pre | Iron Removal |
| | | 02 | Gaseous Chlorination, Post | Disinfection |
| | | | Ion Exchange -Iron (Non-Sdwis Code) | Iron Removal |
| | | | Sequestration | Iron Removal |
| 0170018 | Riverside Complex | 01 | Ph Adjustment | Corrosion Control |
| | | | Gaseous Chlorination, Pre | Disinfection |
| | | | Filtration, Greensand | Iron Removal |
| | | | Gaseous Chlorination, Pre | Iron Removal |
| | | | Permanganate | Iron Removal |

***Table 5. Treatment Methods***

| PWSID | PWS NAME | PLANT ID | TREATMENT METHOD | PURPOSE |
|---|---|---|---|---|
| 0170019 | Stevensville | 01 | Gaseous Chlorination, Pre | Disinfection |
| | | | Coagulation (Non-Sdwis Code) | Iron Removal |
| | | | Filtration, Rapid Sand | Iron Removal |
| | | | Flocculation (Non-Sdwis Code) | Iron Removal |
| | | | Gaseous Chlorination, Pre | Iron Removal |
| | | | Sedimentation | Iron Removal |
| | | | Sequestration | Iron Removal |
| | | | Ph Adjustment | Iron Removal |
| | | 02 | Gaseous Chlorination, Pre | Disinfection |
| | | | Coagulation (Non-Sdwis Code) | Iron Removal |
| | | | Filtration, Rapid Sand | Iron Removal |
| | | | Flocculation (Non-Sdwis Code) | Iron Removal |
| | | | Gaseous Chlorination, Pre | Iron Removal |
| | | | Sedimentation | Iron Removal |
| | | | Ph Adjustment | Iron Removal |
| | | 03 | Gaseous Chlorination, Pre | Disinfection |
| | | | Filtration, Rapid Sand | Iron Removal |
| | | | Gaseous Chlorination, Pre | Iron Removal |
| | | | Sedimentation | Iron Removal |
| 0170020 | Grasonville | 01 | Ph Adjustment | Corrosion Control |
| | | | Gaseous Chlorination, Pre | Disinfection |
| | | | Coagulation (Non-Sdwis Code) | Iron Removal |
| | | | Filtration, Rapid Sand | Iron Removal |
| | | | Flocculation (Non-Sdwis Code) | Iron Removal |
| | | | Gaseous Chlorination, Pre | Iron Removal |
| | | | Sedimentation | Iron Removal |
| | | | Ph Adjustment, Pre | Iron Removal |
| 0170203 | Phonecia Trailer Park | 01 | No Treatment | No Treatment |
| 0170207 | Pine Springs | 01 | Hypochlorination, Pre | Disinfection |
| 1170001 | Beach Harbor | 01 | Hypochlorination, Post | Disinfection |
| | | | Ion Exchange | Solids Removal |
| | | 02 | Hypochlorination, Post | Disinfection |

***Table 5. Treatment Methods (cont.)***

| PWSID | PWS NAME | PLANT ID | IOCs (except Arsenic) | | Arsenic | | Radionuclides | | VOCs | | SOCs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No. of Samples Collected | No. of Samples > Half MCL | No. of Samples Collected | No. of Samples > Half MCL | No. of Samples Collected | No. of Samples > Half MCL | No. of Samples Collected | No. of Samples > Half MCL | No. of Samples Collected | No. of Samples > Half MCL |
| 0170001 | CENTREVILLE | 02 | 58 | 0 | 4 | 4 | 8 | 2 | 4 | 0 | 1 | 0 |
| | | 03 | 26 | 0 | 2 | 2 | 4 | 0 | 6 | 0 | 1 | 1 [1] |
| 0170003 | QUEENSTOWN | 01 | 59 | 0 | 5 | 4 | 11 | 0 | 5 | 1 | 1 | 0 |
| | | 02 | 72 | 0 | 4 | 2 | 9 | 0 | 6 | 0 | 1 | 0 |
| 0170006 | EASTERN PRE-RELEASE UNIT | 01 | 49 | 0 | 4 | 2 | 7 | 0 | 3 | 0 | 1 | 0 |
| 0170007 | BAYSIDE-QUEENSLANDING | 01 | 86 | 0 | 6 | 0 | 8 | 0 | 4 | 0 | 2 | 0 |
| | | 02 | 72 | 0 | 5 | 0 | 8 | 0 | 4 | 0 | 2 | 0 |
| 0170009 | PROSPECT BAY | 01 | 88 | 0 | 5 | 5 | 9 | 2 | 6 | 0 | 2 | 0 |
| | | 02 | 85 | 0 | 5 | 5 | 9 | 2 | 5 | 0 | 2 | 0 |
| 0170010 | FOX RUN CONDOMINIUMS | 01 | 42 | 1 | 4 | 1 | 7 | 0 | 8 | 0 | 1 | 0 |
| 0170011 | OYSTER COVE | 01 | 79 | 1 | 5 | 1 | 7 | 0 | 5 | 0 | 2 | 0 |
| 0170013 | BAYVIEW AT KENT NARROWS | 01 | 44 | 0 | 4 | 1 | 7 | 0 | 6 | 0 | 1 | 0 |
| 0170017 | BRIDGE POINTE | 01 | 87 | 0 | 6 | 0 | 8 | 0 | 5 | 0 | 3 | 0 |
| | | 02 | 17 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 0170018 | RIVERSIDE COMPLEX | 01 | 87 | 0 | 6 | 0 | 8 | 0 | 11 | 0 | 2 | 0 |
| 0170019 | STEVENSVILLE | 01 | 72 | 0 | 5 | 0 | 7 | 0 | 13 | 0 | 2 | 0 |
| | | 02 | 70 | 0 | 4 | 0 | 7 | 0 | 6 | 0 | 2 | 0 |
| | | 03 | 72 | 0 | 5 | 0 | 7 | 0 | 7 | 1 | 2 | 0 |
| 0170020 | GRASONVILLE | 01 | 75 | 1 | 4 | 0 | 7 | 0 | 16 | 0 | 1 | 0 |
| 0170203 | PHONECIA TRAILER PARK | 01 | 40 | 0 | 4 | 2 | 7 | 0 | 6 | 0 | 1 | 0 |
| 0170207 | PINE SPRINGS | 01 | 43 | 0 | 2 | 0 | 7 | 1 | 3 | 0 | 1 | 0 |
| 1170001 | BEACH HARBOR | 01 | 50 | 0 | 2 | 0 | 15 | 0 | 9 | 0 | 0 | 0 |
| | | 02 | 38 | 0 | 2 | 0 | 0 | 0 | 5 | 0 | 0 | 0 |

