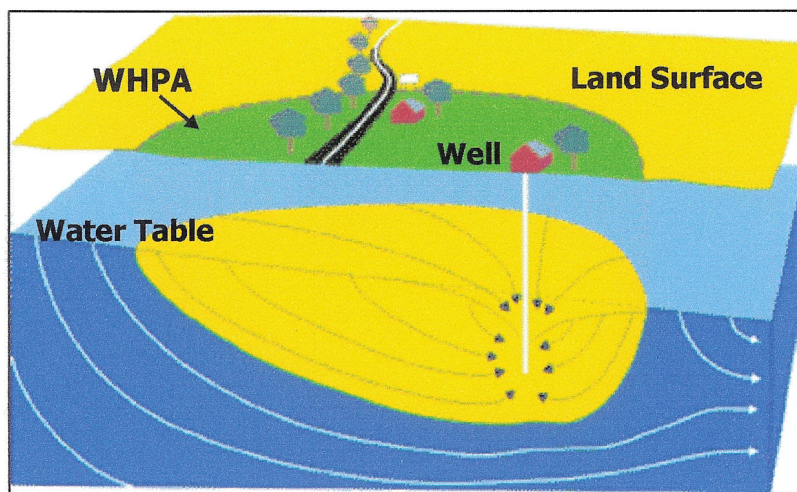


SOURCE WATER ASSESSMENT
FOR THE CARPENTER'S POINT WATER SUPPLY
CECIL COUNTY, MD



Prepared By
Maryland Department of the Environment
Water Management Administration
Water Supply Program
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SUMMARY

The Maryland Department of the Environment Water Supply Program (WSP) has conducted a Source Water Assessment for the Carpenter's Point water system. The required 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 protecting the drinking water supply conclude this report.

The source for the Carpenter's Point water supply is an unconfined aquifer in the Coastal Plain known as the Potomac Group. The privately owned and operated Water Company has three wells to obtain their drinking water. Currently, the water is supplied by Well 3 only and Wells 1 and 2 serve as a backup supply. The source water assessment area for the Carpenter's Point wells was delineated by the WSP using U.S. EPA approved methods specifically designed for each source.

Potential sources of contamination within the assessment area were identified from site visits, database reviews, and land use maps. Well information and water quality data were also reviewed. Figures showing land use and potential contaminant sources within the source water assessment area and an aerial photograph of the well locations are enclosed at the end of the report.

The susceptibility analysis of the Carpenter's Point water supply was based on the review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that the Carpenter's Point water supply is not susceptible to inorganic compounds (IOCs), volatile organic compounds (VOCs), synthetic organic compounds (SOCs), radionuclides, and microbiological contaminants.

INTRODUCTION

The Carpenter's Point Water Company is located approximately 3 miles southwest of Charlestown in Cecil County (Figure 1). Carpenter's Point is a peninsula that is bounded to the east by the Northeast River and to the south and west by the Chesapeake Bay (Figure 2). The privately owned and operated Water Company is located on Water Tower Road just off of Carpenter's Point Road (Figure 1). The water supply system serves part-year and year-round residents (about 138 service connections) and one commercial customer, the Riverside Ponderosa Pines Campground resort. The system has three supply wells. Currently, the water is supplied by Well 3 only and Wells 1 and 2 serve as a backup supply. Figure 1 shows the locations of the supply wells.

WELL INFORMATION

A review of the well completion reports and sanitary surveys indicate that production Well 3 meets the State's well construction standards. Backup Wells 1 and 2 are driven wells and hence have no grouting around the casing. The well logs for Wells 1 and 2 indicate a clay layer of 58 and 64 feet respectively. Table 1 is a summary of the well construction data.

