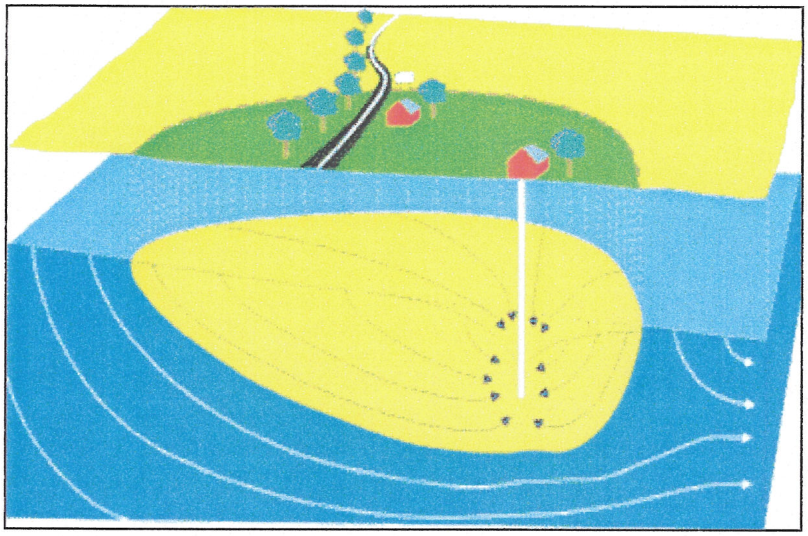
SOURCE WATER ASSESSMENT

THE TOWN OF MIDDLETOWN

FREDERICK COUNTY, MD



Prepared By
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 Middletown 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 Middletown's water supply is an unconfined fractured-rock aquifer. The Source Water Assessment area was delineated by ACER Engineers (1995) and modified 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 2002 digital land use map for Frederick County was used to identify non-point sources of contamination. Well and spring information and water quality data were also reviewed. 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 Middletown water system, the presence of potential sources of contamination in the WHPA, well integrity, and the inherent vulnerability of the aquifer. As Middletown obtains its water from a water table fractured aquifer, it is vulnerable to contamination from various sources; however, there have been no known contaminants above 50% of an MCL in the well head protection areas (WHPAs). The only contaminant of concern has been coliform bacteria, due to the various positive results for fecal coliform during sampling of Coxey Brown Springs.

Due to large number of water sources, the town may be able to supply its needs, if one or a few sources were out of service, although this may require water restrictions to be imposed, especially during a drought. Wells 6-12 are clustered and could be contaminated by a single source; however, these wells have been in service for about 30-40 years, without any evidence of a contamination problem. Recommendations for ensuring ongoing safety and protection of the Town's water sources conclude this report. Frederick County's support is also needed in this effort as much of the recharge areas are outside of the Town's boundaries.

Introduction

The Water Supply Program has conducted a Source Water Assessment for the Middletown water system in Frederick County. Middletown is located approximately five miles west of the City of Frederick in the Middletown Valley. The system serves a total population of 3,425 and has 1,292 service connections. The water system is owned and operated by the Town of Middletown.

Well and Spring Information

Well and spring information was obtained from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports, and published reports. The Middletown system presently obtains its water supply from 16 existing and seven proposed wells, and four springs (Table 1). Developers are drilling or have drilled about 15 other potential municipal wells. Most of the existing wells (14) and the Original Spring are located outside of the community (Fig. 1), in the Hollow Creek watershed, with two existing well (#'s 14 and 16) in the Cone Branch basin and the remaining three springs in the Hawbottom Branch basin. Proposed wells are located in the Cone Branch, Hollow Creek, Little Catoctin Creek and Catoctin Creek watersheds. A review of the well completion reports and sanitary surveys of Middletown's water system indicates Well Nos. 6, 7, and 9 were installed prior to 1973, when well construction regulations went into effect, and may not meet the current construction standards. The remaining 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.

The Middletown water system presently has combined appropriation permits to draw water from the Catoctin Metabasalt formation for an average use of 321,000 gallons per day (gpd) and a maximum of 463,500 gpd in the month of maximum use. The average daily use in 2003 and 2004 was about 300,000 gpd avg, which is expected to be about 10% higher during a severe drought. MDE imposed a building moratorium on the town in 2004 due to concerns about the sustained yield of the water supply during a drought. The moratorium was resolved through a consent agreement and amendment.

