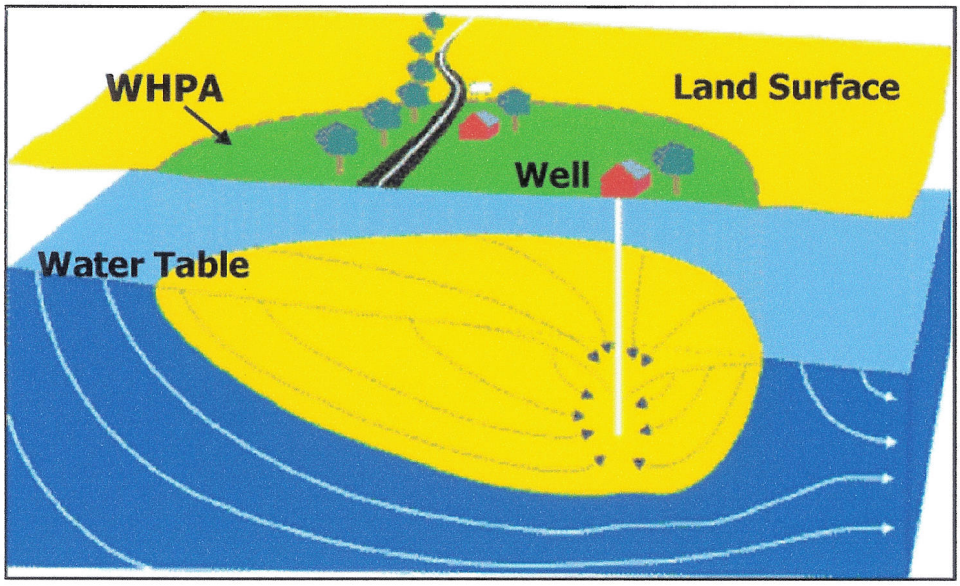
Source Water Assessment
for the White Rock Water System
Frederick County, Maryland



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December 2002

MDE

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SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for the White Rock 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 White Rock's water supply is an unconfined fractured-rock aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for this source type.

Point sources of contamination were identified within the assessment area from field inspections, contaminant inventory databases, and previous studies. The Maryland Office of Planning's 2000 digital land use map for Frederick County was used to identify non-point sources of contamination. Well information and water quality data were also reviewed. An aerial photograph and maps showing contaminant sources and land use within the Source Water Assessment area are included in the report.

The susceptibility analysis is based on a review of the existing water quality data for the water system, the presence of potential sources of contamination in the source water assessment area, well integrity, and the inherent vulnerability of the aquifer. It was determined that the White Rock water supply may be susceptible to radon, depending on the MCL that is adopted for this contaminant. This water supply is not susceptible to inorganic compounds, other radiological contaminants, volatile organic compounds, synthetic organic compounds, and microbiological contaminants.

INTRODUCTION

The Water Supply Program has conducted a Source Water Assessment for the White Rock water system in Frederick County. The White Rock community is located approximately six miles northwest of the City of Frederick. The system currently supplies water to the White Rock subdivision on the west side of Bethel Road. The water system serves a total population of 254 and has 94 service connections. The water system is owned and operated by the Frederick County Division of Utilities and Solid Waste Management.

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. The White Rock system obtains it water supply from one well (Table 1). The well is located adjacent to residential properties within the subdivision (Fig. 1). A review of the well completion report and sanitary surveys of White Rock's water system indicates the well was drilled before 1973, when well construction regulations went into effect and therefore may not meet current construction standards. A summary of the well information is located in Table 1.

SOURCE ID	SOURCE NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	YEAR DRILLED
01	WHITE ROCK WELL	FR-01-8451	214	100	1955

Table 1. White Rock well information

The White Rock water system has an appropriation permit to draw water from the Harpers Formation for an average use of 30,000 gallons per day (gpd) and a maximum of 45,000 gpd in the month of maximum use. Based on the most recent pumpage reports, the average daily use was 27,926 gallons in 1999 and 17,182 gallons in 2000. The months of maximum use for the last two reported years were March 1999 and January 2000 with an average daily use of 37,142 and 29,644 gallons respectively.