***Table 6. Summary of Water Quality Results***

[1] Sample for Di(2-Ethylhexyl)Phthalate invalid because of presence in blank

| PWSID | PWS NAME | PLANT ID | CONTAMINANT | MCL (mg/L) | SAMPLE DATE | RESULT (mg/L)[1] |
|---|---|---|---|---|---|---|
| 0170010 | FOX RUN CONDOMINIUMS | 01 | FLUORIDE | 4.0 | 19-Dec-95 | **2.63** |
| | | 01 | FLUORIDE | 4.0 | 14-Jan-97 | 0.411 |
| | | 01 | FLUORIDE | 4.0 | 06-Feb-97 | 0.51 |
| | | 01 | FLUORIDE | 4.0 | 19-Nov-98 | 0.5 |
| | | 01 | FLUORIDE | 4.0 | 12-Feb-01 | 0.05 |
| 0170017 | BRIDGE POINTE | 02 | NITRITE | 1.0 | 17-Jul-01 | **0.5** |
| | | 02 | NITRITE | 1.0 | 04-Apr-02 | -0.1 |
| 0170020 | GRASONVILLE | 01 | NICKEL | 0.1 | 02-Jun-95 | -0.02 |
| | | 01 | NICKEL | 0.1 | 14-Jun-95 | **0.08** [2] |
| | | 01 | NICKEL | 0.1 | 25-Nov-98 | -0.05 |
| | | 01 | NICKEL | 0.1 | 12-Feb-01 | -0.05 |

***Table 7a. Results of Inorganic Compounds where detected at least once above 50% of their MCL.***

| PWSID | PWS NAME | PLANT ID | CONTAMINANT | MCL (mg/L) | SAMPLE DATE | RESULT (mg/L)[1] |
|---|---|---|---|---|---|---|
| 0170001 | CENTREVILLE | 02 | ARSENIC | 0.010 | 27-Jul-95 | **0.020** |
| | | 02 | ARSENIC | 0.010 | 16-Feb-99 | **0.028** |
| | | 02 | ARSENIC | 0.010 | 12-Feb-02 | **0.024** |
| | | 02 | ARSENIC | 0.010 | 12-Dec-02 | **0.026** |
| | | 03 | ARSENIC | 0.010 | 16-Jan-02 | **0.030** |
| | | 03 | ARSENIC | 0.010 | 02-Apr-02 | **0.025** |
| 0170003 | QUEENSTOWN | 01 | ARSENIC | 0.010 | 18-Aug-97 | **0.007** |
| | | 01 | ARSENIC | 0.010 | 23-Feb-99 | **0.013** |
| | | 01 | ARSENIC | 0.010 | 10-Dec-02 | **0.008** |
| | | 02 | ARSENIC | 0.010 | 26-Jan-93 | **0.010** |
| | | 02 | ARSENIC | 0.010 | 15-Apr-97 | -0.010 |
| | | 02 | ARSENIC | 0.010 | 15-Jul-97 | **0.006** |
| | | 02 | ARSENIC | 0.010 | 06-Jun-00 | -0.010 |
| 0170006 | EASTERN PRE-RELEASE UNIT | 01 | ARSENIC | 0.010 | 15-Jul-97 | **0.010** |
| | | 01 | ARSENIC | 0.010 | 20-Feb-98 | -0.010 |
| | | 01 | ARSENIC | 0.010 | 08-Mar-01 | **0.008** |
| 0170009 | PROSPECT BAY | 01 | ARSENIC | 0.010 | 21-Jul-94 | **0.011** |
| | | 01 | ARSENIC | 0.010 | 23-Apr-97 | **0.020** |
| | | 01 | ARSENIC | 0.010 | 19-Nov-97 | **0.014** |
| | | 01 | ARSENIC | 0.010 | 24-Feb-00 | **0.020** |
| | | 01 | ARSENIC | 0.010 | 15-Jan-03 | **0.019** |
| | | 02 | ARSENIC | 0.010 | 21-Jul-94 | **0.011** |
| | | 02 | ARSENIC | 0.010 | 04-Sep-97 | **0.017** |
| | | 02 | ARSENIC | 0.010 | 19-Nov-97 | **0.016** |
| | | 02 | ARSENIC | 0.010 | 04-Oct-00 | **0.030** |
| | | 02 | ARSENIC | 0.010 | 15-Jan-03 | **0.018** |
| 0170010 | FOX RUN | 01 | ARSENIC | 0.010 | 04-Feb-98 | **0.009** |
| 0170011 | OYSTER COVE | 01 | ARSENIC | 0.010 | 21-Jul-94 | **0.011** |
| | | 01 | ARSENIC | 0.010 | 04-Sep-97 | -0.010 |
| | | 01 | ARSENIC | 0.010 | 19-Nov-97 | 0.004 |
| | | 01 | ARSENIC | 0.010 | 02-Mar-00 | -0.010 |
| | | 01 | ARSENIC | 0.010 | 15-Jan-03 | 0.003 |
| 0170013 | BAYVIEW AT KENT NARROWS | 01 | ARSENIC | 0.010 | 13-Jan-94 | 0.000 |
| | | 01 | ARSENIC | 0.010 | 02-Oct-97 | 0.003 |
| | | 01 | ARSENIC | 0.010 | 28-Jan-98 | -0.010 |
| | | 01 | ARSENIC | 0.010 | 13-Mar-01 | **0.005** |
| 0170203 | PHONECIA TRAILER PARK | 01 | ARSENIC | 0.010 | 23-Oct-97 | **0.005** |
| | | 01 | ARSENIC | 0.010 | 21-Feb-01 | **0.005** |

***Table 7b. Arsenic results where detected at least once above 50% of the MCL.***

| PWSID | PWS NAME | PLANT ID | CONTAMINANT | MCL (pCi/L) | SAMPLE DATE | RESULT (pCi/L)[1] |
|---|---|---|---|---|---|---|
| 0170001 | CENTREVILLE | 02 | RADON-222 | 300 [3] | 18-Apr-94 | **210** |
| | | 02 | RADON-222 | 301 [3] | 05-Aug-97 | **160** |
| 0170009 | PROSPECT BAY | 01 | RADON-222 | 302 [3] | 18-Apr-94 | **210** |
| | | 01 | RADON-222 | 303 [3] | 23-Apr-97 | 130 |
| | | 01 | RADON-222 | 303 [3] | 13-Feb-01 | **150** |
| | | 02 | RADON-222 | 303 [3] | 18-Apr-94 | **195** |
| | | 02 | RADON-222 | 303 [3] | 04-Sep-97 | 100 |
| | | 02 | RADON-222 | 303 [3] | 13-Feb-01 | 80 |
| | | 02 | GROSS ALPHA | 15 | 04-Sep-97 | **9** |
| | | 02 | GROSS ALPHA | 15 | 06-Mar-01 | -1 |
| 0170207 | PINE SPRINGS | 01 | RADON-222 | 303 [3] | 22-May-00 | **315** |

***Table 7c. Results of Radionuclides where detected at least once above 50% of their MCL.***

| PWSID | PWS NAME | PLANT ID | CONTAMINANT | MCL (ug/L) | SAMPLE DATE | RESULT (ug/L)[1] |
|---|---|---|---|---|---|---|
| 0170019 | STEVENSVILLE | 03 | CARBON TETRACHLORIDE | 5.0 | 14-Mar-90 | -0.5 |
| | | 03 | CARBON TETRACHLORIDE | 5.0 | 18-Dec-90 | -0.5 |
| | | 03 | CARBON TETRACHLORIDE | 5.0 | 20-Jul-94 | -0.5 |
| | | 03 | CARBON TETRACHLORIDE | 5.0 | 11-Apr-97 | 2 |
| | | 03 | CARBON TETRACHLORIDE | 5.0 | 20-Jun-97 | **3** |
| | | 03 | CARBON TETRACHLORIDE | 5.0 | 08-Jun-98 | -0.5 |
| | | 03 | CARBON TETRACHLORIDE | 5.0 | 25-Nov-98 | -0.5 |