PLANT ID	SOURCE ID	USE CODE	WELL NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	YEAR DRILLED
01	01	PRODUCTION	Town Well #1	FR-73-8007	475	63	1980
01	02	PRODUCTION	Town Well #2	FR-73-8006	400	84	1980
01	03	PRODUCTION	Town Well #3	FR-74-6400	300	80	1978
01	04	PRODUCTION	Town Well #4	FR-73-6399	425	86	1978
01	05	PRODUCTION	Town Well #5	FR-73-6398	450	80	1978
01	06	PRODUCTION	Town Well #6	FR-65-0491?	160	44	1965
01	07	PRODUCTION	Town Well #7	FR-65-0491	160	32	1965
01	08	PRODUCTION	Town Well #8	FR-73-1944	500	54	1974
01	09	PRODUCTION	Town Well #9	FR-04-8794	465	42	1962
01	10	PRODUCTION	Town Well #10	FR-73-1943	265	38	1974
01	11	PRODUCTION	Town Well #11	FR-73-1706	215	33	1974
01	12	PRODUCTION	Town Well #12	FR-73-1602	304	31	1974
01	25	PRODUCTION	Town Well #13	FR-94-1466	1000	56	1999
01	16	PRODUCTION	Town Well #14	FR-94-1467	500	60	1999
02	26	PRODUCTION	Town Well #15	FR-94-1544	500	60	1999
00	27	PLANNED	Town Well #16	FR-94-3317	500	100	2002
00	17	PLANNED	Town Well #17	FR-94-4362	500	60	2004
00		PLANNED	Town Well #18	FR-94-4332	500	60	2004
00		PLANNED	Town Well #19	FR-94-4331	600	75	2004
00		PLANNED	Brookridge well- Town	FR-94-3217	500	40	2002
00		PLANNED	Brookridge well- Dev	FR-88-0471	300	60	1989
00		PLANNED	Brookridge well- Dev	FR-88-0470	450	42	1989
00		PLANNED	Brookridge well- Dev	FR-88-0469	450	64	1989
01	21	PRODUCTION	Original Springs				
01	22	PRODUCTION	Coxey Brown Springs				
00	23	ABANDONED	Wright Springs				
00	24	ABANDONED	Voluse Springs				
Test or unused wells that should be abandoned							
		TEST/UNUSED	Test Well - Town	FR-94-3543	N/R	N/R	N/R
		TEST/UNUSED	Test Well - Town	FR-94-3544	N/R	N/R	N/R
		TEST/UNUSED	Town Well	FR-81-3709	150	40	1986
		TEST/UNUSED	Test Well - Town	FR-94-2962	600	57	2002
		TEST/UNUSED	Test Well - Town	FR-94-3219	500	54	2002
		TEST/UNUSED	Test Well - Town	FR-94-3220	800	52	2002
		TEST/UNUSED	Test Well - Town	FR-94-3216	780	57	2002
		UNUSED	Original Spring Well #1	FR-81-4600	500	52	1987
		UNUSED	Original Spring Well #2	FR-81-4606	500	21	1987

Table 1. Middletown well and spring information

HYDROGEOLOGY

Middletown 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 underlying bedrock is composed of Precambrian gneiss, phyllite, and metabasalt, which forms the core of the South Mountain anticlinorium and is exposed in the Middletown Valley (Duigon and Dine, 1987). The Middletown wells obtain water from the Catoctin Metabasalt formation - an important aquifer in the Middletown Valley due to its aerial extent. The Catoctin Metabasalt is 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. The maximum average monthly production from the water supply during the 2002 drought was 254,000 gpd avg (Sept 02), or which 223,000 gpd came from the14 wells in service at the time (three of which went dry), or an average of 11 gpm per well. Well 15 is the town's best well, with short- and long-term data indicating that it can produce about 70 gpm during a drought.

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 weathered zone (saprolite + weathered bedrock), which is characterized by high porosity and thus, the amount of storage often depends on the thickness of this zone. 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. Wells located along fracture traces in stream valleys may be hydraulically connected to the stream.

In the case of well 15, there was a drawdown of about 30 feet in an observation 1200 feet south of the well on the opposite side of Hollow Creek. Ground water flow models indicate that drawdown may exceed 80 feet under the stream at permitted withdrawal rates. There were no samples taken that indicate that well 15 is contaminated; however, it may take longer than the typical aquifer test length to demonstrate the effects of stream infiltration. Microbiological contaminants that are present in the stream may be effectively filtered by the saprolite atop the rock aquifer.

Ground water flow models developed for well 16 indicate that withdrawals from that well could produce drawdowns of about 50 feet beneath Cone Branch. This also could produce stream infiltration into well 16.

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 or springs in fractured-rock aquifers is the watershed drainage area that contributes to the well or spring. 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). The capture zone for a well, however, will be greatest during a drought, because the zone has to expand due to the reduced recharge in order to supply the annual average demand.