HYDROGEOLOGY

White Rock lies within the Blue Ridge physiographic province, which is bound by Catoctin and South Mountains. The Blue Ridge province is underlain by some of the oldest rocks in the County that form the core of the mountain ridges. A fault at the

eastern base of Catoctin Mountain marks the boundary between the Blue Ridge and the Frederick Valley (Duigon and Dine, 1987) and the White Rock subdivision lies very close to this boundary. The White Rock well obtains water from the Harpers Formation, which underlies the eastern slope of Catoctin Mountain and is described as brown to dark bluish-gray banded shale, to finely laminated phyllite (Cleaves et al., 1968). The primary porosity and permeability of this aquifer are small due to the dense nature of the bedrock. Ground water moves principally through secondary porosity, fractures and joint openings, and is recharged by precipitation percolating through soil and saprolite. Due to the low primary porosity, large production wells are not common in this formation unless significant, water-bearing fractures are encountered.

Ground water systems in crystalline rock tend to be localized and flow is within topographic divides towards the nearest perennial stream (Bolton, 1998). The water table is generally in the saprolite, which is characterized by high porosity and thus, the amount of storage often depends on the thickness of the saprolite. Stream valleys tend to follow fracture traces and as a result wells drilled in draws and stream valleys tend to have higher yields than those on hilltops and slopes.

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 source water assessment area for public water systems using wells in fractured-rock aquifers is the watershed drainage area that contributes to the well. The area should be modified to account for geological boundaries, ground water divides, and by annual average recharge needed to supply the well (MD SWAP, 1999).

Hydrogeologic mapping identifies the physical and hydrologic features that control ground water flow (EPA, 1991). Hydrogeologic mapping was used to identify drainage basin boundaries and hydrologic features that represent ground water divides. Fracture traces have not been mapped in the White Rock area, thus the source water assessment area follows watershed drainage boundaries. The WHPA should cover an area large enough to supply water at the average appropriated amount using effective recharge. Drought year base flow (effective recharge) in fractured rocks is estimated by the at 400 gpd/acre. The recharge area for the wells using an average use of 30,000 gpd and the drought year recharge rate is approximately 75 acres. The WHPA boundary follows topographic divides that contribute to the recharge area and covers an area of approximately 87 acres. Figure 2 shows the WHPA.

POTENTIAL SOURCES OF CONTAMINATION

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 types of land use practices such as use of pesticides, application of fertilizers or animal wastes, or septic systems that may lead to ground water contamination over a larger area.

Point Sources

A review of MDE contaminant databases and a site visit revealed no potential point sources of contamination within the WHPA.

Non-Point Sources

The Maryland Office of Planning's 2000 digital land use for Frederick County was used to determine the predominant types of land use in the WHPA (Fig. 3). The land use summary is given in Table 2. The majority of the WHPA is made up of forested land with smaller proportions of residential areas that make up the subdivsion.

Land Use Type	Total Acres	Percent of WHPA
Low-density Residential	22	25.3
Medium Density Residential	21	23.7
Forest	44	51.0
Total	87	100

Table 2. Land Use Summary

Residential areas without sewer service may be a source of nitrate from septic systems. Additionally, residential areas may present a source nitrate and SOCs if fertilizers, pesticides, and herbicides are not used carefully in lawns and gardens. Forested areas generally serve as a protective buffer for the water supply.

The Maryland Office of Planning's 1996 digital sewer map of Frederick County shows that most of the WHPA is not planned for service. The remainder covers the subdivision area, which has existing sewer service (Fig. 4). Table 3 summarizes the sewer service categories in the WHPA.

Service Category	Total Acres	Percent of WHPA
Existing Service	24	27.6
Not Planned for Service	63	72.4
Total	87	100

Table 3. Sewer Service Area Summary

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 a MCL, this 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. All data reported is from the finished (treated) water unless otherwise noted. The White Rock water system has one point of entry or plant, which has chlorination for disinfection and pH adjustment for corrosion control as its treatment.

A review of the monitoring data for White Rock water indicates that the water supply meets drinking water standards. No contaminants were detected above 50% of an MCL, with the exception of nitrate. Radon was the only other contaminant present at a level of concern. The water quality sampling results are summarized in Table 4.

