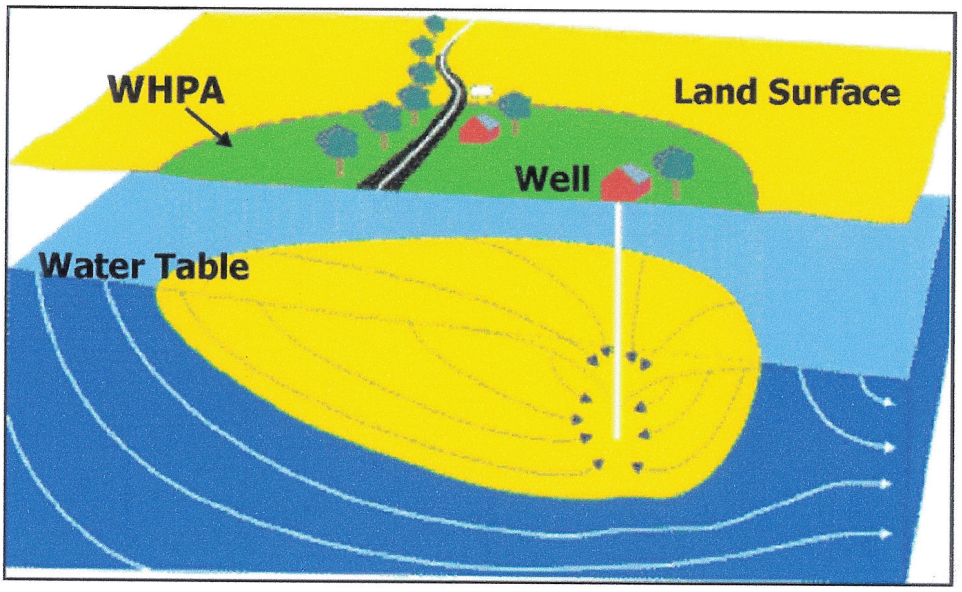
Source Water Assessment
for the Woodspring Water System
Frederick County, Maryland



Prepared By
Maryland Department of the Environment
Water Management Administration
Water Supply Program
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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 Woodspring 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 Woodspring'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 Woodspring water supply is susceptible to nitrate, volatile organic compounds, synthetic organic compounds, and some microbiological contaminants. This water supply is not susceptible to other inorganic compounds, radiological contaminants, and surface water microorganisms.

INTRODUCTION

The Water Supply Program has conducted a Source Water Assessment for the Woodspring water system in Frederick County. The Woodspring community is located approximately ten miles east of the City of Frederick. The water system serves a total population of 686 and has 193 service connections. The system currently serves the Woodspring subdivisions and several commercial properties at the intersection of Routes 144 and 75. 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 Woodspring system obtains it water supply from two wells (Table 1). The two production wells are located adjacent to residential properties (Fig. 1). A review of the well completion reports and sanitary surveys of Woodspring's water system indicates the wells were drilled after 1973 and should meet construction standards for grouting and casing. A summary of the well information is located in Table 1.

SOURCE ID	WELL NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	YEAR DRILLED
01	WELL 1	FR-81-3070	140	40	1987
02	WELL 2	FR-81-3218	120	38	1987

Table 1. Woodspring well information.

The Woodspring water system has an appropriation permit to draw water from the Wakefield Marble formation for an average use of 137,000 gallons per day (gpd) and a maximum of 219,000 gpd in the month of maximum use. Based on the most recent pumpage reports, the average daily use was 35,316 gallons in 1999 and 36,958 gallons in 2000. The months of maximum use for the last two reported years were July 1999 and December 2000 with an average daily use of 52,205 and 42,678 gallons respectively. These amounts are only about 25% of the appropriated amounts because not all of the designated water service area has been built out.

HYDROGEOLOGY

Woodspring lies in the heart of the Piedmont lowlands physiographic province of eastern Frederick County, which is characterized by gently rolling hills with some deeply cut valleys. This portion of the county is underlain by a series of meta-sedimentary and metavolcanic rocks that are structurally complex and the stratigraphic and structural relationships of these geologic units are poorly understood. Lenses of Wakefield marble layered with the Sam's Creek metabasalt are mapped at the surface and either of these formations are likely to be encountered in the subsurface. The Wakefield Marble is described as a white fine-grained formation with variations of pink, green, and blue variegated marbles. The Sam's Creek formation is a grayish-green massive to schistose metabasalt (Cleaves, et al., 1968). Based on drillers report the wells penetrate the marble which is the most significant source of ground water in this area. The marble is an unconfined, fractured rock aquifer whose primary porosity and permeability are small due to compaction and re-crystallization associated with metamorphism of limestone sediments. Ground water moves principally through secondary porosity, fractures and joint openings, and is recharged by precipitation percolating through soil and saprolite. Due to dissolution of carbonate minerals in the marble, fractures and joints are enlarged and can transmit water easily compared to typical fractured rock aquifers. When water-bearing fractures are encountered, large production wells are common in limestone and marble aquifers.

