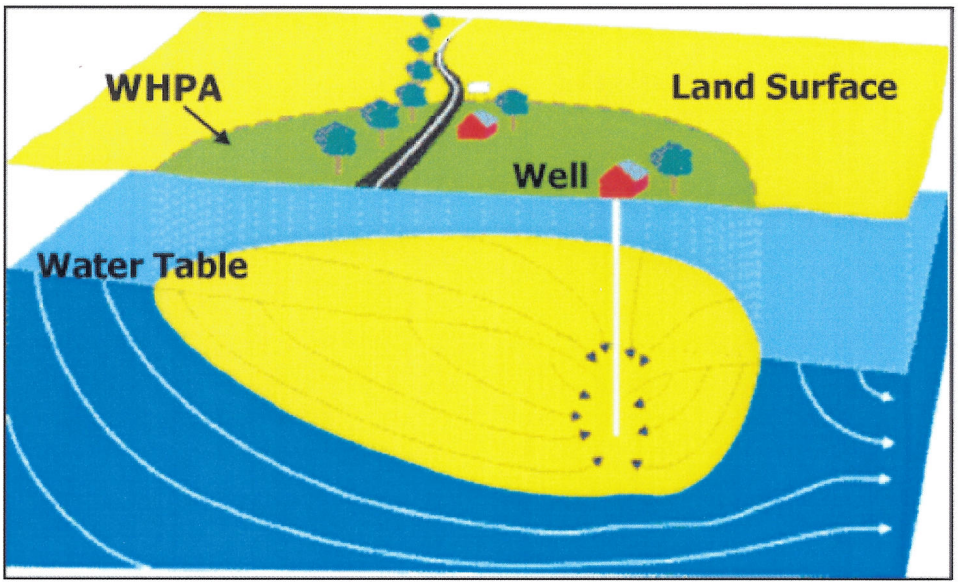
Source Water Assessment
for the Highfield Water System
Washington County, Maryland



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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 Highfield 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 Highfield's water supply are four wells that draw from 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 Washington 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 potential contaminants 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 Highfield 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 Radon-222, a naturally occurring contaminant, may pose a risk to the Highfield water supply. The water supply is not susceptible to contamination by inorganic compounds, other radionuclides, volatile organic compounds, synthetic organic compounds, or microbiological contaminants.

INTRODUCTION

The Water Supply Program has conducted a Source Water Assessment for the Highfield water system in Washington County. Highfield is located adjacent to Fort Ritchie and on the west side of South Mountain near the Maryland-Pennsylvania border in Washington County. The water system serves a population of 1000 and has 325 service connections. The water system is owned and operated by the Washington County Water and Sewer department.

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 Highfield system presently obtains its water supply from four wells (Table 1). The four wells are located throughout the community (Fig. 1). A review of the well completion reports and sanitary surveys of Highfield's water system indicates that the Cascade and Willard Wells were installed prior to 1973, when well construction regulations went into effect, and may not meet the current construction standards. The Pennersville and Highfield wells were drilled after 1973 and should meet construction standards for grouting and casing. Well information is summarized in Table 1.

The Highfield water system has an appropriation permit to draw water from the Catoctin Metabasalt formation for an average use of 100,000 gallons per day (gpd) and a maximum of 150,000 gpd in the month of maximum use. Based on the most recent pumpage reports, the average daily use was 78,365 gallons in 2000 and 77,574 gallons in 2001. The months of maximum use for the last two reported years were February 2000 and May 2001 with an average daily use of 82,526 and 89,754 gallons respectively.

PLANT ID	SOURCE ID	WELL NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	YEAR DRILLED
01	01	CASCADE	N/A	200	Unknown	1940?
01	02	WILLARD	N/A	200	Unknown	1935?
02	03	HIGHFIELD	WA-81-2460	400	41	1988
03	04	PENNERSVILLE	WA-88-0707	600	210	1990

Table 1. Highfield well information.