PLANT	SOURCE NAME	PERMIT	TOTAL DEPTH (ft.)	CASING DEPTH (ft.)	AQUIFER
1	Carpenters Point 1	CE-81-0339	90	71	Potomac Group
1	Carpenters Point 2	CE-81-2350	91	81	Potomac Group
1	Carpenters Point 3	CE-94-2653	120	100	Potomac Group

Table 1. Carpenter's Point Well Information

The production wells (1, 2, and 3) are pumped at average rates of 75, 40 and 150 gallons per minute (gpm) respectively. The three wells are located outside and on the property of the Water Treatment Plant (Figure 1). According to the Water Company owner and operator, Mr. Charles Bowman, a former well located on the property was properly abandoned and sealed. A spring located on the property is no longer used as a potable water source. The spring collection boxes have been disconnected from the system.

HYDROGEOLOGY

The Carpenter's Point wells draw water from the Potomac Group, which is a part of the Coastal Plain sediments in Cecil County. The Potomac Group is of Cretaceous age and functions as an unconfined aquifer in this area. The Potomac Group sediments were deposited in a river-delta environment (Glaser, 1969). They consist of highly variable, unconsolidated sand, sandy clay and clay that ranges in color from red, brown, gray, purple, white, and yellow (Otton & Mandle, 1984). The production wells are screened within the permeable sand layers.

The thickness of the Potomac Group aquifer at Carpenter's Point is approximately 46 feet. Based on available well test data, an average transmissivity of 23,936 gallons per day per foot (3,200 ft²/day) was used for this aquifer (Otton & Mandle, 1984). The regional ground water flow direction is toward the southeast at a gradient of 0.0125. Based on the type of geologic material, a porosity of 30% was assumed for this aquifer (Fetter, 1988).

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment area for the system. According to Maryland's Source Water Assessment Plan document approved by EPA (MDE, 1999), systems using >10,000 gallons per day (gpd) located in unconfined Coastal Plain aquifers are to be delineated using the EPA's WHPA Code ground water model. The pumpage used for the delineations was 24,000 gpd or 3,209 ft³/day. This amount is based on the daily average quantity from the current Water Appropriation and Use Permit issued by the MDE Water Rights Division. The model was run for each well based on simulation time limits of one and ten years respectively.

Delineation Zones (see Figure 2)

Zone 1: Zone 1 is the WHPA delineated using a 1-year time-of-travel (TOT) criterion. Zone 1 serves as the first zone of protection. The one-year criterion was based on the maximum survival times of microbial organisms in ground water. Based on the topography of the area, two major flow directions of 55° (NE) and 285° (SE) from each well were used to obtain the maximum outer limits of the WHPA. Each capture zone length was about 600 feet. Since the wells are within about 130 feet of each other, the resulting capture zones were combined together to form one oval-shaped Zone 1 WHPA (Figure 2). The total area of the Zone 1 WHPA is 15.2 acres.

Zone 2: Zone 2 is the WHPA delineated using a 10-year TOT criterion. It would take any contaminant present at the Zone 2 boundary 10 years to reach the well (if it moves at the same rate as the ground water), using the permitted quantity. Zone 2 provides adequate time for facilities outside the WHPA to address chemical contamination before it reaches the wells. The two major flow directions (55° NE and 285° SE) were used to obtain the maximum outer limits of the WHPA. The 10-year zone was terminated at the topographic boundaries, which are assumed to be ground water divides. The resulting WHPA is sickle-shaped and includes the capture zones for each of the three wells (Figure 2). The total area of this combined Zone 2 is 158.8 acres.

POTENTIAL SOURCES OF CONTAMINATION

For this assessment, MDE Waste and Water Management databases were reviewed, staff consulted, and field inspections conducted, to identify potential sources of contamination in and around the Carpenter's Point WHPA. In addition, on August 31, 2000, MDE staff completed a field survey of the Carpenter's Point WHPA and wells, and

interviewed the Owner and Operator of the Water Company, Mr. Charles Bowman, regarding any water quality concerns and potential ground water contamination sources in the area. No water quality concerns were reported, however, Mr. Bowman expressed some concern about two potential contaminant point sources that are stockpiled on the nearby campground resort properties. This will be discussed later in the report.