***Table 7d. Results of Volatile Organic Compounds where detected at least once above 50% of their MCL.***

| PWSID | PWS NAME | PLANT ID | CONTAMINANT | MCL (ug/L) | SAMPLE DATE | RESULT (ug/L)[1] |
|---|---|---|---|---|---|---|
| 0170001 | CENTREVILLE | 03 | DI(2-ETHYLHEXYL) PHTHALATE | 6.0 | 05-Aug-97 | 0.55 [4] |
| | | 03 | DI(2-ETHYLHEXYL) PHTHALATE | 6.0 | 16-Jan-02 | **5.4** [4] |

***Table 7e. Results of Synthetic Organic Compounds where detected at least once above 50% of their MCL.***

*(Results in bold indicate those above 50% of their MCL.)*

[1] A negative symbol indicates below the detectable level shown.

[2] Raw water sample Well 1

[3] Proposed MCL

[4] Sample for Di(2-Ethylhexyl)Phthalate invalid because of presence in blank

| | | RESULTS (IN PPB) FROM VARIOUS SAMPLE LOCATIONS | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | DISTRIBUTION SYSTEM | RAW WATER FROM DEL RHODES WELL | RAW WATER FROM WALL STREET WELL | RAW WATER FROM CHESAPEAKE VILLAGE WELL | POINT OF ENTRY, PLANT 01 | POINT OF ENTRY, PLANT 02 | POINT OF ENTRY, PLANT 02 |
| CONTAM_NAME | MCL (IN PPB) | 23-Oct-98 | 23-Oct-98 | 23-Oct-98 | 23-Oct-98 | 23-Oct-99 | 14-Dec-98 | 23-Oct-99 |
| 1,2,4-TRICHLOROBENZENE | 70 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| cis-1,2-DICHLOROETHYLENE | 70 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| XYLENES, TOTAL | 10000 | -0.5 | -0.5 | 1.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| METHYLENE CHLORIDE | 5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| o-DICHLOROBENZENE | 600 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| p-DICHLOROBENZENE | 75 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| VINYL CHLORIDE | 2 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| 1,1-DICHLOROETHYLENE | 7 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| trans-1,2-DICHLOROETHYLENE | 100 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| 1,2-DICHLOROETHANE | 5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| 1,1,1-TRICHLOROETHANE | 200 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| CARBON TETRACHLORIDE | 5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| 1,2-DICHLOROPROPANE | 5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| TRICHLOROETHYLENE | 5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| 1,1,2-TRICHLOROETHANE | 5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| TETRACHLOROETHYLENE | 5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| MONOCHLOROBENZENE | 100 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| BENZENE | 5 | -0.5 | -0.5 | **5.1** | -0.5 | -0.5 | -0.5 | -0.5 |
| TOLUENE | 1000 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| ETHYLBENZENE | 700 | -0.5 | -0.5 | 3.9 | -0.5 | -0.5 | -0.5 | -0.5 |
| STYRENE | 100 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |

***Table 7f. VOC results from Queenstown collected in response to discovery of groundwater contamination.***

See Appendix for additional data collected at other locations.

Results in Bold indicate MCL exceedance

A negative symbol indicates below the dectectable level shown.

| PWSID | PWS NAME | No. of Samples Collected | No. of Positve Samples | Disinfection Treatment? |
|---|---|---|---|---|
| 0170001 | CENTREVILLE | 70 | 0 | Y |
| 0170003 | QUEENSTOWN | 71 | 3 | Y |
| 0170006 | EASTERN PRE-RELEASE UNIT | 72 | 0 | Y |
| 0170007 | BAYSIDE-QUEENSLANDING | 72 | 0 | Y |
| 0170009 | PROSPECT BAY | 72 | 0 | Y |
| 0170010 | FOX RUN CONDOMINIUMS, INC. | 69 | 1 | Y |
| 0170011 | OYSTER COVE | 72 | 0 | Y |
| 0170013 | BAYVIEW AT KENT NARROWS | 70 | 0 | Y |
| 0170017 | BRIDGE POINTE | 71 | 1 | Y |
| 0170018 | RIVERSIDE COMPLEX | 72 | 0 | Y |
| 0170019 | STEVENSVILLE | 71 | 2 | Y |
| 0170020 | GRASONVILLE | 69 | 1 | Y |
| 0170203 | PHONECIA TRAILER PARK | 70 | 1 | N |
| 0170207 | PINE SPRINGS | 70 | 0 | Y |
| 1170001 | BEACH HARBOR | 31 | 0 | Y |