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 geologic features that influence ground water flow in the area. Fracture traces have not been mapped in the Woodspring area, thus the source water assessment area follows the modified watershed drainage boundaries. The area delineated includes the area north of the drainage divide through the valley that likely represents the outcrop of Wakefield Marble. As described above the subsurface geology

in this area is very complex, and there is not much area upgradient of the wells within the watershed. Therefore, the WHPA was extended to follow the watershed boundaries downstream to include enough recharge area to supply the average appropriated amount. Drought year base flow (effective recharge) in fractured rocks is estimated by the MDE's to be 400 gpd/acre. The recharge area for the wells using an average use of 137,000 gpd and the drought year recharge rate is 342 acres. The delineated WHPA is approximately 356 acres and is shown 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 within the WHPA (Fig.3). Two gasoline stations with underground storage tanks (UST) are located on Old National Pike approximately 1500 feet from the wells. The number of tanks and storage capacity for the High's store Texaco is unknown but this facility was built in the last three years and their tanks should meet the latest State construction standards for underground storage tanks (Table 2).

ID[1]	Type	Facility Name	Address	Comments
1	UST	New Market Mobil	11719 Old Nat'l Pike	3 - 8,000 gallon gasoline and 1- 8,000 gallon diesel tank
2	UST	High's/Texaco now Shell	11780 Old Nat'l Pike	Tanks unknown

Table 2. Potential Contaminant Sources in the Woodspring WHPA

[1]See Figure 3.

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. 4). The land use summary is given in Table 3. The majority of the WHPA is made up of agricultural land and residential land, with smaller proportions of commercial and forested areas. As can be seen in the aerial photograph (Fig. 1) and the 1990 digital land use coverage, land use has changed in the WHPA from entirely agricultural to an increasing amount of residential land in recent years.

Land Use Type	Total Acres	Percent of WHPA
Medium Density Residential	114	32.0
Commercial	43	12.2
Open Urban Land	4	1.0
Cropland	173	48.5
Pasture	4	1.1
Forest	19	5.2
Total	356	100

Table 3. Land Use Summary

Agricultural land (cropland and pasture) may be associated with nitrate loading of ground water and also represents a potential source of SOCs depending on fertilizing practices and use of pesticides. 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. Commercial areas are generally associated with facilities that may have point sources of contamination as described above.

The Maryland Office of Planning's 1996 digital sewer map of Frederick County shows that the most of the WHPA is split into areas that are eventually planned for sewer service (Fig. 5). However, the sewer map has not been updated since 1996. Therefore, the Woodspring subdivisions, which are shown on Fig. 5 as "3 year planned", are actually existing service and are served by the New Market wastewater plant. Table 4 summarizes the sewer service categories in the WHPA.

Service Category	Total Acres	Percent of WHPA
Existing Service	17	4.9
3 Year Planned Service*	208	58.3
4 to 6 Year Planned Service	58	16.3
7 to 20 Year Planned Service	7	1.8
Not Planned for Service	67	18.7
Total	357	100

Table 4. Sewer Service Area Summary
*see above paragraph

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 Woodspring water system has one point of entry or plant, which has chlorination for disinfection as its treatment.

A review of the monitoring data for Woodspring water indicates that the water supply meets drinking water standards. Contaminants were not detected above 50% of an MCL, with the exception of nitrate. The water quality sampling results are summarized in Table 5.

Contaminant Group	No. of Samples Collected	No. of Samples above 50% of an MCL
Inorganic Compounds (except Nitrate)	8	0
Nitrate	24	22
Radiological Contaminants	3	0
Volatile Organic Compounds	9	0
Synthetic Organic Compounds	17	0

Table 5. Summary of Water Quality Samples

Inorganic Compounds (IOCs)

A review of the data shows that nitrate levels in the water supply range from 4.6 to 6.9 ppm, but are consistently below the MCL of 10 ppm (Table 6). Nitrate was detected at or above the SWAP threshold level of 5 parts per million (ppm) in 22 of 24 samples collected. No other inorganic compounds were detected above 50% of an MCL.