The WHPA should cover an area large enough to supply water at the average appropriated amount using effective recharge. Drought year (10-yr return) base flow (effective recharge) in the Catoctin Creek Basin was estimated by MDE (Hammond, 2000, revised 2004) at 424 gpd/acre. The recharge area for the 14 wells in service during the 2002 drought (effective recharge 312.5 gpd/ac), using an average use of 180,000 gpd and the 2002 recharge rate, is calculated to be 576 acres. The WHPA boundary for that area, prepared by ACER Engineers (1995) for the town, follows topographic divides (Zone 1), adjusts for fracture possibly crossing those divides (Zone 2), and is 768 acres, or an area greater than that that calculated from the 2002 drought data. The ACER delineation; however, may be reasonable, since the high topographic relief in the watershed could produce a zone of contribution greater than the capture zone of the well field. Figure 1 shows the WHPA, based on the 1995 ACER report. This was modified by MDE to include wells 15, 16, and the seven proposed production wells (Zone 1 – capture zone of wells; Zone 2 – potential zone of contribution to wells).

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 12 potential point sources of contamination within the WHPA and 5 others near the WHPA (Table 2). All of the point sources are included for historical purposes, since not all of the locations in the databases were accurate. Underground storage tanks (UST) were identified in seven facilities and CHS-generators at five others, all of which may be in use, but none of which are in the immediate proximity to any of the wells or springs (Fig. 2). One pesticide dealer was identified (Southern States), but is now out of business. The Frederick County Division of Utilities and Solid Waste Management has an NPDES permit to discharge in the unnamed tributary to Hollow Creek, upstream of well 15. The Town of Middletown has a NPDES permit to discharge to Catoctin Creek, in the vicinity of the proposed Brookridge wells. This wastewater treatment plant includes a sewage lagoon. The town has a second WWTP in the immediate vicinity of well 15. Wastewater effluent can contain a variety of contaminants; including pathogens, partially treated organic compounds and inorganic compounds such as nitrates or metals that are not completely removed by the treatment process.

Other potential contaminant sources in the WHPA for well 15 are the Fountaindale Sunoco gas station, and the Town Cleaners. In addition, the Hollow Creek (Klein Family) Golf Course is located immediately up gradient and in the recharge area for well 15. Spray effluent, with a monitoring system in place, is to be used for irrigation at the golf course. Also, an algae bloom was observed immediately down gradient of the property during the drought of 2002, which was most probably due to runoff from the golf course. While the available data do not necessarily indicate that well 15 will become contaminated, it should be monitored carefully to ensure a safe water supply.

There are no known contaminant sources in the immediate vicinity of well 16. The two facilities that handle regulated contaminants in the WHPA are a CHS-generator at the Harp Medical Center (site I) and a UST tank at BP/Amoco (site K), located at distances, 1700 and 2700 feet, respectively, that may provide some protection for the well.

ID*	Type	Facility Name	Address	Comments	Tax Map	Parcel
A	NPDES-mun	Middletown WWTP		+sewage lagoon	65	102
B	CHS-gen	Middletown Ford, Inc.	2 Walnut St.@ W. Main		500	809
C	UST-bad	Evangelical Lutheran Church	107 W. Main St.	Heating oil tank	500	593
D	UST-in use	Middletown Municipal Center	31 W. Main St.	Heating Oil tank	500	601
E	UST-in use	Middletown Valley Bank	24 W. Main St.	Heating Oil tank	500	829
F	UST-in use	Model Garage, Inc.	5 W. Main St.	Heating Oil tank	500	595
G	CHS-gen	Model Garage, Inc.	7 N. Church St.		500	675
H	Pest-dealer	Southern States	100 N. Church	Out of business	500	677
I	CHS-gen	J. Elmer Harp Medical Center	300 S. Church St.		501	1064
J	CHS-gen	Hanover Shoe, Inc.	207 S. Church St.	Out of business	500	849
K	UST-in use	Middletown BP/Amoco	211 E. Main St.	3 gasoline tanks	500	722
L	CHS-gen	Town Cleaners (Center Plaza)	813 E. Main St.		501	567
M	NPDES-mun	Fountaindale WWTP			65	171
N	UST-in use	Fountaindale Sunoco	4304 Old National Pike	5 fuel tanks	65	89
O	UST	Fountaindale Sunoco?				
P	UST	Gambrill State Park			56	522
Q	NPDES-mun	Middletown WWTP			65	216A

Table 2. Potential Contaminant Sources in or near Middletown 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. Regulated facilities are required to undergo routine testing and all facilities in

Frederick County under new MDE regulations are required to install on-site monitoring wells. These regulatory requirements make it less likely for subsurface leaks to significantly impact ground water resources.

Non-Point Sources

The Maryland Department of Planning's 2002 digital land use coverage of Frederick County was used to determine the dominant types of land use in the WHPA (Fig. 3). The land use summary is given in Table 3. Most of the WHPA is made up of cropland, pasture, or forest. The remainder of the WHPA is low to medium density residential areas, with smaller pockets of commercial and miscellaneous areas.