Contaminant Group	No. of Samples Collected	No. of Samples above 50% of an MCL
Inorganic Compounds (except Nitrate)	8	0
Nitrate	11	1
Radiological Contaminants	3	1*
Volatile Organic Compounds	14	0
Synthetic Organic Compounds	7	0

Table 4. Summary of Water Quality Samples
*Lower proposed MCL

Inorganic Compounds (IOCs)

A review of the data shows that nitrate levels in the water supply are stable and average 4.6 ppm, (Table 5). Nitrate was detected above the SWAP threshold level of 5 parts per million (ppm) in one of twelve samples collected. No other inorganic compounds were detected above 50% of an MCL.

SAMPLE DATE	RESULT (PPM)
14-Apr-94	4.6
20-Dec-94	4.5
21-Feb-95	4.6
16-Nov-95	4.3
29-Feb-96	4.4
27-Jan-97	4.7
06-Jan-98	5.2
30-Mar-98	4.9
11-Mar-99	4.7
03-Feb-00	4.8
08-Feb-01	4.4
19-Mar-02	4.1

Table 5. Nitrate Data from White Rock

Radionuclides

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. Only one Radon-222 result has been reported for White Rock at 1350 pCi/L, which is above the lower proposed MCL. No other radionuclides have been detected above 50% of an MCL.

Volatile Organic Compounds (VOCs)

A review of the data shows that several volatile organic compounds have been detected at very low levels and well below 50% of an MCL. Some of the contaminants detected are petroleum products and their byproducts. Other VOC's that have been detected at very low levels are disinfection byproducts grouped as trihalomethanes (THMs).

Synthetic Organic Compounds (SOCs)

A review of the data shows that synthetic organic compounds have not been detected in the water supply.

Microbiological Contaminants

Raw water bacteriological data is available from evaluation for ground water under the direct influence of surface water (GWUDI). This data showed that the well is not under the direct influence of surface water. The raw water quality was very good with very low turbidity and was free of coliform bacteria.

SUSCEPTIBILITY ANALYSIS

The wells serving the White Rock water supply draw water from unconfined fractured-rock aquifers. Wells in unconfined aquifers are generally vulnerable to any activity on the land surface that occurs within the wellhead protection area. Therefore, continued monitoring of contaminants is essential in assuring a safe drinking water supply. The *susceptibility* of the source to contamination is determined for each group of contaminants based on the following criteria: 1) the presence of potential contaminant sources within the WHPA, 2) water quality data, 3) well integrity, and 4) the aquifer conditions. Table 6 summarizes the susceptibility of White Rock's water supply to each of the groups of contaminants.

In the fracture rock settings, if a well is constructed properly with the casing extended to competent rock and with sufficient grout, the saprolite serves as a natural filter and protective barrier. Properly constructed wells with no potential sources of contamination in their WHPA should be well protected from contamination.

Inorganic Compounds

Nitrate is present in less than 10% of samples at or above 5 ppm (Table 5). The MCL for nitrate is 10 ppm. Sources of nitrate can generally be traced back to land use. Fertilization of residential lawns and residential septic systems are all common sources of nitrate loading in ground water and are present to some extent in the WHPA. Most of the residential areas in the WHPA have sewer service, but there are some outlying properties that may still have individual septic. Otherwise, there are not many sources of nitrate that would cause levels to rise. Land use in the WHPA has not changed much in the last ten years and nitrate levels appear to be stable. Since levels of nitrate are relatively stable and the nitrate sources are minimal in the WHPA, the water supply is **not** susceptible to this contaminant.

The water supply is **not** susceptible to other inorganic compounds based on water quality data and lack of potential contaminant sources within the WHPA.

Radionuclides

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 the water supply above the lower proposed MCL. The source of radon in ground water can be traced back to the natural occurrence of uranium in rocks. Radon is prevalent in ground water of consolidated rock aquifers due to radioactive decay of uranium bearing minerals in the bedrock. 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 the water supply may be susceptible to radon, if the lower MCL is adopted.

The water supply is **not** susceptible to other radionuclides. Other radionuclides were not detected above 50% of an MCL and thus, the aquifer is not a source of these contaminants in this area.

Volatile Organic Compounds

Low levels of petroleum products have been detected in the water supply, however there are no significant sources that have been identified in the WHPA. Since the well is located adjacent to residential properties, it is possible that unregistered residential heating oil tanks may be in use near the well that would not be kept in an MDE database. Also, improper disposal of automobile fluids on residential properties could be a source of these contaminants to the water supply. The VOC's found were at barely detectable levels and thus the water supply is considered **not** susceptible to contamination by VOC's.