***Table 8. Routine Bacteriological Monitoring Results from System Distribution***
(Sample results available since 1995)

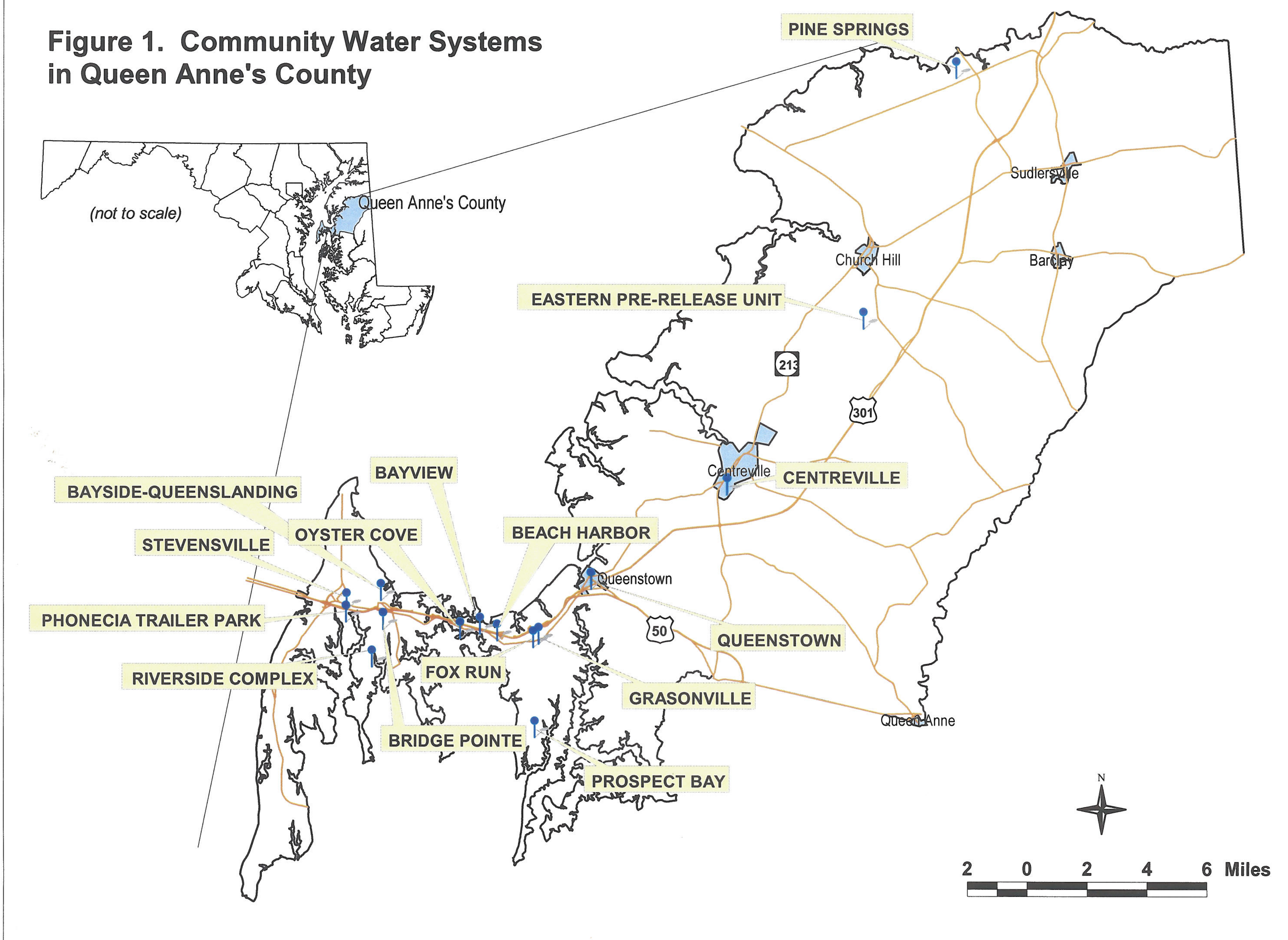
| PWSID | PWS Name | Is the Water System Susceptible to... | | | | | |
|---|---|---|---|---|---|---|---|
| | | Inorganic Compounds (except Arsenic) | Arsenic | Radionuclides | Volatile Organic Compounds | Synthetic Organic Compounds | Microbiological Contaminants |
| 0170001 | CENTREVILLE | NO | YES | YES [1] | NO | NO | NO |
| 0170003 | QUEENSTOWN | NO | YES | NO | YES | NO | NO |
| 0170006 | EASTERN PRE-RELEASE UNIT | NO | YES | NO | NO | NO | NO |
| 0170007 | BAYSIDE-QUEENSLANDING | NO | NO | NO | NO | NO | NO |
| 0170009 | PROSPECT BAY | NO | YES | YES [1] | NO | NO | NO |
| 0170010 | FOX RUN CONDOMINIUMS | NO | YES | NO | NO | NO | NO |
| 0170011 | OYSTER COVE | NO | YES | NO | NO | NO | NO |
| 0170013 | BAYVIEW AT KENT NARROWS | NO | YES | NO | NO | NO | NO |
| 0170017 | BRIDGE POINTE | NO | NO | NO | NO | NO | NO |
| 0170018 | RIVERSIDE COMPLEX | NO | NO | NO | NO | NO | NO |
| 0170019 | STEVENSVILLE | NO | NO | NO | NO | NO | NO |
| 0170020 | GRASONVILLE | NO | NO | NO | NO | NO | NO |
| 0170203 | PHONECIA TRAILER PARK | NO | YES | NO | NO | NO | NO |
| 0170207 | PINE SPRINGS | NO | NO | YES [1] | NO | NO | NO |
| 1170001 | BEACH HARBOR | NO | NO | NO | NO | NO | NO |

***Table 9. Susceptibility Analysis Summary***

[1] Based on Proposed MCL for Radon-222

# FIGURES

# Figure 1. Community Water Systems in Queen Anne's County



# APPENDIX

Table 2. Generalized hydrogeology and stratigraphy of Queen Anne's and Talbot Counties

| System | Series | Hydrogeologic unit | Stratigraphic unit | Approximate thickness (feet) | Lithology | Water-bearing properties |
|---|---|---|---|---|---|---|
| Quaternary | Pleistocene | Columbia aquifer | Kent Island Formation | 0-40 | Loose, light-colored medium to coarse sand and dark-colored, massive silt clay. | Functions as an unconfined or semi-confined aquifer. Yields moderate amounts of water to shallow wells. Vulnerable to contamination from surface sources. |
| Tertiary | Pliocene (?) and/or Upper Miocene (?) | | Pensauken Formation | 0-80 | Orange to reddish brown, fine to coarse sand and gravelly sand. | |
| | ? Miocene | Miocene aquifers/ confining unit | Chesapeake Group: Choptank Formation | 0-360 | Gray quartz sand and dark gray silt with clay with abundant shell material. | Contains multiple aquifers in the southeastern part of the study area. Elsewhere functions as a leaky confining unit. |
| | | | Chesapeake Group: Calvert Formation | | | |
| | Eocene | Piney Point aquifer | Piney Point Formation | 0-175 | Green to gray, fine to coarse glauconitic quartz sand with abundant shell material. | An important confined aquifer in the southeastern part of the study area. |
| | | Nanjemoy confining unit | Nanjemoy Formation | 0-260 | Green to gray glauconitic sandy silt and clay. | Functions as a leaky confining unit in all but the northwestern part of the study area. |
| | | Aquia aquifer | Unnamed Lower Eocene sand | 120-260 | Green to gray, fine to medium, glauconitic quartz sand with abundant shell material and layers of calcite-cemented sand. | An important confined aquifer throughout most of the study area. Produces the majority of fresh water on the central Eastern Shore, for domestic, commercial, and public-supply wells. Contains brackish water along the bay shore of Kent Island. |
| | Paleocene | | Aquia Formation | | | |
| | | | Hornerstown Formation | | | |
| Cretaceous | Upper Cretaceous | Severn/ Monmouth confining unit | Monmouth Formation | 70-180 | Dark gray to dark green glauconitic sandy, silty clay. | Functions as a tight confining unit. |
| | | Matawan aquifer/ confining unit | Matawan Group (undivided) | 100-150 | Dark gray to dark green glauconitic sandy, silty clay with lenses of light gray, fine to medium quartz sand. | Functions as a poor aquifer in the Kent Island area, elsewhere as a confining unit. Produces water relatively low in iron. |
| | | Magothy aquifer/ confining unit | Magothy Formation | 100-120 | Light gray, fine to coarse quartz sand and gray to black lignitic clay. | Functions as a confined aquifer in parts of the study area, elsewhere as a confining unit. Produces water high in iron. |
| | ? | Upper Patapsco aquifer | Potomac Group: Patapsco Formation | 50-150 (?) | Light gray to white fine to very coarse quartz sand. Interbedded with dark gray and variegated clay. | A productive confined aquifer throughout the study area; produces water high in iron. |
| | Lower Cretaceous | Middle Patapsco confining unit | | 800-900 (?) | Dark gray and variegated clay, interbedded with light gray to white, fine quartz sand. | Functions as a tight confining unit; may contain localized water-bearing zones. |
| | | Lower Patapsco aquifer | | 150-180 (?) | Fine to medium quartz sand, interbedded with dark gray and variegated silty clay. | A very productive confined aquifer in the Kent Island area, and possibly elsewhere. Produces water relatively low in iron. |
| | | Arundel confining unit | Potomac Group: Arundel Formation | ~600 | Predominantly gray, red, and variegated silty clay. | Functions as a very tight confining unit. |
| | | Patuxent aquifer | Potomac Group: Patuxent Formation | ~80 | Fine to coarse, silty quartz sand with partially-pyritized lignite. | A poor aquifer in the Kent Island area, and possibly elsewhere. |
| Paleozoic | -- | -- | Basement Complex | – | Variable types of crystalline and sedimentary rocks. | Not used for water supply in the study area. |