A review and consultation with MDE Waste and Water Management Administration Program databases and personnel was conducted. Currently, there is no record of any registered underground storage tanks (USTs), hazardous waste sites, solid waste facilities, ground water contamination sites, pesticide dealers, and ground water discharge permit sites within the Carpenter's Point WHPA.

A field inspection was conducted within and near the WHPA to determine the potential of any unpermitted ground water discharges (e.g. open floor drains) to the Coastal Plain aquifer. No ground water discharges were reported since there are no industrial or commercial facilities located within the WHPA.

Pesticides and herbicides used in agriculture are potential non-point sources of synthetic organic compounds (SOCs). In addition, the application of fertilizers on agricultural fields is a potential non-point source of nitrate. Figures 1 and 3 show the active cropland areas within the Carpenter's Point WHPA. Lawn maintenance and landscaping activities on residential land are also potential non-point sources of nitrates and SOC's to the Carpenter's Point water supply.

Based on the Maryland Office of Planning's 1997 Land Use Map, the land use within the WHPA is as follows:

LAND USE	TOTAL AREA (Acres)	PERCENT OF WHPA
Low Density Residential	8.8	6
Medium Density Residential	4.9	3
Commercial	14.2	9
Cropland	92.4	58
Forest	38.5	24

Table 2. Land Use Summary Within WHPA Zones 1 & 2

The breakdown of land use within the WHPA Zones is shown in Figure 3. Note that the land use map shows the Water Treatment Plant and adjoining properties as commercial land. However, there are no commercial activities occurring on these properties.

A review of the Maryland Office of Planning 1995 Cecil County Sewerage Coverage Map indicates that 65% (103.7 acres) of the WHPA is in the planned service area (Figure 4). The remaining 35% (55.1 acres) of the land area within Zones 1 and 2 have no plans for public sewerage. Figure 3 shows that the areas with no planned service are currently agricultural and forested lands. Undeveloped forest and agricultural areas account for 82% of the land within the WHPA (Table 2). Currently, all the homes and

the recreational resort at Carpenter's Point are on private septic systems. Septic systems are sources of nitrates and potential sources of microbial pathogens to the ground water. Connecting the homes and the commercial facility to public sewerage service should address this potential risk.

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 data described is from the finished (treated) water unless otherwise noted. The treatment currently used at Carpenter's Point is hypochlorination for disinfection, and pH adjustment for corrosion control. The pH adjustment is done through the addition of soda ash. The treated water is stored in an 80,000 gallon elevated tank tower that was put into service in 1998.

In accordance with Maryland's SWAP, data from the treatment plant was compared with the maximum contaminant levels (MCLs). If the monitoring data is greater than 50% of a MCL, the written assessment will describe the sources of such a contaminant and, if possible, locate the specific sources that are the cause of the elevated contaminant level. A review of the monitoring data since 1991 for Carpenter's Point finished water indicates that the system's water supply meets the drinking water standards.

Inorganic Compounds (IOCs)

No IOC detects above 50% of the MCL have been reported over the past seven years of sampling data. The land use map and Table 2 shows that cropland makes up 58% of the WHPA. Review of sampling data since 1993 indicates that nitrate detects have not exceeded 4.5 ppm. The average nitrate value since 1993 is 3.8 ppm. The MCL for nitrate is 10 ppm.

Volatile Organic Compounds (VOCs)

The only VOC detects that have been reported from five sets of sampling data since 1991 are the disinfection by-products known as trihalomethanes. Chloroform detects range from 2.0 ppb to 21.7 ppb. Bromodichloromethane detects range from 0.6 ppb to 9.2 ppb. Dibromochloromethane detects range from 0.8 ppb to 3.7 ppb. Bromoform was not detected. The total of these four contaminants did not exceed 30.5 ppb in any of the five data sets. Trihalomethanes are currently regulated for systems serving a population of over 10,000. The current MCL for regulated systems is 100 ppb for the total of these four VOCs. By the year 2003, this MCL total will be reduced to 80 ppb. Disinfection by-products are the result of a reaction between chlorine used for disinfection and organic material in the water supply. At Carpenter's Point, the organic material may be naturally occurring from within the aquifer itself.