SAMPLE DATE	RESULT (PPM)
20-Dec-94	5.3
02-Jun-95	5.0
07-Jun-95	5.0
28-Sep-95	4.6
16-Nov-95	4.8
29-Feb-96	5.5
14-May-96	5.0
04-Sep-96	5.8
05-Nov-96	6.1
30-Jan-97	6.4
07-May-97	6.9
06-Aug-97	6.3

SAMPLE DATE	RESULT (PPM)
08-Oct-97	6.2
07-Jan-98	6.1
03-Apr-98	6.8
07-Jul-98	6.8
10-Aug-98	6.3
07-Oct-98	6.1
03-Feb-99	6.3
04-May-99	6.2
06-Apr-00	6.0
19-Sep-00	6.5
03-Apr-01	6.6
10-Apr-02	5.6

Table 6. Nitrate Data from Woodspring water treatment plant

Radionuclides

A review of the data shows that no radionuclides were detected above 50% of an MCL. 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 in Woodspring, but it was well below the lower proposed MCL.

Volatile Organic Compounds (VOCs)

A review of the data shows that VOCs have not been detected above 50% of an MCL. Disinfection byproducts grouped as trihalomethanes (THMs), are the only VOC's that have been detected, but at very low levels.

Synthetic Organic Compounds (SOCs)

No SOC's have been detected above 50% of an MCL. The SOC's that have been detected at low levels are Di(2-Ethylhexyl)Phthalate for which the highest level reported was 2.04 ppb, Dalapon at 0.34 ppb, and Atrazine at 0.4 ppb. The phthalate contaminant is commonly found in laboratory blank samples and the method for analyzing this contaminant was just starting to be used in 1995 and had many false positive results. Dalapon is a herbicide used to control grasses in a wide variety of crops and is also registered for use in a number of non-crop applications such as lawns, drainage ditches, along railroad tracks, and in industrial areas. The MCL for Dalapon is 200 ppb. Atrazine is a widely used herbicide for control of broadleaf and grassy weeds in corn, sorghum, rangeland, sugarcane, macadamia orchards, pineapple, turf grass sod, asparagus, forestry, grasslands, grass crops, and roses. It also was used until 1993 for control of vegetation in fallow and in noncrop land. The MCL for Atrazine is 3 ppb.

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). This data showed that the wells were not under the direct influence of surface water. The raw water quality was very good with very low turbidity and was free of fecal coliform. Some samples had total coliform present at low levels.

SUSCEPTIBILITY ANALYSIS

The wells serving the Woodspring water supply draw water from unconfined fractured-rock carbonate 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 Woodspring's water supply to each of the groups of contaminants.

In the Piedmont region, 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 92% of samples at or above 5 ppm (Table 6). The MCL for nitrate is 10 ppm. Sources of nitrate can generally be traced back to land use. Fertilization of agricultural fields and residential lawns, residential septic systems, and livestock are all common sources of nitrate loading in ground water and are all present to some extent in the WHPA. Agricultural land in the WHPA has decreased by roughly 35% when comparing 2000 and 1990 land use data, while residential land has increased by the same amount in that time period. As less land is used for agriculture, fertilizer use may decrease; however fertilizing lawns in new residential subdivisions can also be a source of in nitrate in ground water.

Due to the levels of nitrate found, the vulnerability of the aquifer to land activity, and the presence of nitrate sources in the WHPA, the water supply **is** 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

The water supply is **not** susceptible to radionuclides. The source of radionuclides in ground water is the natural occurrence of uranium in rocks. Based on the low levels detected in the water supply, the aquifer is not a source of these contaminants in this area.

Volatile Organic Compounds

The water supply **is** susceptible to contamination by VOC's. Two gasoline stations with underground storage tanks in the WHPA present a potential source of VOC's to the water supply. Petroleum products have not been detected in the water supply, however the proximity of the UST's to the wells represents a significant risk and thus the water supply is considered susceptible to this group of contaminants. In addition, a dry cleaning establishment is located in the New Market Shopping Center and presents another source of VOC's with the WHPA. Tetrachloroethylene (PCE) was detected in the shopping center well in the past, but has not been detected in the Woodspring wells.

Synthetic Organic Compounds

The water supply **is** susceptible to synthetic organic compounds. SOCs have been detected in the water supply at low levels, but not above 50% of an MCL. Atrazine is monitored annually due to levels found in the water supply. A potential source of SOCs in the WHPA may be herbicide and pesticide use in agricultural areas. Due to the presence of potential sources in the WHPA and the water quality data, the water supply is considered susceptible to these contaminants.