HYDROGEOLOGY

Highfield lies within the Blue Ridge physiographic province, which is bound by Catoctin and South Mountains and is underlain by the oldest sequence of rocks in the County. The Blue Ridge Province is underlain by metamorphosed igneous and

sedimentary rocks that are the eroded remnants of an overturned anticlinorium (Duigon and Dine, 1991). The Highfield wells obtain water from the Catoctin Metabasalt formation, an unconfined, fractured-rock aquifer, composed of a dense green crystalline rock believed to be a series of metamorphosed lava flows (Meyer and Beall, 1958). The primary porosity and permeability of this aquifer are small due to the dense nature of the metabasalt. 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. However, based on the well log for the Pennersville Well, a significant weathered zone exists in the bedrock along the small valley in Highfield which likely accounts for the relatively high-producing wells for this formation. The thickness of the saprolite in this area (based on the well log for this well) is approximately 200 feet.

Ground water systems in crystalline rock tend to be localized and flow is within topographic divides towards the nearest perennial stream (Bolton, 1996). 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).

A fracture trace analysis has not been completed for the area, thus the WHPA is delineated as the modified watershed drainage area needed to supply the appropriated amount using the effective recharge rate. Drought year base flow (effective recharge) in the South Mountain area was estimated by Duigon and Dine (1991) at 390 gpd/acre. The recharge area for the wells using an average use of 100,000 gpd and the drought year recharge rate is calculated to be 260 acres. The WHPA was delineated following topographic divides upgradient of the wells and the estimated needed recharge area. The WHPA is 286 acres and is illustrated in Figure 2.

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 revealed two potential point sources of contamination near the WHPA (Table 2). Underground storage tanks (UST) were identified in two facilities, both of which are located along the southern boundary of the WHPA (Fig. 3).

Type	Facility Name	Comments
UST	Cascade Elementary School	1-10,000 gal. Heating Oil tank in use, two older tanks removed from ground
UST	Delauter	3 - 4,000 gal. Gasoline tanks in use, 1- 6,000 gal. Kerosene tank in use

Table 2. Potential Contaminant Sources in Highfield WHPA

Underground Storage Tanks (UST's) are a potential source of volatile organic compounds from petroleum products if they leak. Newer tanks are less likely to leak due to new construction standards, however leaks may still be common in underground piping. Leaks often go undetected unless a water supply is impacted, because they are located in the subsurface.

Non-Point Sources

The Maryland Office of Planning's 2000 digital land use coverage of Washington County was used to determine the predominant types of land use in the WHPA (Fig. 4). The land use summary is given in Table 3. The majority of the WHPA is made up of residential and forested land, with small areas of pasture and commercial land.

Land Use Type	Acres	Percent of WHPA
Low Density Residential	154	53.9
Medium Density Residential	24	8.4
Commercial	2	0.7
Pasture	4	1.5
Forest	101	35.5
Total	285	100.0

Table 3. Land Use in the Highfield WHPA

Residential areas may be a source nitrate and synthetic organic compounds if fertilizers, pesticides, and herbicides are not used carefully in lawns and gardens. Commercial areas are associated with facilities that may have point sources of contamination as described above. Forested areas within the WHPA serve as protective buffers for the water supply as they do not contribute contaminants and

may take up nutrients (such as nitrogen) that may be introduced to ground water from other types of land use.

The Maryland Office of Planning's 1996 digital sewer map of Washington County shows that the most of the WHPA has existing sewer service. A small portion (approximately 15%) of the WHPA is in the area not planned for service, which is currently all forested land on the mountain slope (Fig. 5).

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 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 Highfield water system has three points of entry or plants, which each use pH adjustment for corrosion control and hypochlorination for disinfection.

A review of the monitoring data since 1993 for Highfield's water indicates that the water supply meets drinking water standards. The only contaminant that was present at a significant level was Radon-222 in the Pennersville well. No contaminants were present above 50% of an MCL. The water quality sampling results are summarized in Table 4.

	Plant 01 (Cascade & Willard Wells)		**Plant 02 (Highfield Well)**		**Plant 03 (Pennersville Well)**	
Contaminant Group	No. of Samples Collected	No. of Samples > 50% of an MCL	No. of Samples Collected	No. of Samples > 50% of an MCL	No. of Samples Collected	No. of Samples > 50% of an MCL
Inorganic Compounds (except Nitrate)	43	0	41	0	27	0
Nitrate	14	0	12	0	5	0
Radiological Contaminants	6	0	7	0	20	1
Volatile Organic Compounds	8	0	6	0	5	0
Synthetic Organic Compounds	4	0	3	0	2	0

Table 4. Summary of Water Quality Samples for Highfield Plants

Inorganic Compounds (IOCs)

Inorganic compounds were not detected above 50% of an MCL. Nitrate, fluoride, and sodium have been detected in very low levels.