Synthetic Organic Compounds (SOCs)

No SOC detects have been reported in three sets of available sampling data since 1993.

Radionuclides

Gross alpha was detected at 2 picocuries per Liter (pCi/L) on 2/18/97 and at 1 pCi/L on 10/28/92. The MCL for gross alpha is 15 pCi/L. Gross beta was detected at 3 pCi/L on 2/18/97. The MCL for gross beta is 50 pCi/L. Radon-222 was detected at 75 pCi/L and at 65 pCi/L on 4/4/94 and at 70 pCi/L on 6/11/97. There is currently no MCL for radon-222, however EPA has proposed a MCL of 300 pCi/L or an alternate MCL of 4,000 pCi/L. MDE is waiting for EPA's final rule to determine how radon will be regulated for public water systems.

Microbiological Contaminants

Raw water sampling was conducted on 9/15/98 for Carpenter's Point Wells 1 and 2 to determine the sensitivity of these wells to surface water. The wells at Carpenter's Point were classified as low risk sources to surface water influence. Therefore, 1 dry weather raw water sample was collected for Wells 1 and 2. All results were negative for the presence of total and fecal coliform. Well 3 was placed on-line after the initial raw water sampling for this system was completed and has not been tested for surface water influence to date.

SUSCEPTIBILITY ANALYSIS

Carpenter's Point wells draw water from an unconfined aquifer. In general, water supplies in unconfined aquifers are susceptible to contamination from land use activities. Therefore, continued routine monitoring of contaminants is essential in assuring a safe drinking water supply. The criteria that was used to conduct the susceptibility analysis is as follows: (1) evaluation of available water quality data, (2) review of the contaminant sources within the WHPA, (3) evaluation of the aquifer characteristics, (4) evaluation of the well integrity, and (5) evaluation of the likelihood of change to the natural conditions.

Inorganic Compounds (IOCs)

No IOC detects above 50% of the MCL have been reported over the past seven years of sampling data at Carpenter's Point. The average nitrate level since 1993 is 3.8 ppm, well below the MCL of 10 ppm. Sources of nitrate can generally be traced back to land use. Fertilization of agricultural fields and residential lawns, and on-site septic systems are non-point sources of nitrate in ground water. Currently, 58% of the WHPA is agricultural land (Table 2). All the homes and the campground resort located within the WHPA utilize private septic systems, however the area is to be connected to public sewerage service in the near future (Figure 4).

There are potential non-point sources of nitrates located within the WHPA. However, sampling results at the Carpenter's Point Wells over the past seven years have not shown the levels to be of significant concern. Based on available water quality data, and aquifer characteristics, the Carpenter's Point water supply is **not** susceptible to nitrates or other inorganic compounds.

Volatile Organic Compounds (VOCs)

Review of sampling data reported since 1991 indicates that no VOCs have been detected at Carpenter's Point other than the disinfection-by-products discussed earlier in the Water Quality Section. Currently, there are no registered USTs or other VOC threats to the wells located within the WHPA (Figure 2). Mr. Bowman expressed concern about two potential point sources of contamination located on the nearby campground resort properties. The point sources are stockpiled asphalt aggregate and dredged sand spoils from the Chesapeake Bay respectively (Figure 2). The asphalt aggregate may pose a potential VOC threat to the wells if the exposed material were stockpiled within the WHPA boundaries. Figure 2 shows that the potential contaminant sources are located outside and to the southeast of the existing WHPA. Thus, the potential point sources do not pose a threat to the wells.

The current WHPA Zone boundaries will increase only if increased water demands for the water system are required. There is no evidence that an increase in water pumpage is necessary for the Carpenter's Point area at the present time. Therefore, the Carpenter's Point water supply is **not** susceptible to VOC contamination.