(FROM MGS R.I. NO 72, 2001)

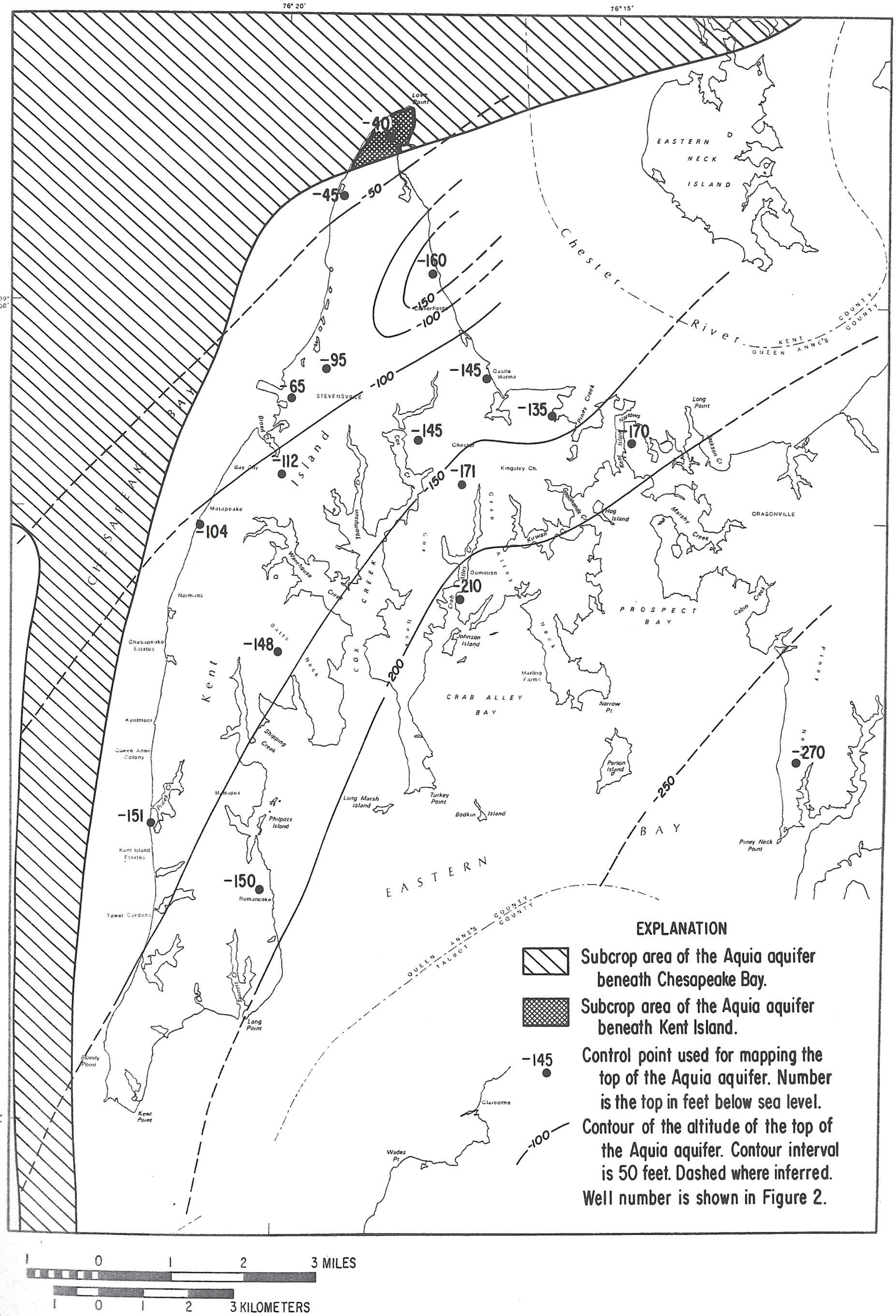



**Figure 6. — Altitude of the top and subcrop area of the Aquia aquifer.**

(From MGS R.I. 51, 1988)