Radionuclides

A review of the data shows that the only radionuclide detected above 50% of an MCL was Radon-222. 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 detected at 2415 pCi/L in the Pennersville Well, which is higher than 50% of the higher proposed MCL. The Highfield Well had a result of 30 pCi/L and the other wells have not been tested for Radon-222.

Volatile Organic Compounds (VOCs)

A review of the data shows that VOCs have not been detected above 50% of an MCL.

Synthetic Organic Compounds (SOCs)

A review of the data shows that SOCs have not been detected above 50% of an MCL.

Microbiological Contaminants

Raw water bacteriological data is available for each of the wells from evaluation for ground water under the direct influence of surface water (GWUDI). A review of the data shows that coliform bacteria were not detected in raw water from each of the wells.

SUSCEPTIBILITY ANALYSIS

The wells serving the Highfield 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 5 summarizes the susceptibility of Highfield's water supply to each of the groups of contaminants.

In fractured rock areas, 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 protected from contamination.

Inorganic Compounds

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

Radionuclides

The water supply **may be** susceptible to Radon-222. The source of radionuclides in ground water is the natural occurrence of uranium in rocks. The concentration of constituents such as Radon-222, Radium-226, and Radium-228 can vary considerably in the same aquifer to due to many factors such as pH, exposed surface area of minerals, and other natural conditions. The Pennersville Well had a considerably higher concentration of Radon-222 than the Highfield well, despite the fact that they are drilled into the same formation. Gross-Alpha and Gross-Beta results indicate that other radionuclides are not likely to be a problem in the water supply.

Volatile Organic Compounds

The water supply is **not** susceptible to contamination by VOC's, based on water quality results. There are two UST sites near the WHPA boundary, but their distance from the wells together with water quality results suggests that they are not a significant threat.

Synthetic Organic Compounds

The wells are **not** susceptible to synthetic organic compounds. SOCs were not detected in the water supply and there are no significant sources of these contaminants in the WHPA.

Microbiological Contaminants

The wells are **not** susceptible to microbiological contaminants. Raw water data shows that coliform bacteria, which is used as an indicator for other microbiological

contaminants, was not detected in the water supply. In addition no significant sources such as large pasture areas or septic systems are present within the WHPA.

Contaminant Group	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected Above 50% of MCL?	Is Well Integrity a Problem?	Is the Aquifer Vulnerable?	Is the System Susceptible?
Nitrate	NO	NO	NO	YES	NO
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Radiological Compounds	YES (aquifer material)	YES	NO	YES	YES* (Radon-222 only)
Volatile Organic Compounds	YES	NO	NO	YES	NO
Synthetic Organic Compounds	NO	NO	NO	YES	NO
Microbiological Contaminants	NO	NO	NO	YES	NO

Table 5 . Susceptibility Analysis Summary.
*Based on proposed MC for Radon-222

MANAGEMENT OF THE SOURCE WATER ASSESSMENT AREA

With the information contained in this report the Washington County Water and Sewer Department is in a position to protect the Highfield 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 Water and Sewer Department should coordinate with the County Planning Department to form a local planning team to begin to implement a wellhead protection plan. The team should represent all the interests in the community, such as the water supplier, home association officers, the County Health Department, 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.
- A management strategy adopted by 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.

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 Water and Sewer Department or MDE.
- Conduct educational outreach to the facilities that may present potential contaminant sources. Important topics include: (a) compliance with MDE and federal guidelines for UST's, (b) monitoring well installation near UST's, (c) appropriate use and application of fertilizers and pesticides in lawns and gardens, and (d) chemical 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 samples are a good test for well integrity.

Planning/ New Development

- Review the State's model wellhead protection zoning ordinances for potential adoption. Coordinate with Washington County Department of Planning to adopt a wellhead protection ordinance.

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

- Highfield should have a Contingency Plan for its water system. 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 Department 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 water system 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.

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, 1991, Water Resources of Washington County, Maryland, MGS Bulletin 36, 109 pp.