Synthetic Organic Compounds (SOCs)

The current land use indicates that non-point sources exist within the WHPA that could potentially contaminate the water supply with SOC. Pesticides and chemicals used in agricultural operations and on residential lawns are a potential threat. The wells at Carpenter's Point draw from an unconfined aquifer in the Coastal Plain. Based on three sets of data since 1993, no SOC detects have been reported for the Carpenter's Point water supply. Additionally, the well logs indicate clay layers ranging from 12 to 64 feet above the water-bearing zone of the aquifer. The clay layers may inhibit the infiltration of SOC from entering the water supply. Based on limited data available, the Carpenter's Point water supply is **not** susceptible to SOC contamination.

Radionuclides

Gross alpha and gross beta radiation was detected at low levels in water samples at Carpenter's Point. The results were less than 50% of the 15 pCi/L and 50 pCi/L MCLs respectively. Radon-222 results were less than 50% of the more conservative 300 pCi/L MCL currently under consideration by EPA. The source of radon in ground water can be traced back to the natural occurrence of uranium in rocks. Based on limited sampling data, the Carpenter's Point water supply is **not** susceptible to radiological contaminants.

Microbiological Contaminants

The nearest natural surface water body to the Carpenter's Point wells is the Northeast River that flows southward into the Chesapeake Bay (Figure 2). Wells 1, 2, and 3 are about 700, 830, and 1,000 feet to the west of the Northeast River respectively. Based on coliform sampling data, Wells 1 and 2 were determined **not** to be susceptible to protozoans or bacteriological contaminants. Well 3 has not been tested for surface

water influence to date, and therefore, a final susceptibility determination could not be made at the present time. The wells may be susceptible to viral contaminants, as these are much smaller, can survive longer, and may not be as effectively filtered by the aquifer as protozoans and bacteria. Future monitoring will be needed to determine susceptibility to viruses.

MANAGEMENT OF THE WHPA

Form a Local Planning Team

- Teams should represent all of the interests in the community. The water supplier, elected officials, the County Health Department, local planning agencies, local businesses, developers, farmers and residents within and near the WHPA should work together to reach a consensus on how to protect the water supply.

Public Awareness and Outreach

- Placing signs at the WHPA boundaries is a good way to make the public aware of protecting their source of water supply and to help in the event of spill notification and response.
- Pamphlets, flyers and bill stuffers sent to local residents, the farmer, and the campground resort will help to educate the public about Wellhead Protection. An MDE pamphlet entitled "Gardening in a Wellhead Protection Area" is such an example.

Cooperative Efforts with Other Agencies

- Request the assistance of the University of Maryland Agricultural Extension Service, the Soil Conservation Service to work with the nearby farmer to adopt Best Management Practices (BMP's) for cropland located within the WHPA.
- The nearby farmer can also participate in the New Conservation Reserve Program (CREP) applicable to the cropland located within the WHPA. Government funding is available to qualified farmers equal to the cost and financial benefit of farming the area. The Natural Resources Conservation Service is responsible for determining the relative environmental benefits of each acre offered for participation.

Monitoring

- Cropland currently makes up 58% of the land use within the WHPA. In addition, all homes and the campground located within the WHPA are currently using private septic systems. It is recommended that the Water Company continue to monitor the nitrate values closely and continue sampling for nitrates annually.
- Continue to monitor for all Safe Drinking Water Act Contaminants as required by MDE.
- Perform raw water sampling to determine the sensitivity of Well 3 to surface water as required by the Surface Water Treatment Rule.
- Annual raw water sampling for microbiological contaminants is a good check on well integrity.

Planning/New Development

- Cecil County Department of Planning is currently working on a land use ordinance to protect water quality. The Water Company should seek their guidance on any land use ordinance for the WHPA.
- Planners should address future land use and recharge preservation with consideration to Wellhead Protection.

Land Acquisition/Easements

- The availability of loans for purchasing land or easements for the purpose of protecting a designated WHPA is available from MDE. Loans are offered at zero percent interest and zero points.
- The preservation of the existing forested recharge area is an important step that the Water Company can take to ensure the long-term safety of its water supply. Currently, 24% of the WHPA is forestland (Table 2).

