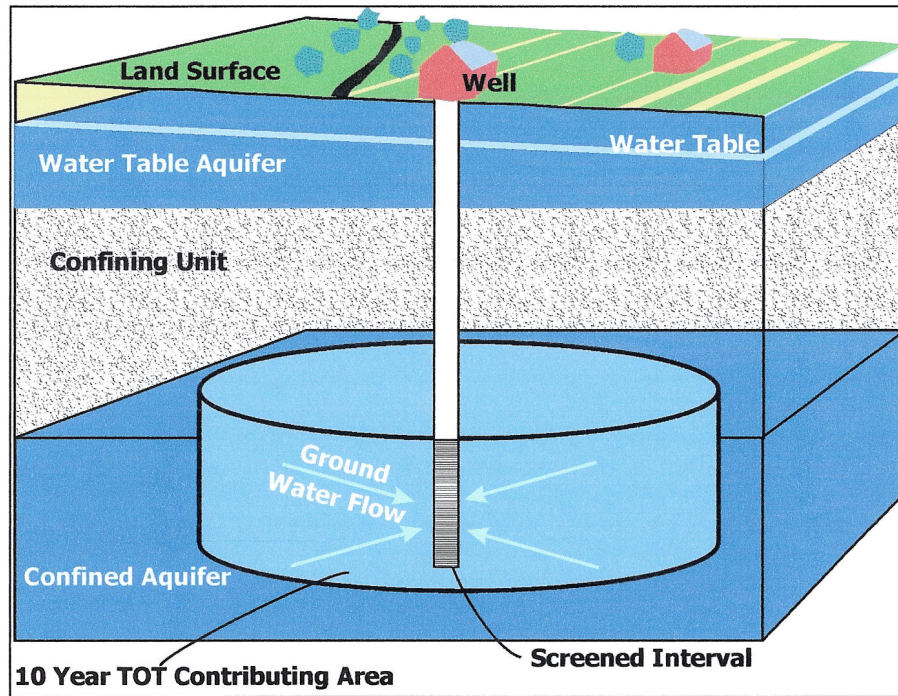


SOURCE WATER ASSESSMENT

FOR PINEY CREEK CORPORATION

QUEEN ANNES COUNTY, MD



Prepared By
Water Management Administration
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SUMMARY

The Maryland Department of the Environment's (MDE) Water Supply Program (WSP) has conducted a Source Water Assessment for the Piney Creek Corporation Water System. The major components of this report as described in Maryland's Source Water Assessment Plan (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 management of the assessment area conclude this report.

The source of Piney Creek Corporation's water supply is a Coastal Plain confined aquifer-the Aquia. One well is currently being used to supply the water from this aquifer. The source water assessment area was delineated by the Water Supply Program using methods approved by the U. S. EPA.

Potential sources of contamination within the assessment area were identified based on MDE site visits, and a review of MDE's databases. Well information and water quality data were also reviewed. A map showing the source water assessment area and potential contaminant sources is enclosed.

The susceptibility analysis for Piney Creek Corporation's water supply is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. Piney Creek Corporation's water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifer, except for microbiological contaminants due to the location of the supply well in an area subject to tidal flooding.

INTRODUCTION

The Maryland Department of the Environment's (MDE) Water Supply Program (WSP) has conducted a Source Water Assessment for the Piney Creek Corporation Water System. Piney Creek Corporation is located on Kent Island between Piney Creek and Kent Narrows in Queen Anne's County. The system is owned and operated by Piney Creek Corporation and serves a population of approximately 31. Currently, the water is being pumped from one well with no treatment. The Piney Creek water system was only recently identified (January 2004) as a community water supply. Therefore, sampling data is limited.

WELL INFORMATION

Well information was obtained from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports and published reports. A review of the well data and sanitary surveys of the system indicates the well was drilled prior to 1973, when the State's well construction regulations went into effect, and may not meet current well construction standards. A review of the well completion report indicates that the well was grouted to a depth of 85 feet. Table 1 contains a summary of the well construction data.