Microbiological Contaminants

The wells did not have fecal coliform bacteria in their raw water samples and were determined not under direct influence of surface water. Therefore, the wells are **not** susceptible to microbiological contaminants that may be present in surface water such as *Giardia* and *Cryptosporidium*. Each of the wells did have low levels of total coliform bacteria, which are ubiquitous in the environment, and *may* be indicators of organisms with longer survival rates such as viruses. Without additional data however, it is not possible to determine whether or not the water supply is susceptible to viral contamination. The wells **are** susceptible to total coliform bacteria but not fecal coliform bacteria.

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	YES
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Radiological Compounds	NO	NO	NO	NO	NO
Volatile Organic Compounds	YES	NO	NO	YES	YES
Synthetic Organic Compounds	YES	NO	NO	YES	YES
Microbiological Contaminants	YES	YES[2]	NO	YES	YES - Total Coliform only

Table 7. Susceptibility Analysis Summary.

[2] There is no MCL for total coliform, presence is considered a violation in *finished* water samples.

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 Woodspring 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 the facilities and the 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 and gasoline underground storage tanks (b) monitoring well installation near UST's, (c) appropriate use and application of fertilizers and pesticides, and (d) 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

- Woodspring'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 FR1989G024
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 Walkersville
USGS Topographic 7.5 Minute Quadrangles for Walkersville
Maryland Office of Planning 2000 Frederick County Digital Land Use Map
Maryland Office of Planning 1996 Frederick County Digital Sewer Map

FIGURES

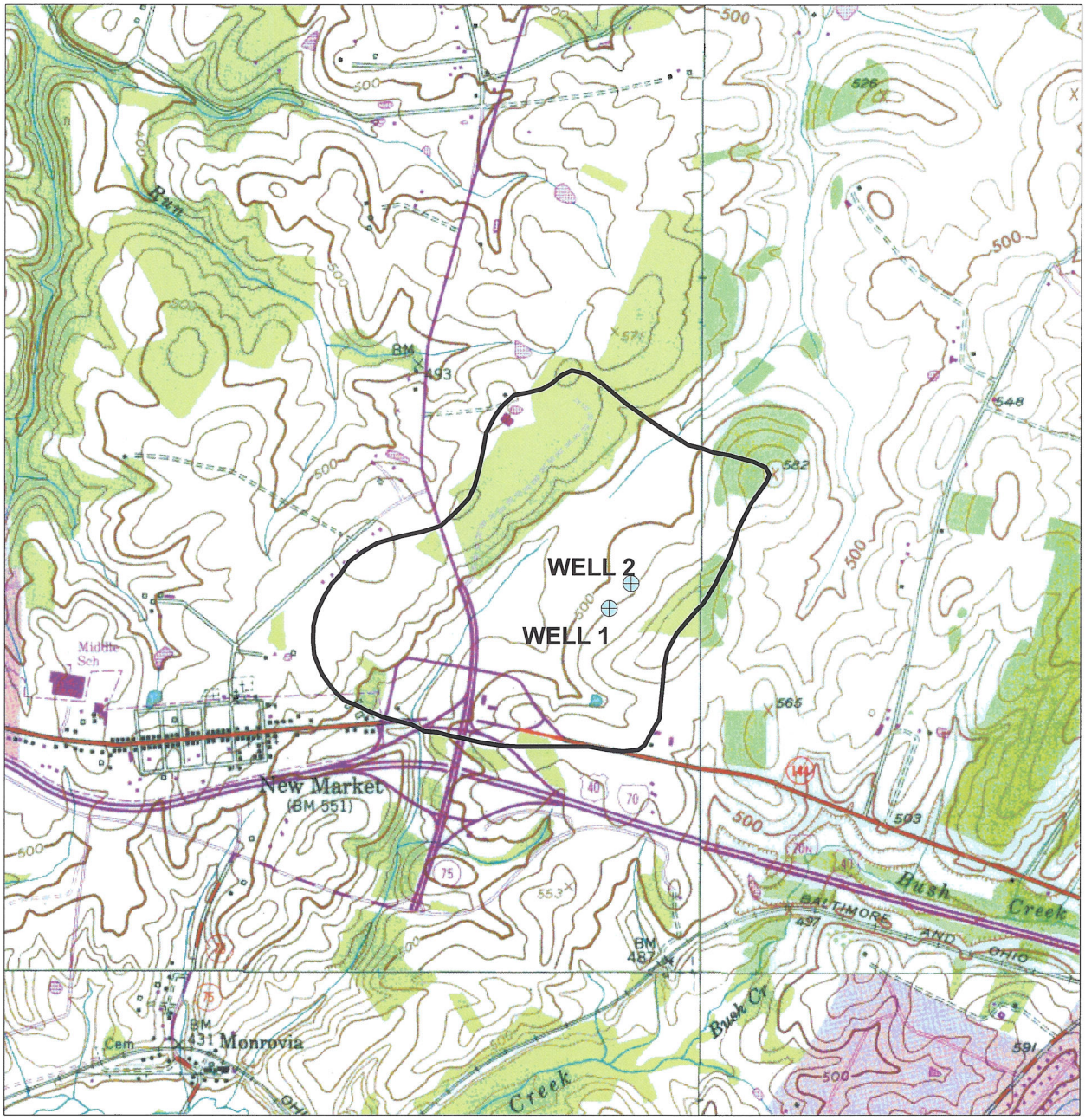


Figure 2. Woodspring Wellhead Protection Area (WHPA).