Contingency Plan

- COMAR 26.04.01.22 regulations require all community water systems to prepare and submit for approval a plan for providing a safe and adequate drinking water supply under emergency conditions. According to Mr. Bowman, an agreement has been established with the Perryville Water System to purchase between 50,000 to 100,000 gpd of supply as needed in the event of an emergency.

Changes in Uses

- Any increase in pumpage at the Water Treatment Plant or the addition of new wells will require revision of the WHPA since it is affected by pumpage. The Water Company is required to contact the MDE Water Supply Program when an increase in pumpage is applied for and when proposed new wells are being considered.

Contaminant Source Inventory Updates/Well Inspections

- The Water Company should conduct its own detailed survey to ensure that there are no other potential sources of contamination within the WHPA. Updated records of new development within the WHPA should be maintained.
- The Water Company should have a regular inspection and maintenance program for the supply wells to ensure their integrity and to protect the aquifer from surficial contamination.
- Ensure that all unused wells are properly abandoned and sealed as per COMAR 26.04.04.11.

REFERENCES

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- Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 p.
- Otton, E.G. and Mandle, R.J., 1984, Hydrogeology of the Upper Chesapeake Bay Area, Maryland, With Emphasis on Aquifers in the Potomac Group: Maryland Geological Survey Report of Investigations No. 39, 62 p.
- Willey, R.E., McGregor, R.A., de Grouchy, J., and Tomkins, M.D., 1987, Hydrologic Data for Cecil County, Maryland: Maryland Geological Survey Basic Data Report No. 16, 150 p.

OTHER SOURCES OF DATA

Water Appropriation and Use Permit No. CE54G006
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Department of Natural Resources 1995 Digital Orthophoto Quarter Quadrangles for Havre De Grace SE
USGS 7.5 Minute Series Topographic Maps, Havre De Grace and North East Quadrangles
Maryland Office of Planning 1997 Cecil County Land Use Map
Maryland Office of Planning 1995 Cecil County Sewerage Coverage Map