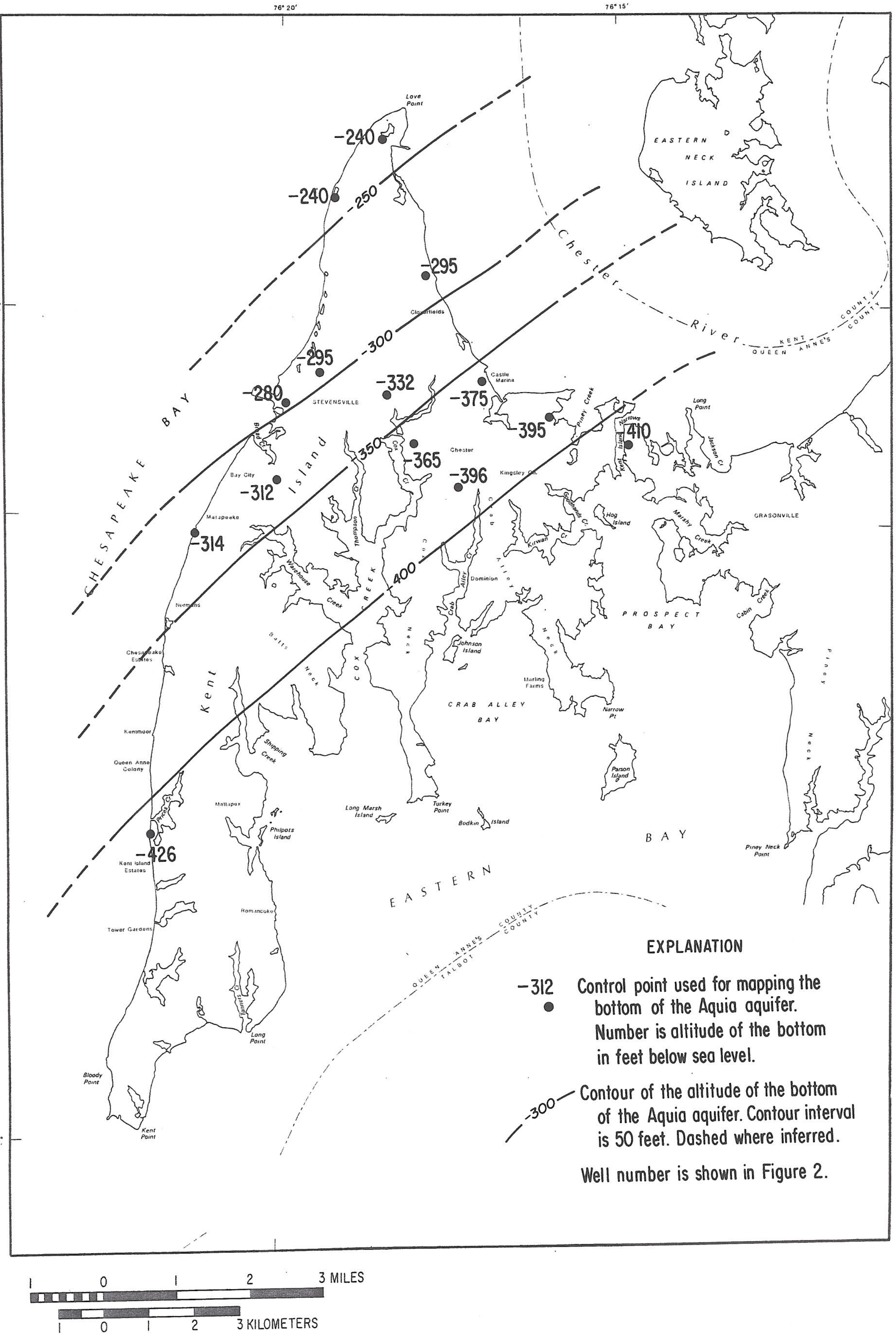



**Figure 7. — Altitude of the bottom of the Aquia aquifer.**

(FROM MGS R.I. 51, 1988)

# Summary Letters and Reports of VOC Sampling

# at Queenstown Bank (Case # 99-0703QA)

# Queenstown Volunteer Fire Department(Case # 990701QA)

November 18, 1998

Newman Walter
Queenstown Bank
P.O. Box 120
Queenstown, MD 21658

RE: Report of water sampling and soil sampling analysis

Mr. Walter:

**Direct push water sampling and soil sampling analysis**

On November11, 1998 (12) water samples and (12) soil samples were collected by use of a direct push technology. The samples were analyzed by EPA methods 8020 (BTEX) and 8015 (TPH DRO and GRO). A copy of the report of analysis is provided with this document. The sample locations and concentrations are represented on the attached site drawings. Samples were not collected in the area of Borings (B-3, B-4 and B-5) due to a subsurface obstruction.

The following tables summarize the analytical results of the water sampling:

Concentrations in ug/l (PPB)

| Sample | WS-1 | WS-2 | WS-6 | WS-7 | WS-8 | WS-9 |
|---|---|---|---|---|---|---|
| Benzene | ND | ND | 68.7 | 390 | 165 | ND |
| Toluene | ND | ND | 79.6 | 300 | 170 | ND |
| Ethyl benzene | ND | ND | 100 | 400 | 215 | ND |
| Xylene | ND | ND | 103 | 350 | 550 | ND |

| Sample | WS-10 | WS-11 | WS-12 | WS-13 | WS-14 | WS-15 |
|---|---|---|---|---|---|---|
| Benzene | 460 | 160 | 190 | 560 | 68 | ND |
| Toluene | 247 | 236 | 250 | 810 | 137 | ND |
| Ethyl benzene | 414 | 180 | 155 | 880 | 8.51 | 18.6 |
| Xylene | 148 | 90.1 | 250 | 3300 | 180 | 22.1 |

| Sample | WS-1 | WS-2 | WS-6 | WS-7 | WS-8 | WS-9 |
|---|---|---|---|---|---|---|
| TPH DRO | ND | ND | ND | ND | ND | ND |
| TPH GRO | ND | ND | ND | 8,700 | 11,500 | ND |

| Sample | WS-10 | WS-11 | WS-12 | WS-13 | WS-14 | WS-15 |
|---|---|---|---|---|---|---|
| TPH DRO | ND | 3,000 | 6,700 | 13,500 | ND | ND |
| TPH GRO | 6,560 | 7,300 | 40,600 | 120,000 | 5,500 | 2,980 |

ND indicates concentrations below detectable limits

November 30, 1998

Town of Queenstown
P.O. Box 4
Queenstown, MD 21658
RE: Report of water sampling and soil sampling analysis

**Direct push water sampling and soil sampling analysis**

On November17, 1998 (3) water samples were collected by use of a direct push technology. The samples were analyzed by EPA methods 8020 (BTEX) and 8015 (TPH DRO and GRO). A copy of the report of analysis is provided with this document. The sample locations and concentrations are represented on the attached site drawings.

The following tables summarize the analytical results of the water sampling:
Concentrations in ug/l (PPB)

| Sample | WP-1 | WP-2 | WP-3 |
|---|---|---|---|
| Benzene | ND | ND | ND |
| Toluene | ND | ND | ND |
| Ethyl benzene | ND | ND | ND |
| Xylene | ND | ND | ND |
| Total BTEX | ND | ND | ND |
| Naphthalene | ND | ND | ND |

| Sample | WP-1 | WP-2 | WP-3 |
|---|---|---|---|
| TPH DRO | ND | ND | ND |
| TPH GRO | ND | ND | ND |

ND indicates concentrations below detectable limits

**Limitations**

The scope of work is limited to the activities and results contained in this report. Industry standard hydrogeologic investigative procedures and protocol were used in order to complete the scope of work. No other warranty expressed or implied is made.

If you have any questions regarding the information within this report please contact me at (410) 548-5001.

Gregory A. Beal
Advanced Environmental Concepts

November 30, 1998

J.C. Lewis
Queenstown Fire Department
Queenstown, MD 21658

RE: Report of water sampling and soil sampling analysis

Mr. Lewis:

**Direct push water sampling and soil sampling analysis**
On November17, 1998 (7) water samples and (15) soil samples were collected by use of a direct push technology. The samples were analyzed by EPA methods 8020 (BTEX) and 8015 (TPH DRO and GRO). A copy of the report of analysis is provided with this document. The sample locations and concentrations are represented on the attached site drawings.

The following tables summarize the analytical results of the water sampling:
Concentrations in ug/l (PPB)

| Sample | WS-1 | WS-2 | WS-3 | WS-4 | WS-5 | WS-6 | WS-7 |
|---|---|---|---|---|---|---|---|
| Benzene | ND | ND | ND | 110 | ND | 1,600 | ND |
| Toluene | ND | ND | ND | 215 | ND | 1,100 | ND |
| Ethyl benzene | ND | 20.8 | ND | 100 | ND | 8,100 | ND |
| Xylene | ND | 21.6 | ND | 105 | ND | 9,760 | ND |
| Total BTEX | ND | 42.4 | ND | 530 | ND | 20,560 | ND |
| Naphthalene | ND | ND | ND | ND | ND | 760 | ND |

| Sample | WS-1 | WS-2 | WS-3 | WS-4 | WS-5 | WS-6 | WS-7 |
|---|---|---|---|---|---|---|---|
| TPH DRO | ND | ND | ND | ND | ND | ND | ND |
| TPH GRO | ND | ND | ND | 113,000 | ND | 281,000 | ND |