Legend

Wells

Wellhead Protection Area

N

1000 0 1000 2000 Feet

Base Map: USGS Topographic 7.5 Minute Quad for Walkersville

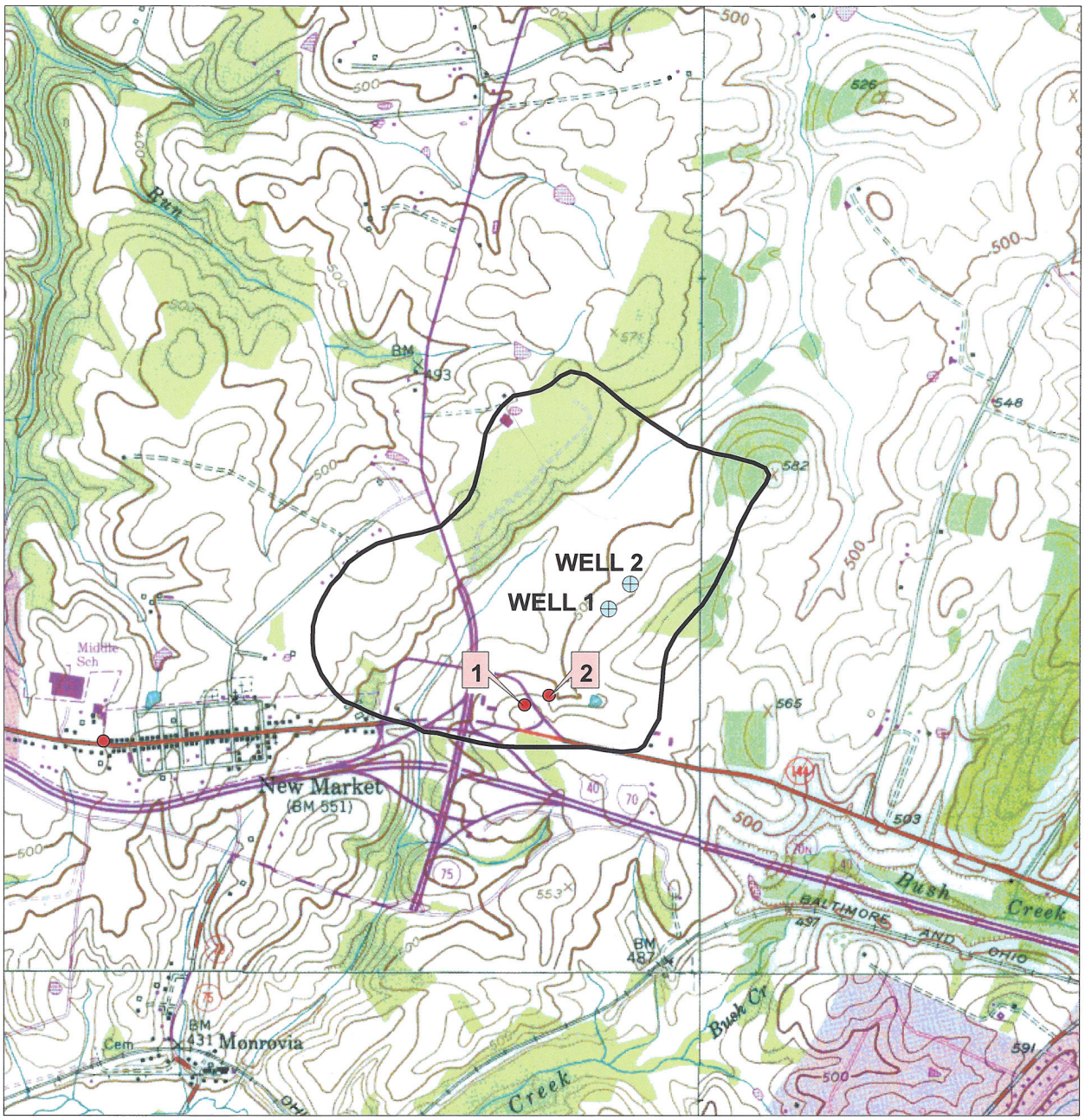


Figure 3. Woodspring WHPA with Potential Contaminant Sources.