FIGURES

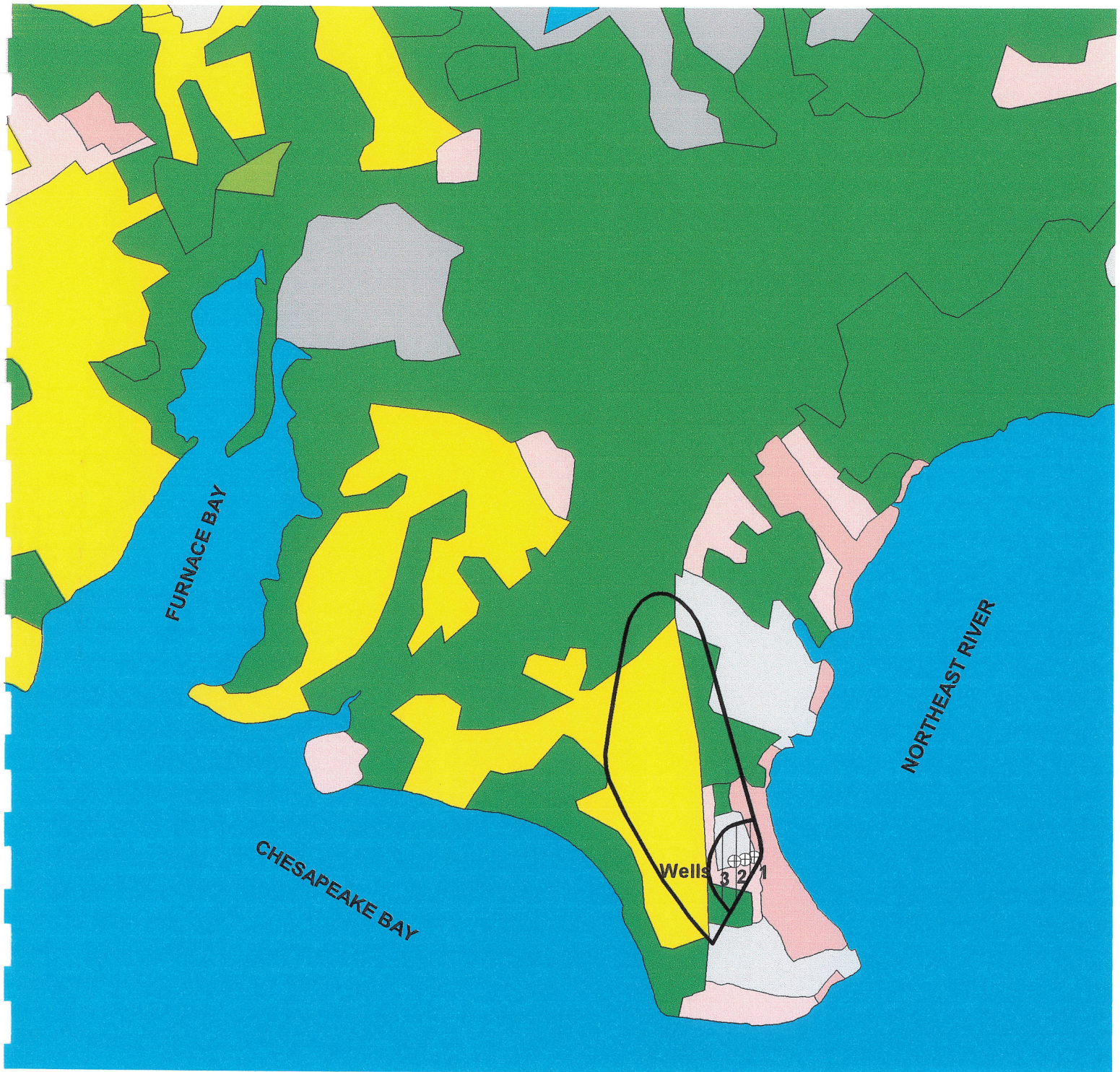
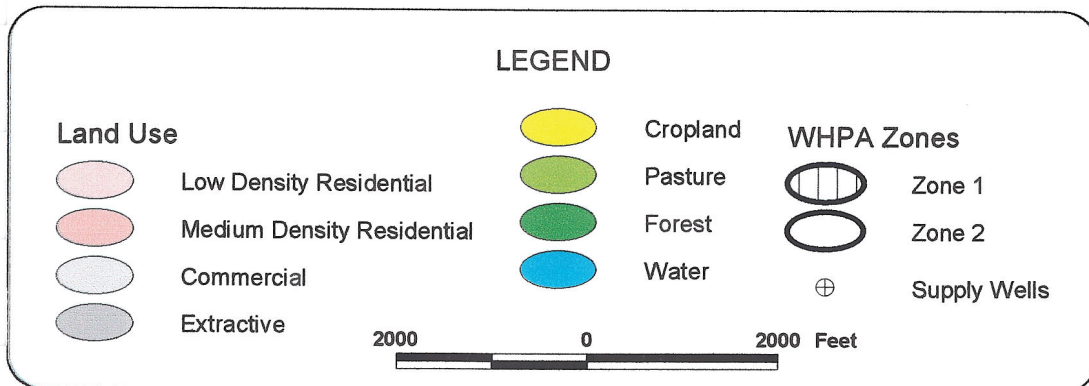