Synthetic Organic Compounds

The water supply is **not** susceptible to synthetic organic compounds. SOC's have not been detected and there are no significant sources of these contaminants in the WHPA.

Microbiological Contaminants

The well did not have coliform bacteria in raw water samples and was determined not under direct influence of surface water. Thus, these wells are **not** susceptible to microbiological contaminants.

Contaminant Group	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected Above 50% of MCL?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible?
Nitrate	YES	YES	NO	YES	NO
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Radiological Compounds	NO	YES[1]	NO	NO	YES[1]
Volatile Organic Compounds	NO	NO	NO	YES	NO
Synthetic Organic Compounds	NO	NO	NO	YES	NO
Microbiological Contaminants	YES	NO	NO	YES	NO

Table 6. Susceptibility Analysis Summary.

[1] Lower proposed MCL

MANAGEMENT OF THE SOURCE WATER ASSESSMENT AREA

With the information contained in this report the Frederick County Division of Utilities and Solid Waste Management is in a position to protect the White Rock water supply by staying aware of the area delineated for source water protection and evaluating future development and land planning. Specific management recommendations for consideration are listed below:

Form a Local Planning Team

- The Division of Utilities and Solid Waste Management should continue to work with the County Planning Department and Wellhead Protection committee to implement a County Wellhead Protection Ordinance. The committee should ensure that all interests in the community are represented, such as the water supplier, home association officers, the County Health Department, local businesses, developers, and property owners, and residents within and near the WHPA.
- A management strategy adopted by the Division and the County should be consistent with the level of resources available for implementation. MDE remains available to assist in anyway we can help the process.
- MDE has grant money available for Wellhead Protection projects, such as developing and implementing wellhead protection ordinances, digitizing layers that would be useful for wellhead protection (such as geology), and developing additional protection strategies. An application can be obtained by contacting the water supply program.

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 Division or MDE.
- Conduct educational outreach to residents of the community focusing on activities that may present potential contaminant sources. Important topics include: (a) compliance with MDE and federal guidelines for heating oil underground tanks (b) appropriate use and application of fertilizers and pesticides, and (c) hazardous material disposal and storage.
- Road signs at the WHPA boundary are an effective way of keeping the relationship of land use and water quality in the public eye, and help in the event of spill notification and response.

Monitoring

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

Land Acquisition/Easements

- Loans are available for the purchase of property or easements for protection of the water supply. Eligible property must lie within the designated WHPA. Loans are currently offered at zero percent interest and zero points. Contact the Water Supply Program for more information.

Contingency Plan

- White Rock's Contingency Plan was submitted to and approved by MDE in November 2001. 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.
- Develop a spill response plan in concert with the Fire Department and other emergency response personnel.

Contaminant Source Inventory Updates/ Inspections

- The Division should conduct their own field survey of the source water assessment area to ensure that there are no additional potential sources of contamination.
- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.

Changes in Use

- The Division is required to notify MDE if new wells are to be put into service. Drilling a new well outside the current WHPA would modify the area; therefore the Water Supply Program should be notified if a new well is being proposed.

REFERENCES

Bolton, D.W., 1996, Network Description and Initial Water-Quality Data from a Statewide Ground-Water-Quality Network in Maryland: Maryland Geological Survey Report of Investigations No. 60, 167 pp.

Cleaves, E.T., Edwards, J., and J.D. Glaser, compilers, 1968., Geologic map of Maryland, Maryland Geological Survey, 1 sheet, scale 1:250,000.

Committee on Health Risks of Exposure to Radon, 1999, Health Effects of Exposure to Radon: BEIR VI, (http://www.epa.gov/iaq/radon/beirvi1.html).

Duigon, M.T., and J.R. Dine, 1987, Water Resources of Frederick County, Maryland, MGS Bulletin 33, 101 pp.

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

Nutter, L.J. and E.G. Otton, 1969, Ground Water Occurrence in the Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 10, 56 pp

U.S. Environmental Protection Agency, 1991, Delineation of Wellhead Protection Areas in Fractured Rocks: Office of Ground Water and Drinking Water, EPA/570/9-91-009, 144 pp.