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

Meyer G. and R.M. Beall, 1958, The Water Resources of Carroll and Frederick Counties: Department of Geology, Mines and Water Resources Bulletin 22, 355 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 WA1988G032
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 Blue Ridge Summit
USGS Topographic 7.5 Minute Quadrangles for Blue Ridge Summit
Maryland Office of Planning 2000 Washington County Digital Land Use Map
Maryland Office of Planning 1996 Washington County Digital Sewer Map

FIGURES

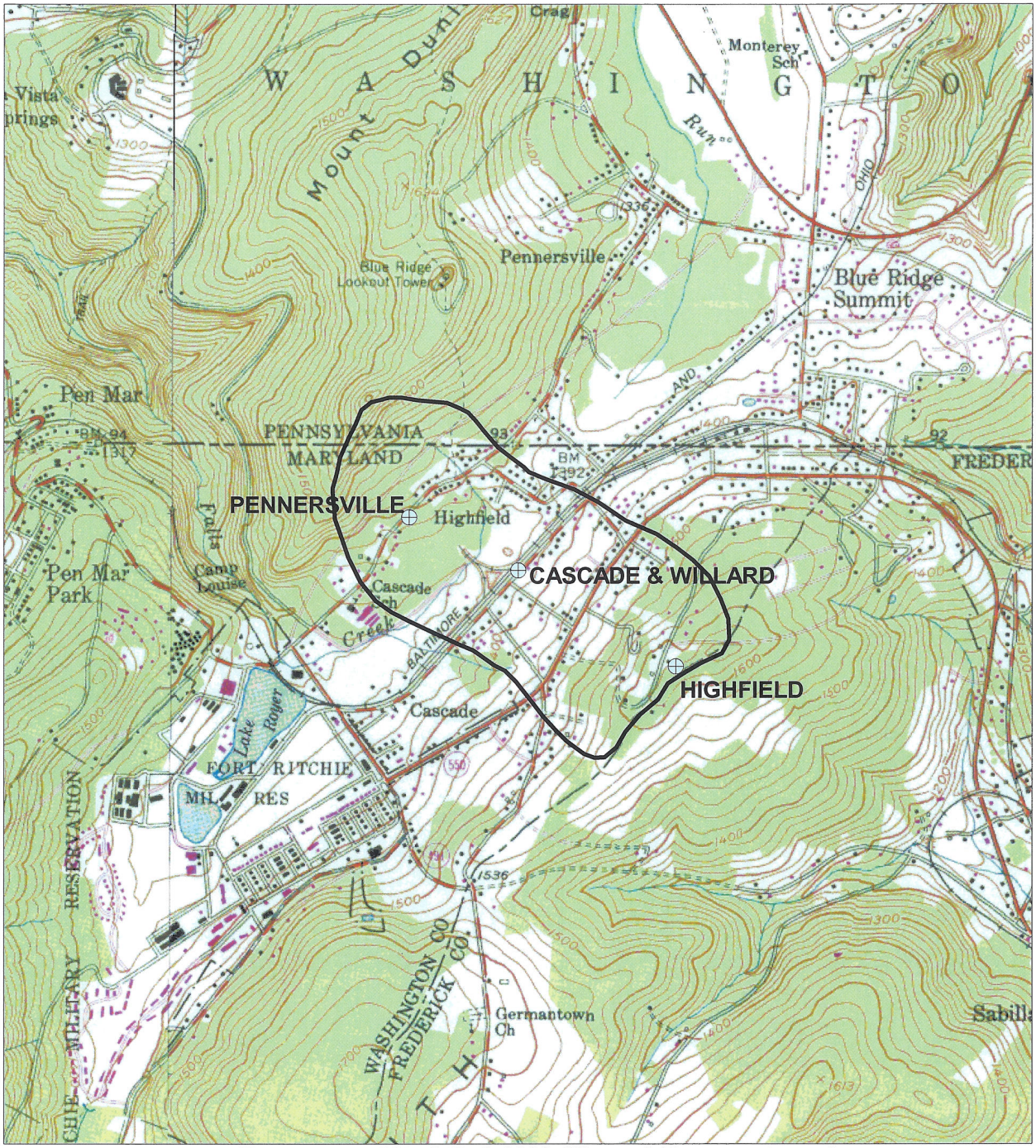

Figure 2. Highfield Wellhead Protection Area

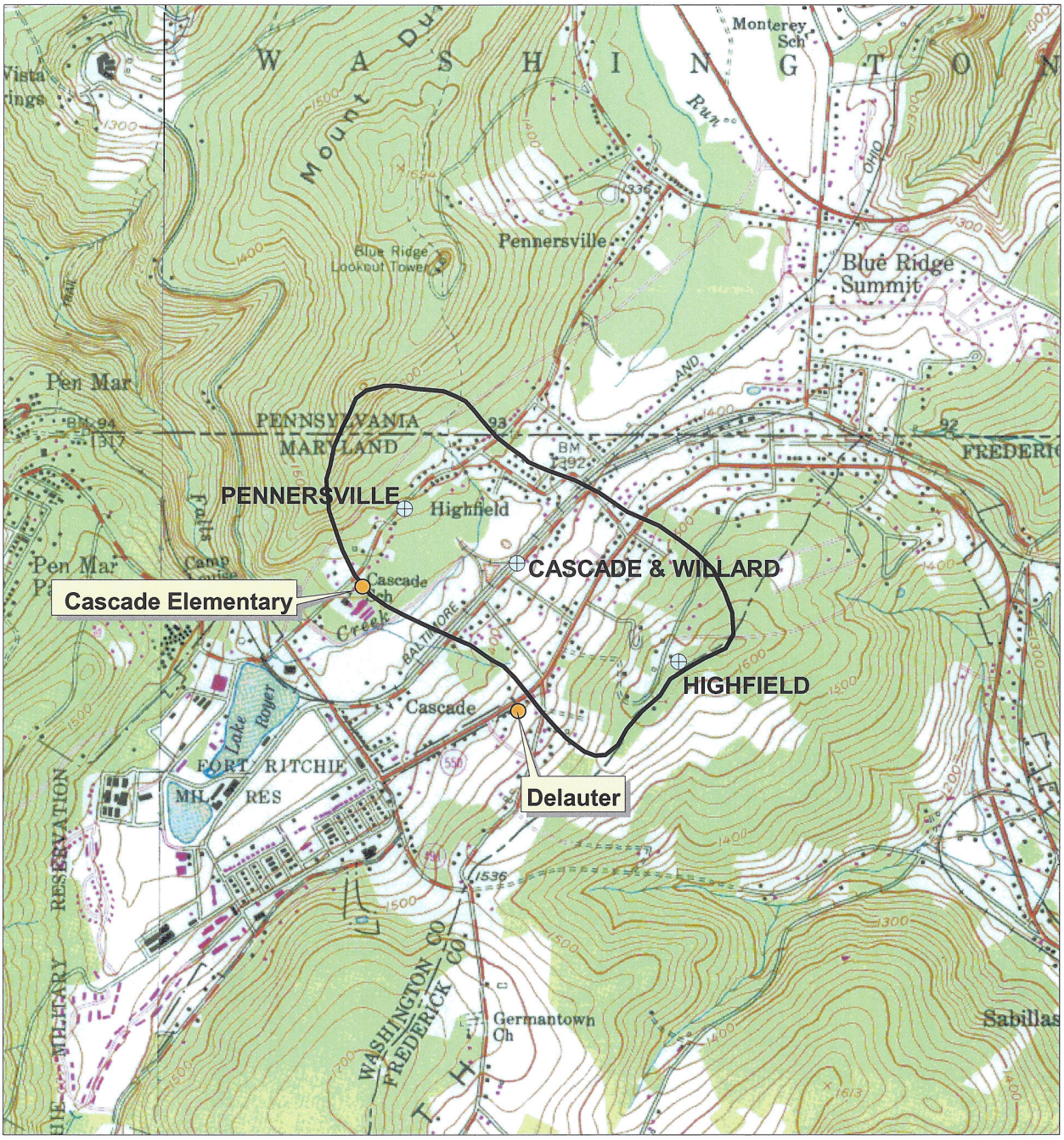

Fig 3. Highfield Wellhead Protection Area with Potential Contaminant Sources

Legend

- Wells
- Wellhead Protection Area
- Underground Storage Tanks (USTs)