ND indicates concentrations below detectable limits

The following tables summarize the analytical results of the soil sampling:
Concentrations in ug/kg (PPB)

| Sample | B-1 (8ft) | B-1 (12ft) | B-2 (8ft) | B-2 (12ft) | B-3 (8ft) | B-3 (12ft) | B-4 (8ft) | B-4 (12ft) |
|---|---|---|---|---|---|---|---|---|
| Benzene | ND | ND | ND | ND | ND | ND | ND | ND |
| Toluene | ND | ND | ND | ND | ND | ND | 80.3 | ND |
| Ethyl benzene | ND | ND | ND | ND | ND | ND | 140 | 211 |
| Xylene | ND | ND | ND | ND | ND | ND | 1,100 | 400 |
| Total BTEX | ND | ND | ND | ND | ND | ND | 1,320.3 | 611 |
| Naphthalene | ND | ND | ND | ND | ND | ND | 500 | 1,200 |

| Sample | B-5 (8ft) | B-5 (12ft) | B-5 (14ft) | B-6 (8ft) | B-6 (12ft) | B-6 (14ft) | B-7 (14ft) |
|---|---|---|---|---|---|---|---|
| Benzene | ND | ND | ND | 2,480 | 4,060 | 800 | ND |
| Toluene | ND | ND | ND | 10,400 | 18,000 | 1,860 | ND |
| Ethyl benzene | ND | ND | ND | 60,000 | 66,000 | 30,000 | ND |
| Xylene | ND | ND | ND | 280,000 | 220,000 | 48,000 | ND |
| Total BTEX | ND | ND | ND | 382,880 | 308,060 | 80,660 | ND |
| Naphthalene | ND | ND | ND | 28,000 | 6,000 | 6,000 | ND |

| Sample | B-1 (8ft) | B-1 (12ft) | B-2 (8ft) | B-2 (12ft) | B-3 (8ft) | B-3 (12ft) | B-4 (8ft) | B-4 (12ft) |
|---|---|---|---|---|---|---|---|---|
| TPH DRO | ND | ND | ND | ND | ND | ND | 233 | ND |
| TPH GRO | ND | ND | ND | ND | ND | ND | 767 | 477 |

| Sample | B-5 (8ft) | B-5 (12ft) | B-5 (14ft) | B-6 (8ft) | B-6 (12ft) | B-6 (14ft) | B-7 (14ft) |
|---|---|---|---|---|---|---|---|
| TPH DRO | ND | ND | ND | ND | ND | ND | ND |
| TPH GRO | ND | ND | ND | 2,940 | 8,160 | 2,520 | ND |

**Limitations**

The scope of work is limited to the activities and results contained in this report. Industry standard hydrogeologic investigative procedures and protocol were used in order to complete the scope of work. No other warranty expressed or implied is made.

If you have any questions regarding the information within this report please contact me at (410) 548-5001.

Gregory A. Beal

Gregory A. Beal
Advanced Environmental Concepts

January 27, 1999

Town of Queenstown
P.O. Box 4
Queenstown, MD 21658
RE: Report of water sampling and soil sampling analysis

**Direct push water sampling and soil sampling analysis**
On January 22, 1999 (6) water samples and (1) soil sample were collected by use of a direct push technology. The samples were analyzed by EPA methods 8020 (BTEX) and 8015 (TPH DRO and GRO). A copy of the report of analysis is provided with this document. The sample locations and concentrations are represented on the attached site drawings.

The following tables summarize the analytical results of the soil sampling:
Concentrations in ug/l (PPB)

| Sample | B-1 14ft |
|---|---|
| Benzene | ND |
| Toluene | ND |
| Ethyl benzene | ND |
| Xylene | ND |
| Total BTEX | ND |

| Sample | B-1 14ft |
|---|---|
| TPH DRO | ND |
| TPH GRO | ND |

ND indicates concentrations below detectable limits

The following tables summarize the analytical results of the water sampling:
Concentrations in ug/l (PPB)

| Sample | B-1 | B-2 | B-3 | B-4 | B-5 | B-6 |
|---|---|---|---|---|---|---|
| Benzene | ND | ND | ND | ND | ND | ND |
| Toluene | ND | ND | ND | ND | ND | ND |
| Ethyl benzene | 85 | ND | ND | ND | ND | ND |
| Xylene | 63 | ND | ND | ND | ND | ND |
| Total BTEX | 148 | ND | ND | ND | ND | ND |

| Sample | B-1 | B-2 | B-3 | B-4 | B-5 | B-6 |
|---|---|---|---|---|---|---|
| TPH DRO | ND | ND | ND | ND | ND | ND |
| TPH GRO | ND | ND | ND | ND | ND | ND |

ND indicates concentrations below detectable limits

The following tables summarize the analytical results of the soil sampling:
Concentrations in ug/kg (PPB)

| Sample | B-6 (6ft) | B-6 (8ft) | B-6 (12ft) | B-6 (14ft) | B-7 (10ft) | B-7 (12ft) | B-7 (14ft) |
|---|---|---|---|---|---|---|---|
| Benzene | ND | 11,760 | 11,800 | ND | ND | 6.33 | 72 |
| Toluene | ND | 17,300 | 14,400 | ND | ND | ND | 53.2 |
| Ethyl benzene | 9.61 | 292,000 | 211,400 | 820 | 7.5 | 776 | 1,240 |
| Xylene | 10.2 | 303,000 | 217,000 | 560 | 7.9 | 900 | 860 |

| Sample | B-12 (12ft) | B-12 (14ft) | B-13 (12-14ft) | B-14 (12-14ft) | B-15 (12-14ft) |
|---|---|---|---|---|---|
| Benzene | ND | 148 | ND | 154 | ND |
| Toluene | ND | 1,120 | 34.1 | 102 | ND |
| Ethyl benzene | ND | 15,940 | 130 | 820 | 56.8 |
| Xylene | ND | 6,620 | 340 | 940 | 47 |

| Sample | B-6 (6ft) | B-6 (8ft) | B-6 (12ft) | B-6 (14ft) | B-7 (10ft) | B-7 (12ft) | B-7 (14ft) |
|---|---|---|---|---|---|---|---|
| TPH DRO | ND | 1,500 | 700 | ND | ND | 53.1 | 63.9 |
| TPH GRO | ND | 4,600 | 2,740 | ND | ND | 260 | 450 |

| Sample | B-12 (12ft) | B-12 (14ft) | B-13 (12-14ft) | B-14 (12-14ft) | B-15 (12-14ft) |
|---|---|---|---|---|---|
| TPH DRO | ND | ND | ND | ND | ND |
| TPH GRO | ND | 880 | ND | 170 | ND |

**Limitations**

The scope of work is limited to the activities and results contained in this report. Industry standard hydrogeologic investigative procedures and protocol were used in order to complete the scope of work. No other warranty expressed or implied is made.

If you have any questions regarding the information within this report please contact me at (410) 548-5001.