OTHER SOURCES OF DATA

Water Appropriation and Use Permit FR1954G007
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 for Frederick
USGS Topographic 7.5 Minute Quadrangles for Frederick
Maryland Office of Planning 2000 Frederick County Digital Land Use Map
Maryland Office of Planning 1996 Frederick County Digital Sewer Map

FIGURES

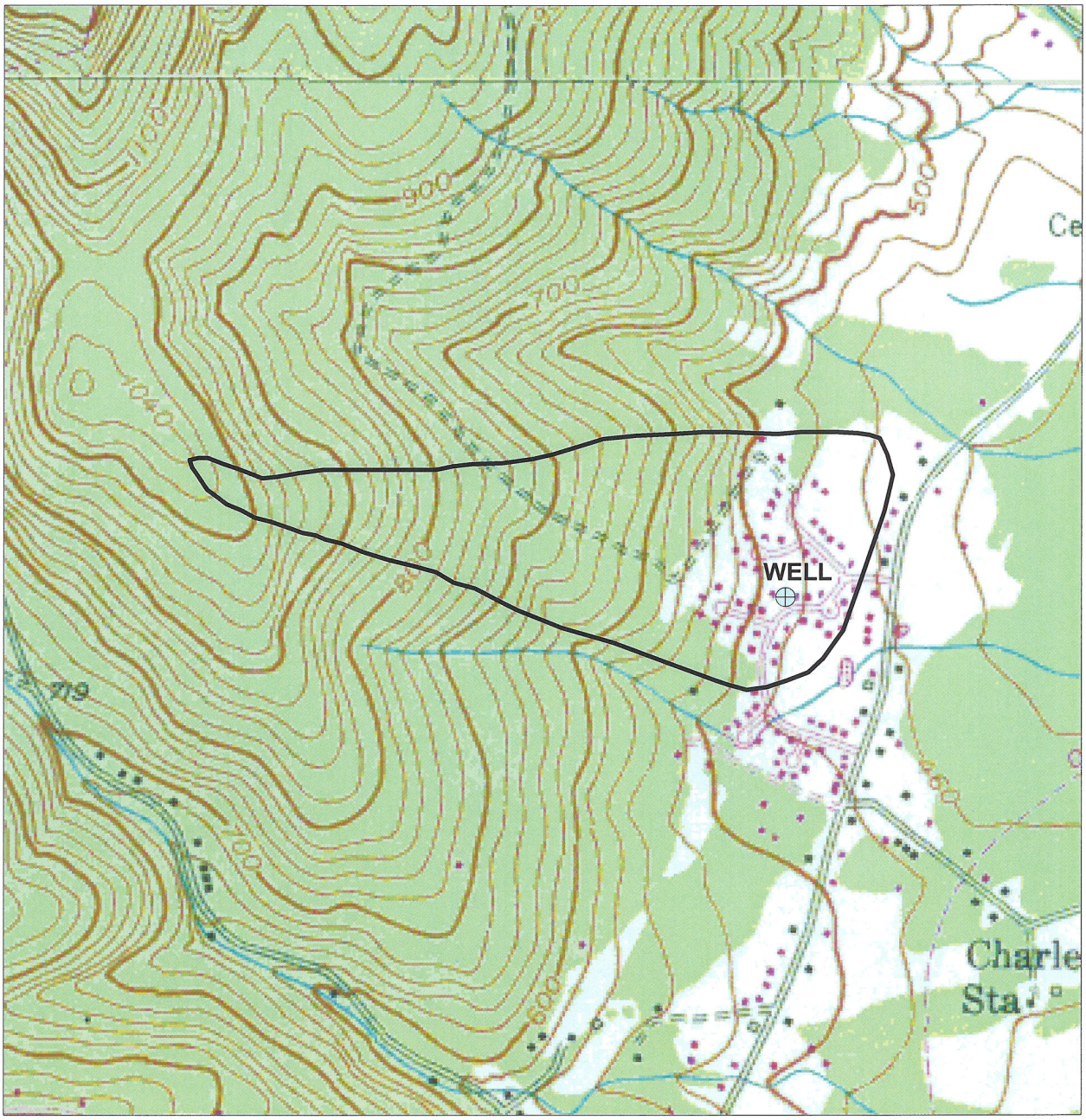

Figure 2. White Rock Wellhead Protection Area

Legend

⊕ Well

Wellhead Protection Area (WHPA)