Figure 3. Land Use Map of Carpenter's Point Wellhead Protection Area



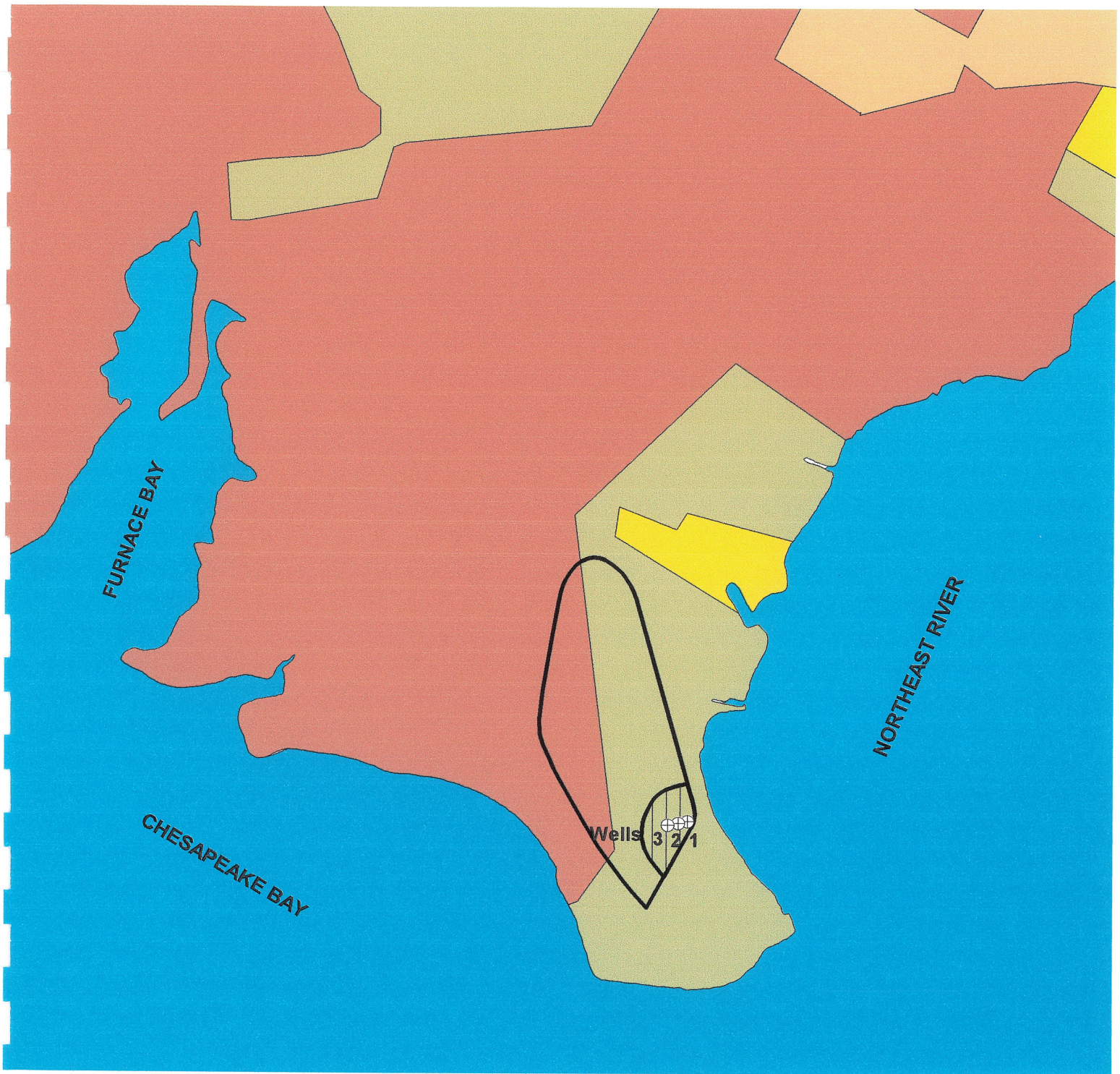








Figure 4. Sewer Service Area Map of Carpenter's Point Wellhead Protection Area

LEGEND

Sewerage Coverage

-  No Planned Service Area
-  Existing Service Area
-  Planned Service Within 5 Yrs.
-  Planned Service Within 5 to 10 Yrs.

WHPA Zones

-  Zone 1
-  Zone 2
-  Supply Wells

2000 0 2000 Feet



Source: MD Office of Planning 1995 Cecil County Sewerage Coverage Map