Legend

Wells

WHPA

Potential Contaminant Sources
(See Table 2 in text)

UST

N

1000 0 1000 2000 Feet

Base Map: USGS Topographic 7.5 Minute Quad for Walkersville

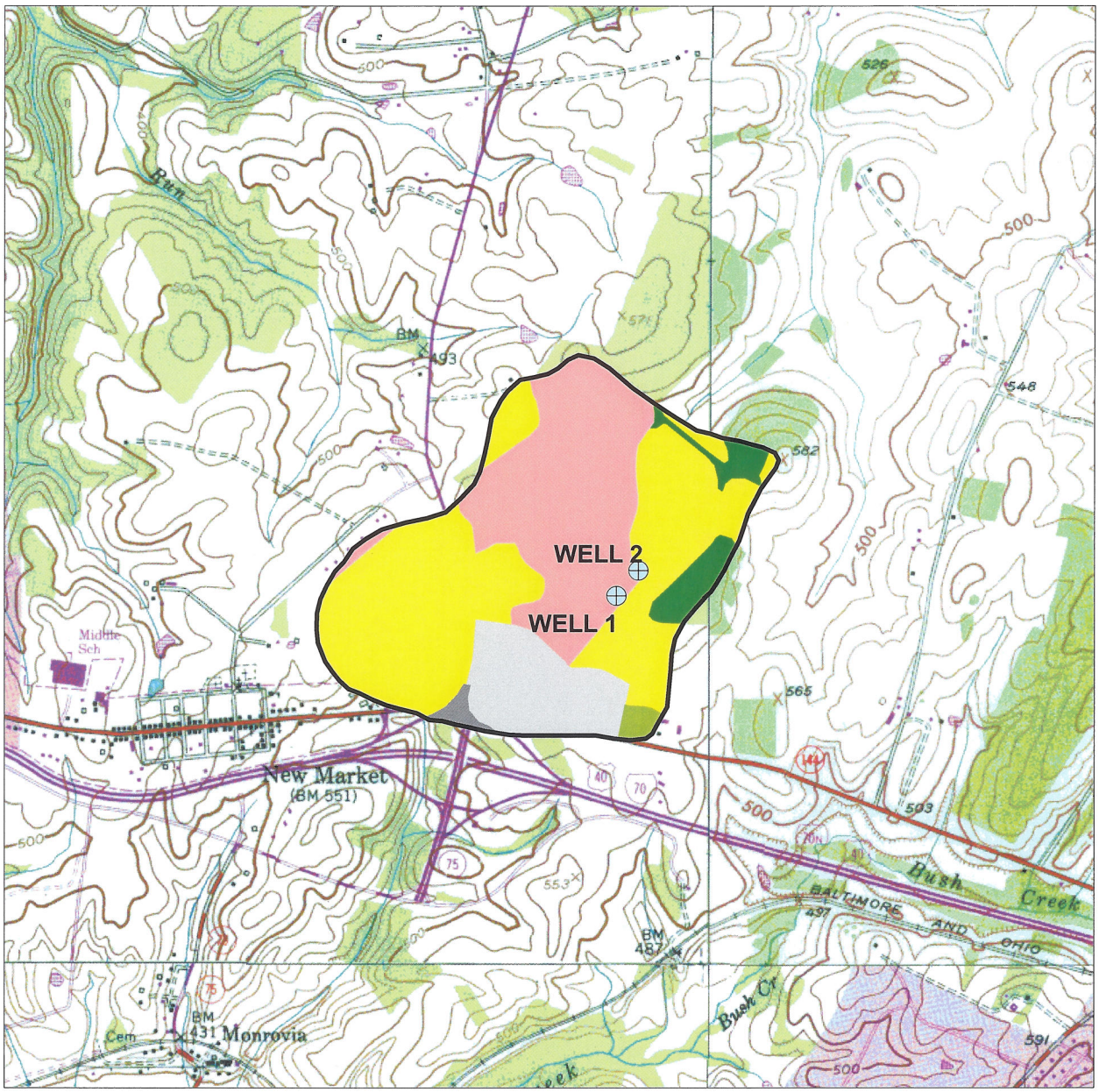


Figure 4. Land Use in the Woodspring WHPA.