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH (ft)	CASING DEPTH (ft)	YEAR DRILLED	AQUIFER NAME
01	Well 1	QA-72-0074	210	190	1971	AQUIA

Table 1. Piney Creek Corporation Well Information.

HYDROGEOLOGY

Ground water flows through pores between gravel, sand and silt grains in unconsolidated sedimentary rock aquifers such as the one used by Piney Creek Corporation. 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 layer is 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.

The Piney Creek area lies within the Atlantic Coastal Plain physiographic province. 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 so that they appear wedge-shaped. These sediments crop

out in a concentric band that lies parallel to the Fall Line which marks the western boundary of the Coastal Plain. Piney Creek Corporation's wells pump water from the Aquia aquifer, which is confined and is composed of fine to coarse-grained, greenish-brown sand that contains layers of grayish-green silt and clay, indurated calcite-cemented sand and fossil beds composed of shell debris (DNR, 1987). The top of the Aquia aquifer in the Piney Creek area is approximately 120 feet below sea level.

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WMPA) is considered to be the Source Water Assessment Area (SWAA) for the system. The SWAA for the Piney Creek Corporation well was delineated using the methodology described in Maryland's Source Water Assessment Plan (1999) for confined aquifers in the Coastal Plain using less than 10,000 gallons of water per day (gpd). The Source Water Assessment Plan prescribes using a circle with a fixed radius of 600 feet for all confined wells pumping less than 10,000 gpd. The 600-foot radius circle was calculated using the following parameters: minimum aquifer thickness of 20 feet, porosity of 0.25, and daily pumpage of 10,000 gpd for ten years.

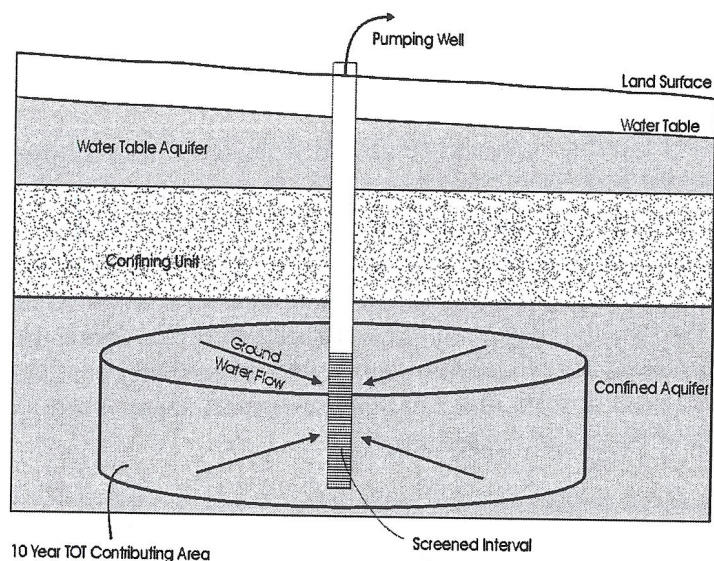
Piney Creek Corporation has a water appropriation permit, one for 3500 gallons per day (gpd). The source well, QA-72-0074, has a well screen length of 20 feet.

The fixed radius was derived from methodology 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), pumping rate and the screened interval(s) of the well or wells included in the SWAA, 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 SWAA's were calculated using the following volumetric equation:

$$r = \sqrt{\frac{Qt}{\pi nH}}$$

where r = calculated fixed radius (ft)
 Q = pumping rate of well (ft³/yr)
 n = aquifer porosity (dimensionless)
 H = length of well screen (ft)
 t = time of travel (yr.)

The circle shown in Figure 1 represents the aquifer zone of transport in the subsurface as illustrated below.