N

500 0 500 1000 Feet

Base Map: USGS Topographic 7.5 Minute Quadrangle for Frederick

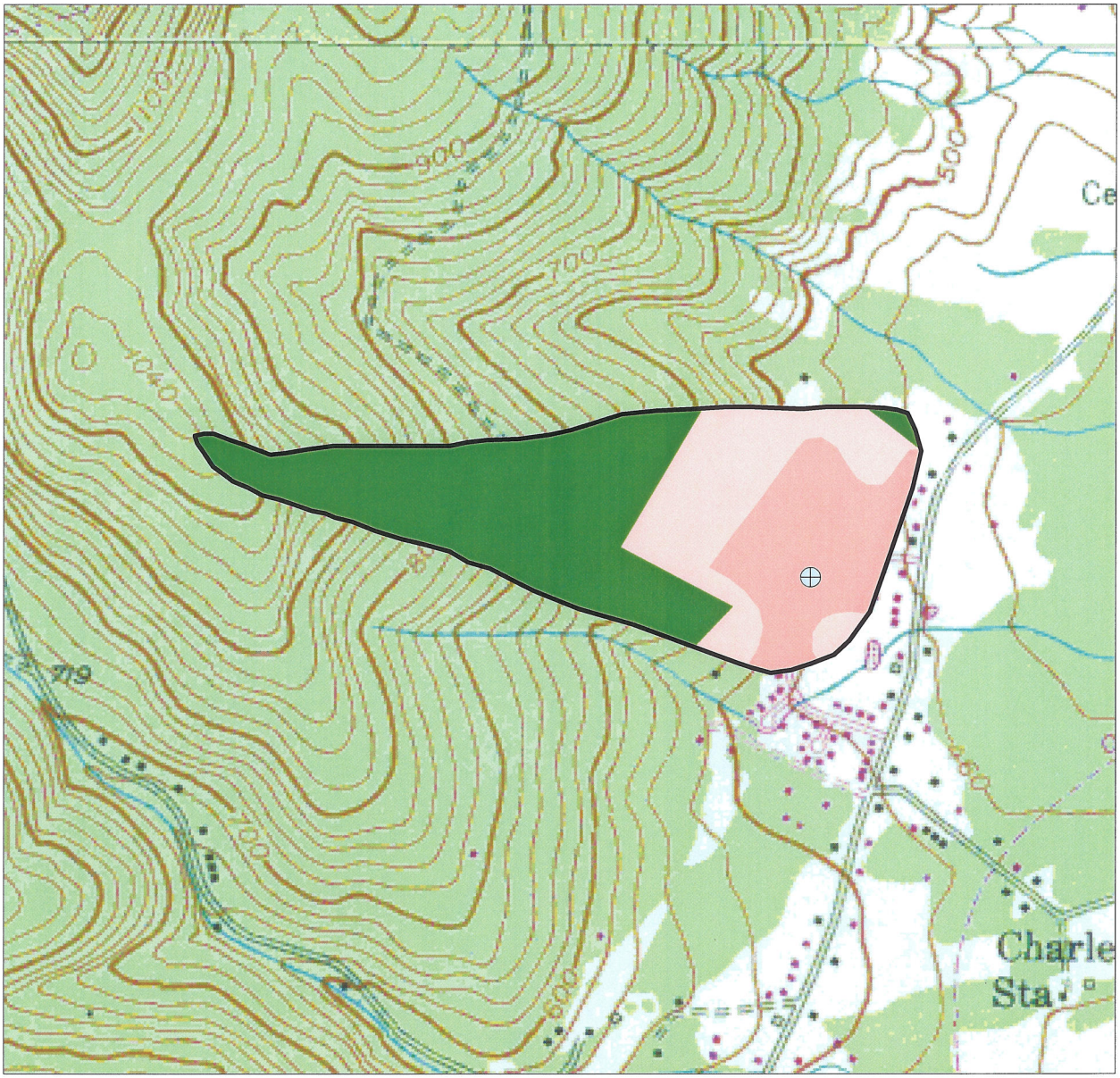

Figure 3. Land Use in the White Rock WHPA.