Gregory A. Beal

Gregory A. Beal
Advanced Environmental Concepts

August 5, 1999

Newman Walter
Queenstown Bank
P.O. Box 120
Queenstown, MD 21658

RE: Report of groundwater monitoring well sampling and testing MDE case # 99-0703 QA

Mr. Walter:

On July 22,1999 monitoring wells MW-1 and MW-2 were purged and samples were collected for laboratory analyses by EPA method 8020 (BTEX) and EPA method 8015 (TPH GRO). The well locations are represented on the attached site drawing. Monitoring Well testing and analysis results were obtained by the collection of groundwater by generally accepted environmental and hydrogeological practices. A copy of the report of analysis is provided with this document. MDE also required the sampling of monitoring well MW-4. However, MW-4 AEC was unable to locate MW-4 due to the presence of newly placed gravel.

Prior to sampling, the on-site monitoring wells were gauged. The following was observed:

| | depth to groundwater | depth to product | product thickness |
|---|---|---|---|
| MW-1 | 14.58' | NA | NA |
| MW-2 | 15.06' | NA | NA |

The following table summarizes the monitoring well testing and analysis:
Concentrations inug/l

| M.W. | DATE | BENZENE | TOLUENE | ETHYL-BENZENE | XYLENES | TPH GRO |
|---|---|---|---|---|---|---|
| MW-1 | 7/99 | ND | 19.4 | 9.27 | 10.8 | ND |
| MW-2 | 7/99 | 60.2 | 60.3 | 23.8 | 211 | 12200 |

A copy of this full report was sent to the attention of:

Charlie Jones MDE,120 Broadway Ave., Multi-Sevice Building, Centerville, MD 21617

If you have any questions regarding the information within this report please contact me at (410) 548-5001.

Gregory A. Beal
Advanced Environmental Concepts

The following table summarizes the monitoring well testing and analysis:
Concentrations inug/l

| M.W. | DATE | BENZENE | TOLUENE | ETHYL-BENZENE | XYLENES | TPH DRO | TPH GRO |
|---|---|---|---|---|---|---|---|
| MW-1 | 1/99 | ND | 25.8 | 13.7 | 19.5 | ND | 577 |
| MW-2 | 1/99 | 60.2 | 60.3 | 23.8 | 211 | ND | 2620 |
| MW-3 | 1/99 | ND | ND | ND | ND | ND | ND |
| MW-4 | 1/99 | ND | ND | ND | ND | ND | ND |

A copy of this full report was sent to the attention of:
Charlie Jones MDE,120 Broadway Ave., Multi-Sevice Building, Centerville, MD 21617

If you have any questions regarding the information within this report please contact me at (410) 548-5001.

Gregory A. Beal
Advanced Environmental Concepts

November 1, 1999

J.C. Lewis
Queenstown Fire Department
P.O. Box 118
Queenstown, MD 21658

RE: Report of groundwater monitoring well sampling and testing
MDE case # 99-0701 QA

Mr. Lewis:

The scope of work, to collect and analyze groundwater samples from (2) 4" monitoring wells has been completed. The work was completed to the specifications required by the Maryland Department of the Environment (MDE).

On October 18,1999 monitoring wells MW-1and MW-2 were purged and samples were collected for laboratory analyses by EPA method 8020 (BTEX) and EPA method 8015 (TPH GRO). The well locations are represented on the attached site drawing. Monitoring Well testing and analysis results were obtained by the collection of groundwater by generally accepted environmental and hydrogeological practices. A copy of the report of analysis is provided with this document.

Prior to sampling, the on-site monitoring wells were gauged. The following was observed:

| | depth to groundwater | depth to product | product thickness |
|---|---|---|---|
| MW-1 | 8.60' | NA | NA |
| MW-2 | 8.65' | NA | NA |

The following table summarizes the monitoring well testing and analysis:
Concentrations in ug/l

| M.W. | DATE | BENZENE | TOLUENE | ETHYL-BENZENE | XYLENES | MTBE | TPH GRO |
|---|---|---|---|---|---|---|---|
| MW-1 | 10/99 | 73 | 59.6 | 14.7 | 35.4 | 194 | 2130 |
| MW-2 | 10/99 | ND | ND | ND | ND | ND | ND |

If you have any questions regarding the information within this report please contact me at (410) 548-5001.

Gregory A. Beal
Advanced Environmental Concepts, Inc.

November 15, 1999

Newman Walter
Queenstown Bank
P.O. Box 120
Queenstown, MD 21658

RE: Report of groundwater monitoring well sampling and testing MDE case # 99-0703 QA

Mr. Walter:

On November 4,1999 monitoring well MW-4 was purged and samples were collected for laboratory analyses by EPA method 8020 (BTEX) and EPA method 8015 (TPH GRO). The well locations are represented on the attached site drawing. Monitoring Well testing and analysis results were obtained by the collection of groundwater by generally accepted environmental and hydrogeological practices. A copy of the report of analysis is provided with this document. MDE also required the sampling of monitoring well MW-4. However, MW-4 AEC was unable to locate MW-4 due to the presence of newly placed gravel.

Prior to sampling, the on-site monitoring wells were gauged. The following was observed:

| | depth to groundwater | depth to product | product thickness |
|---|---|---|---|
| MW-4 | 7.18 | NA | NA |

The following table summarizes the monitoring well testing and analysis:
Concentrations in ug/l

| M.W. | DATE | BENZENE | TOLUENE | ETHYL-BENZENE | XYLENES | TPH GRO |
|---|---|---|---|---|---|---|
| MW-4 | 11/99 | ND | ND | ND | 23 | ND |

A copy of this full report was sent to the attention of:
Charlie Jones MDE,120 Broadway Ave., Multi-Sevice Building, Centerville, MD 21617
If you have any questions regarding the information within this report please contact me at (410) 548-5001.

Gregory A. Beal
Advanced Environmental Concepts, Inc.

April 28,2000

Newman Walter
Queenstown Bank
P.O. Box 120
Queenstown, MD 21658

RE: Report of groundwater monitoring well sampling and testing MDE case # 99-0703 QA

Mr. Walter:

On April 17, 2000 monitoring well MW-4 was purged and samples were collected for laboratory analyses by EPA method 8020 (BTEX and MTBE). The well location is represented on the attached site drawing. Monitoring Well testing and analysis results were obtained by the collection of groundwater by generally accepted environmental and hydrogeological practices. A copy of the report of analysis is provided with this document.

Prior to sampling, the on-site monitoring wells were gauged. The following was observed:

| | depth to groundwater | depth to product | product thickness |
|---|---|---|---|
| MW-4 | 6.08 | NA | NA |

The following table summarizes the monitoring well testing and analysis:
Concentrations in ug/l

| M.W. | DATE | BENZENE | TOLUENE | ETHYL-BENZENE | XYLENES | MTBE |
|---|---|---|---|---|---|---|
| MW-4 | 4/00 | ND | ND | ND | ND | ND |

ND- Indicates concentrations below detectable concentrations

A copy of this full report was sent to the attention of:
Charlie Jones MDE, 120 Broadway Ave., Multi-Service Building, Centerville, MD 21617
If you have any questions regarding the information within this report please contact me at (410) 548-5001.

Gregory A. Beal
Advanced Environmental Concepts, Inc.