Legend

Wells

WHPA

N

1000 0 1000 2000 Feet

Frederick County 2000 Land Use

- Medium Density Residential
- Commercial
- Open Urban Land
- Cropland
- Pasture
- Forest

Base Map: USGS Topographic 7.5 Minute Quad for Walkersville

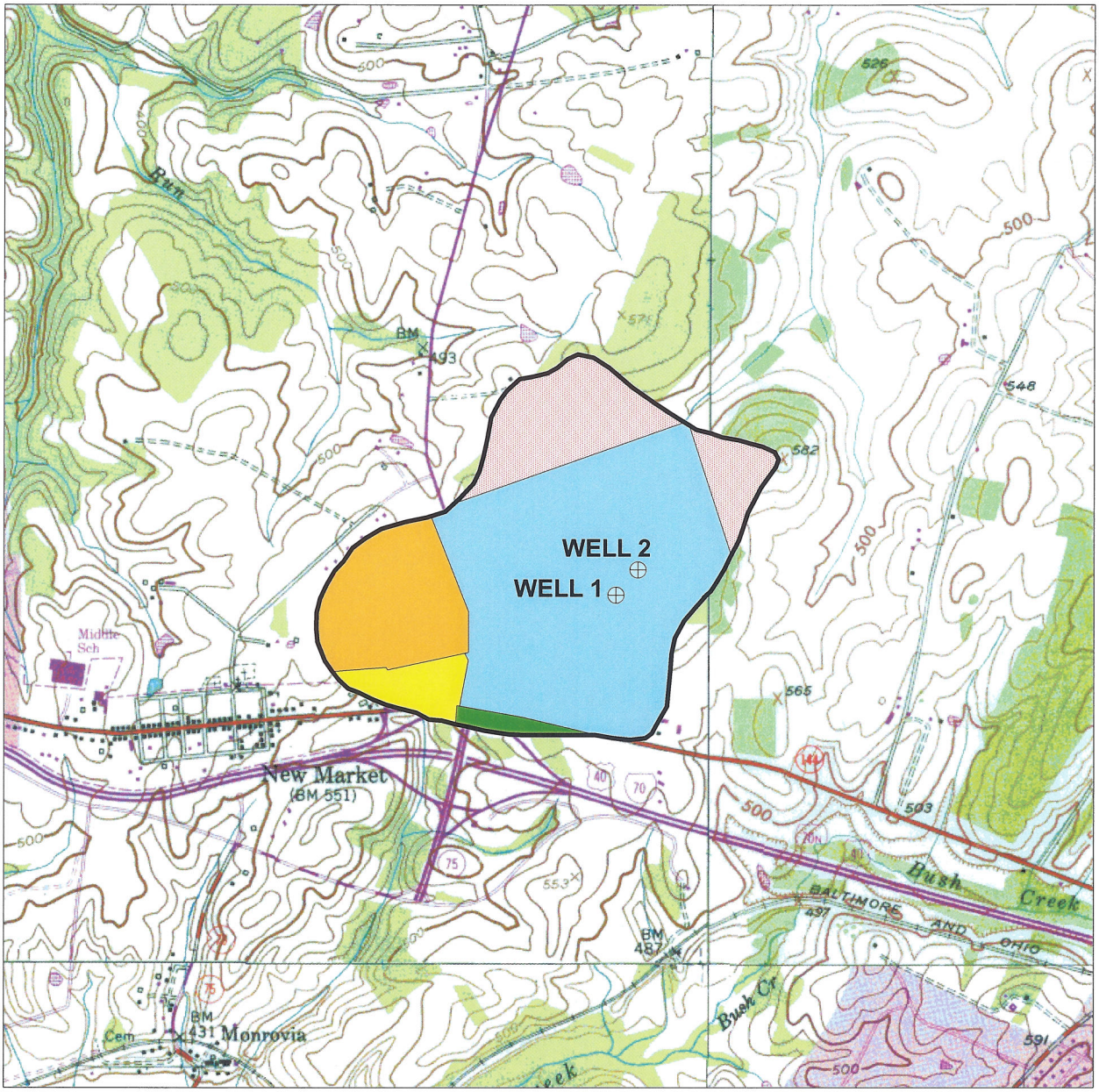


Figure 5. Sewer Service Areas in the Woodspring WHPA.