N

1000 0 1000 2000 Feet

Base Map: USGS 7.5' Quadrangle for Blue Ridge Summit

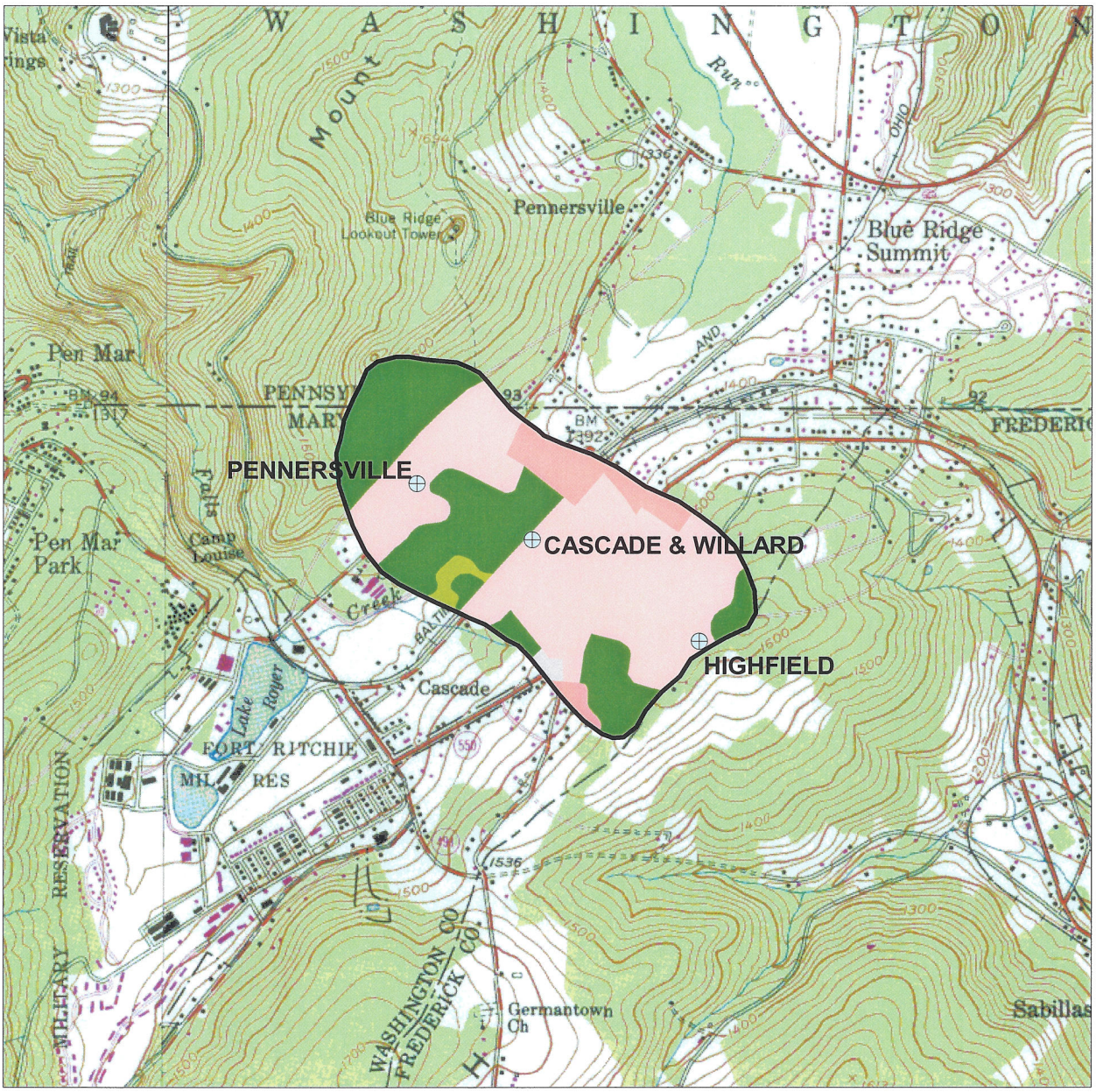

Figure 4. Highfield Wellhead Protection Area with Land Use

Legend

Washington County 2000 Land Use*

- Low Density Residential
- Medium Density Residential
- Commercial
- Pasture
- Forest