Legend

Frederick County 2000 Land Use

Well

WHPA

Low Density Residential

Medium Density Residential

Forest

N

500 0 500 1000 Feet

Base Map: USGS Topographic 7.5 Minute Quadrangle for Frederick

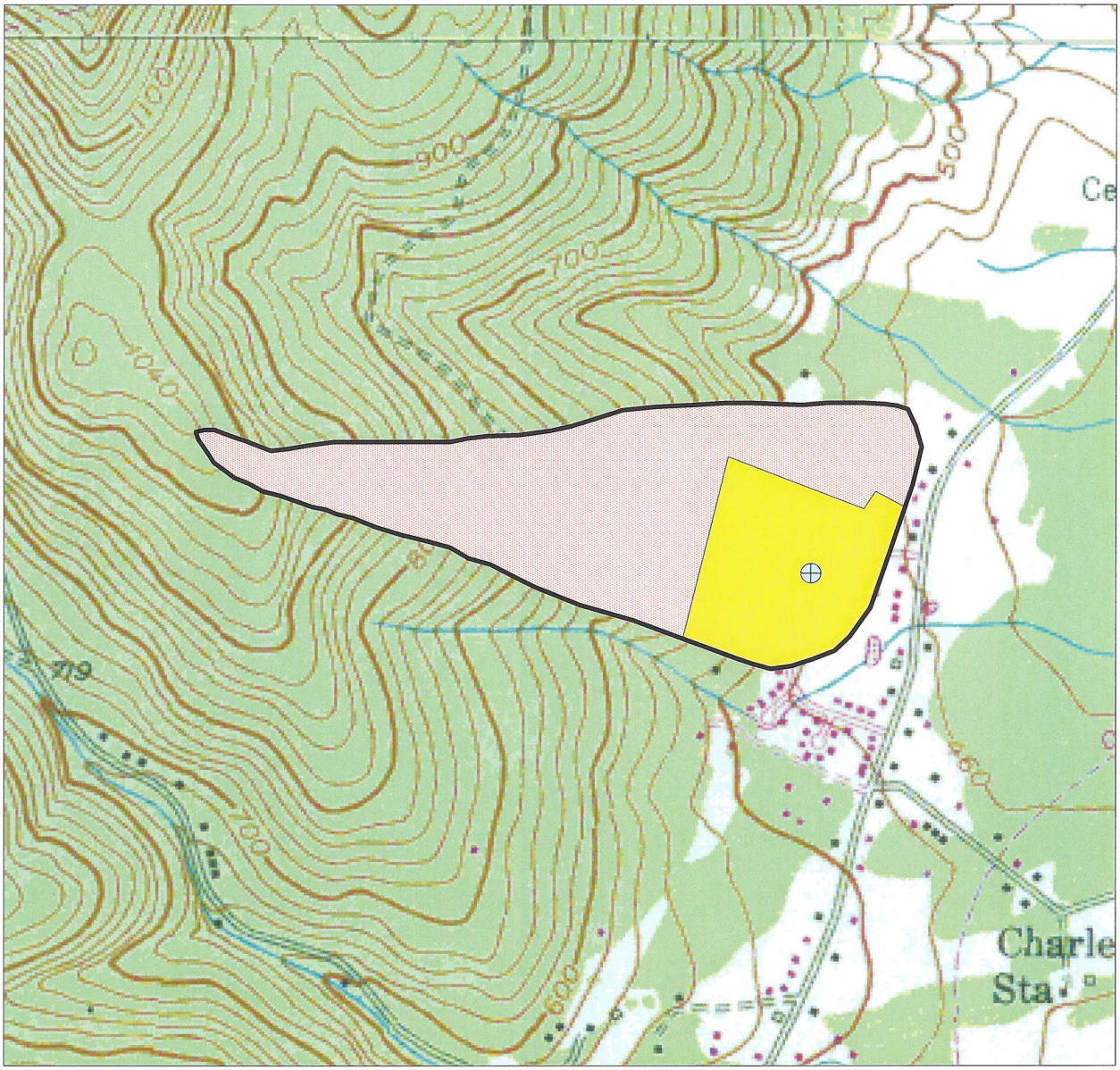

Figure 4. Sewer Service Areas in the White Rock WHPA.

Legend

Well

WHPA

N

Frederick County Sewer Service Areas

Existing Service

Not Planned for Service

500 0 500 1000 Feet

Base Map: USGS Topographic 7.5 Minute Quadrangle for Frederick