Legend

Wells

WHPA

Sewer Service Areas

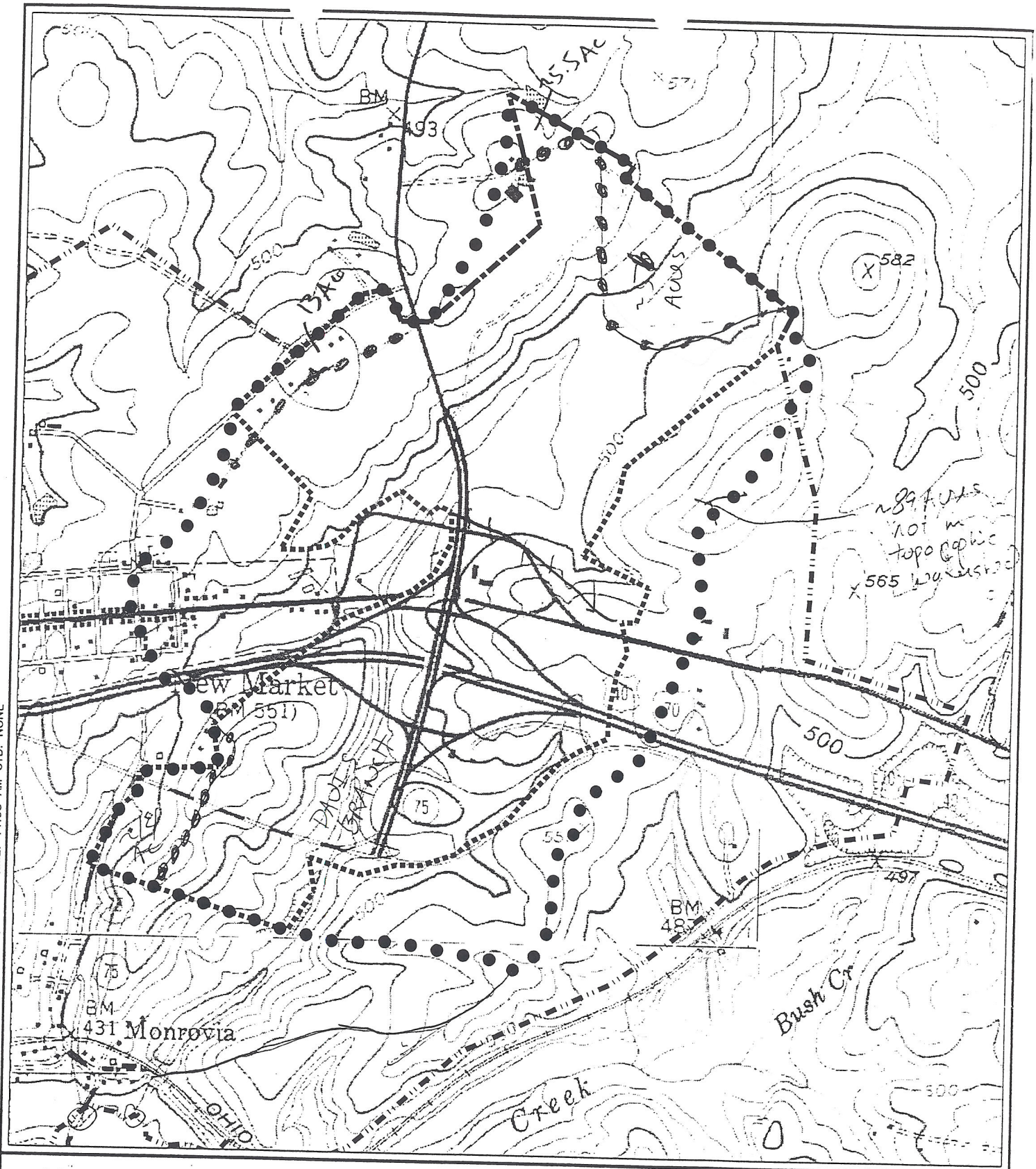
- Existing Service
- 3 Year Planned Service
- 4 to 6 Years Planned Service
- 7 to 20 Year Planned Service
- Not Planned for Service

N

1000 0 1000 2000 Feet

Base Map: USGS Topographic 7.5 Minute Quad for Walkersville

APPENDIX



LEGEND

- NEAR-TERM SERVICE AREA & OPEN SPACE (436.0 ACRES)
- WATER SERVICE AREA (1202.6 ACRES SHOWN)
- TOPOGRAPHIC WATERSHED BOUNDARY (646.1 ACRES)

N

MARYLAND

SITE LOCATION

0 1200'

SCALE IN FEET

SEAWRIGHT CORPORATION, INC.

NEW MARKET, MARYLAND

SERVICE AREA MAP

drawn	checked	approved	figure no.
MDS	ESA	MDH	1
date 12/01/00	date	date	
job no. xx-xxxx-xx-xxxx-xxx		file no. xxxx-001-A	

Science Applications International Corporation
An Employee-Owned Company

NAME: LAYOUT1 – K:\DRAFTING\SEAWRIGHT\PERMIT.DWG DATE: DEC 01, 2000 TIME: 11:05 AM CTB: NONE