*(*Land Use in PA estimated from US EPA's Multi-resolution Land Cover)*

- Wells
- Wellhead Protection Area

N

1000 0 1000 2000 Feet

Base Map: USGS 7.5' Quadrangle for Blue Ridge Summit

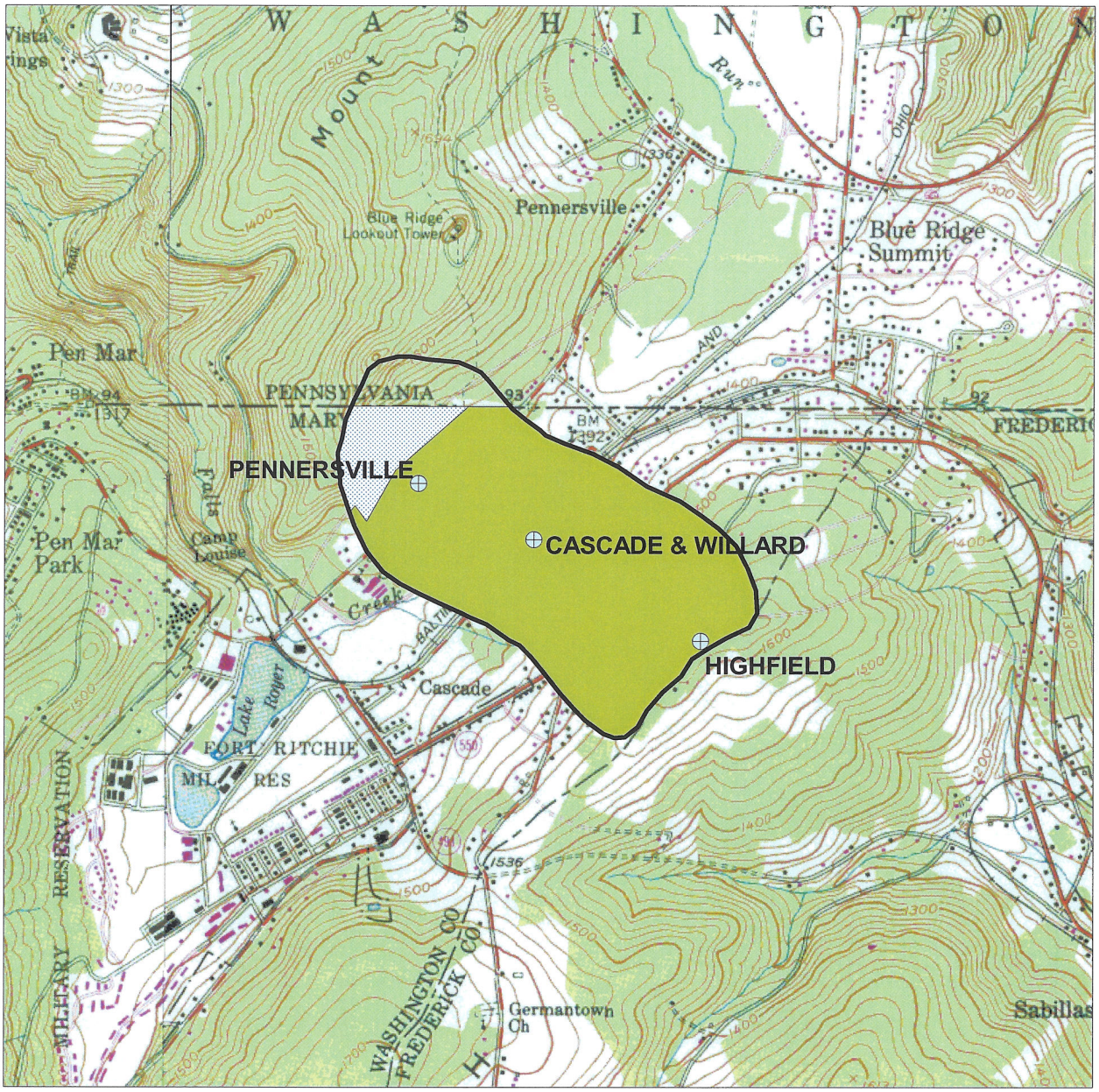

Figure 5. Highfield Wellhead Protection Area with Sewer Service Areas

Legend

Wells

Wellhead Protection Area

Sewer Service Areas*

Existing Service

Not Planned for Service

*(*Coverage not available for Pennsylvania)*

N

1000 0 1000 2000 Feet

Base Map: USGS 7.5' Quadrangle for Blue Ridge Summit