Conceptual illustration of a zone of transport for a confined aquifer

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 unused wells or along well casing that are not intact or have no grout seal. Wells that are not being used or maintained will eventually corrode and provide a pathway for contaminants present in the shallow aquifers at higher-pressure heads to migrate to the deeper aquifers.

Potential sources of contamination identified at the land surface have the potential to impact the shallow water table aquifer. Based on the MDE databases, no potential sources of contamination were identified in the Piney Creek Corporation WHPA. Therefore, except for the direct injection of contaminants into the deeper confined aquifer, Piney Creek Corporation's water supply should be well protected from contamination.

A potential source of contamination, not addressed by the databases, is localized flooding and tidal surges, which could submerge the well and allow bay water to directly enter the well. A well flooded is unsafe for human consumption as pathogenic organisms are present in high numbers in floodwater. According to the system's contact the well was submerged during a recent hurricane. Another source of contamination, also not addressed by the databases, is the stagnation of water at the end of the system. The water distribution system is a dead end system and some of the homes served by the system are not occupied continuously, which allows water to stand in the line.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database and system files for Safe Drinking Water Act 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 at or greater than 50% of a MCL, this assessment will describe the sources of such a contaminant and, if possible, locate the specific sources which are the cause of the elevated contaminant level. Since there is no treatment currently in use at Piney Creek Corporation, all data reported is for untreated water. Recent inspection reports indicate that the system is considering the installation of disinfection and a softening treatment.

A review of the monitoring data since March 2004 for Piney Creek Corporation's water supply indicates that it meets the current drinking water standards for inorganic radiobiological, and organic compounds. The water quality sampling results are summarized in Table 2.

IOCs		SOCs		VOCs		Radionuclides	
No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL
3	0	1	0	3	0	3	0

Table 2. Summary of Water Quality Samples for Piney Creek Corporation's Water Supply

Inorganic Compounds (IOCs)

No IOCs above 50% of the MCL have been detected in Piney Creek Corporation's water supply.

Volatile Organic Compounds (VOCs)

No VOCs have been detected in Piney Creek Corporation's water supply.

Synthetic Organic Compounds (SOCs)

No SOCs above 50% of the MCL have been detected in Piney Creek Corporation's water supply.

Radionuclides

No radionuclides above 50% of the MCL have been detected in Piney Creek Corporation's water supply.

Microbiological Contaminants

Routine bacteriological monitoring is conducted in the finished water for each community water system on a monthly basis and measures total coliform bacteria. 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 aquifers

would likely cause a positive total coliform result despite disinfection and would require follow-up total and fecal coliform analysis.

Since March 2004 Piney Creek Corporation has conducted routine bacteriological sampling nine times. Total coliform bacteria were detected in five of these samples. As a result, 15 repeat samples have been taken. Four of the repeat samples have also shown positive results for total coliform bacteria. It should be noted that none of the raw water samples have been positive for fecal coliform.

SUSCEPTIBILITY ANALYSIS

The well serving Piney Creek Corporation's water system obtains water from a confined aquifer. Confined aquifers are naturally well protected from activity on the land surface due to low permeability sediments that provide a barrier for water movement from the surficial aquifers into the deeper aquifer. A properly constructed well with the casing extended to the confining layer above the aquifer and with sufficient grout should be well protected from contamination at the land surface. Wells that are not being used or maintained will eventually corrode and can provide a pathway for contaminants present in the shallow aquifers at higher-pressure heads to migrate to the deeper aquifers. The information that was used to conduct the susceptibility analysis is as follows: (1) available water quality data (2) presence of potential contaminant sources in the WHPA (3) aquifer characteristics (4) well integrity and (5) the likelihood of change to the natural conditions. The susceptibility of Piney Creek Corporation's water supply to the various contaminant groups is shown in Table 3 at the end of this section.

Inorganic Compound (IOCs)

No IOCs above 50% of the MCL have been detected in the Piney Creek Corporation water supply.

Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination, Piney Creek Corporation's water supply is **not** susceptible to the other inorganic compounds.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of the MCL have been detected in Piney Creek Corporation's water supply.

Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination in the aquifers, Piney Creek Corporation's water supply is **not** susceptible to volatile organic compounds.

Synthetic Organic Compounds (SOCs)

No SOC's above 50% of the MCL were detected in Piney Creek Corporation's water supply.

Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination, Piney Creek Corporation's water supply is **not** susceptible to synthetic organic compounds.

Radionuclides

No radionuclides above the 50% of the MCL were detected in Piney Creek Corporation's water supply.

Since the natural occurrence of radionuclides is not present in water from the Aquia aquifer, Piney Creek Corporation's water supply is **not** susceptible to other radionuclides

Microbiological Contaminants

Raw water monitoring for microbiological contaminants is not required of water systems in confined aquifers because they are considered naturally protected from sources of pathogens at the land surface. Routine bacteriological testing at Piney Creek has shown five out of nine samples positive for total coliform and no positives for fecal coliform.

Piney Creek Corporation's water system has no treatment and is installed without any looping of the distribution system. In addition, the units connected to the system are not all occupied daily. Some of the residents are weekend-only, seasonal, or temporarily non-existent. As a result, water in the distribution line may not be flushed out at a frequency to prevent water stagnation, which may be contributing to the total coliform problem. In addition, the locations of the sample taps with total coliform are at the farthest end of the distribution system.

The well site, however, was submerged under a few feet of water during tropical storm Isabel (2003). However, since no data exists prior to March 2004, it is unclear if the source of contamination may be resultant of damage from the tidal surge and/or subsequent renovations to the residential units to repair structural/cosmetic damages. Therefore, Piney Creek Corporation's water supply is susceptible to microbiological contaminants.

CONTAMINANT TYPE	Are Contaminant Sources present in the WHPA?	Are Contaminants detected in WQ samples at 50% of the MCL	Is Well Integrity a Factor?	Is the Aquifer* Vulnerable?	Is the System Susceptible to the Contaminant
Inorganic Compounds	NO	NO	NO	NO	NO
Volatile Organic Compounds	NO	NO	NO	NO	NO
Synthetic Organic Compounds	NO	NO	NO	NO	NO
Radionuclides	NO	NO	NO	NO	NO
Microbiological Contaminants	YES*	YES	YES*	NO	YES*

Table 3. Susceptibility Chart for Piney Creek Corporation's Water Supply

* Located in an area subject to tidal flooding

MANAGEMENT OF THE WELLHEAD PROTECTION AREA

Specific management recommendations for consideration are listed below:

Public Awareness and Outreach

The Consumer Confidence Report should include a summary of this report and indicate that the full report is available to the general public through the county library, or by contacting the operator or MDE.

Monitoring

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

Contaminant Source Inventory Updates

Conduct a survey of the WHPA and inventory any potential sources of contamination, including unused wells that may not have 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.

Well Inspection/Maintenance

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. All unused wells must be abandoned and seal as per State well construction regulations.

Water operation personnel should have a program for periodic inspections and maintenance of the supply well to ensure its integrity and protect the aquifer from contamination.

Since the well is subject to tidal flooding, the system should install a flood proof well cap and ensure that the conduit line is plugged to prevent infiltration.

Changes in Use

The system is required to notify the MDE Water Supply Program if new wells are to be added or an increase in water usage is proposed. An increase in use or the addition of new wells may require revisions to the WHPA.

REFERENCES

Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 p.

Maryland Department of Natural Resources (DNR), 1987, The Quantity and Natural Quality of Ground Water in Maryland: DNR Water Resources Administration.

United States Environmental Protection Agency, Office of Ground-Water Protection, 1987, Guidelines for Delineation of Wellhead Protection Areas.

SOURCES OF DATA

Water Appropriation and Use Permit No. QA1972G001
Public Water Supply Inspection Reports
Monitoring Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Queenstown DNR DOQQ (2000)