Use Code	Land Use Type	Total Acres	% WHPA
11	Low Density Residential	547.9	12.7
12	Medium Density Residential	702.6	16.3
13	High Density Residential	11.5	0.2
14	Commercial	61.8	1.4
16	Commercial	44.6	1.0
18	Open Urban Land	71.0	1.6
21	Cropland	1434.2	33.3
22	Pasture	320.8	7.4
41	Forest	1090.1	25.3
42	Forest	22.6	0.5
50	Water	3.0	0.1
	Total	4310.0	100.0

Table 3. Land Use Summary

Agricultural and golf course lands are commonly 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 be a source of 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 Department of Planning's 2002 digital sewer map of Frederick County shows that about 2/3 of the WHPA has no planned sewer service, and is primarily forest or agricultural lands (Fig. 4). The remaining area has existing sewer service or is planned for service in the near future. Table 4 summarizes the sewer service categories in the WHPA.

Service Category	Total Acres	Percent of WHPA
Existing Service	771.5	17.9
3 Year Planned Service	139.7	3.2
4 to 6 Year Planned Service	394.1	9.1
Ultimate Service Area	186.9	4.3
Not Planned for Service	2817.8	65.4
Total	4310.0	100

Table 4. 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 Middletown currently has two points of entry or plants, which have varying treatment that are outlined in Table 5. In addition, the town has not added fluoride since 2002, because the fluoride analyzer is broken.

SYSTEM	PLANT ID	TREATMENT	PURPOSE
WELLS 1-14 SPRINGS	01	pH ADJUSTMENT	CORROSION CONTROL
WELLS 1-14 SPRINGS	01	HYPOCHLORITE	DISINFECTION
WELL 15	02	GASEOUS CHLORINATION	DISINFECTION

Table 5. Treatment Methods in Middletown Plants

A review of the monitoring data since 1993 for Middletown's water indicates that the water supply meets drinking water standards. No inorganic, volatile organic, synthetic organic, or radiological contaminants were present above 50% of an MCL. Low level detections of these chemicals in samples will be discussed below. The water quality sampling results are summarized in Tables 6.

Contaminant Group	Plant 01		Plant 02	
	No. of Samples Collected	No. of Samples > 50% of an MCL	No. of Samples Collected	No. of Samples > 50% of an MCL
Inorganic Compounds	11	0	1	0
Radiological Contaminants	4	0	1	0
Volatile Organic Compounds	7	0	0	0
Synthetic Organic Compounds	10	0	0	0

Table 6. Summary of Water Quality Samples for Middletown Plants

Inorganic Compounds (IOCs)

No inorganic compounds were detected above 50% of an MCL. The nitrate levels in the water supply fluctuate between 0.002 and 3.5 ppm and an average of about 2 ppm. The MCL for nitrate is 10 ppm. In addition, wells 14 (0.096 mg/L) and 16 (0.21 mg/L) exceed the secondary drinking water standard for manganese of 0.05 mg/L.

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. Radon-222 results (a maximum of 45 pCi/L) have been reported 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. The only detects have been for Bromodichloromethane (maximum of 5.38 ug/L), Chloroform (maximum of 7.2 ug/L) and Dibromochloromethane (maximum of 3.06 ug/l). These are all disinfection byproducts (Trihalomethanes), with a maximum total concentration of 15.64 ug/L (06/17/2004), which was below the total Trihalomethane MCL of 80 ug/L.

Synthetic Organic Compounds (SOCs)

Three SOCs were detected, all below the MCLs. One was Di(2-Ethylhexyl)Phthalate for which the highest level reported was 0.9 ppb. This contaminant is commonly found in laboratory blank samples. The method for analyzing this contaminant was started in 1995 and had produced many false positive results. The other SOCs detected were Atrazine (maximum of 0.35 ppb) and Dalapon (maximum of 0.04 ppb), both of which are related to runoff associated with herbicide use. Atrazine is commonly used for row crop production and Dalapon in utility right-of-ways.

Microbiological Contaminants

Raw water bacteriological data is available for each of the wells and the springs for evaluation for ground water under the direct influence of surface water (GWUDI). The springs have had persistent total and fecal coliform (Tables 7a-c). The wells (Table 7d) were free of fecal coliform bacteria, although wells 3-5 and 14 have had positive total coliform results.

Rain Date	Rain Amt (inches)	Remarks	Sample Date	Total Coliform (col./100 ml)	Fecal Coliform[1] (col./100 ml)
		Dry Sample	3-Dec-97	6.9	-1.1
18-Feb-98	1	Wet Set	18-Feb-98	16.1	9.2
18-Feb-98	1	Wet Set	19-Feb-98	16.1	16.1
18-Feb-98	1	Wet Set	20-Feb-98	23	16.1
18-Feb-98	1	Wet Set	21-Feb-98	1.1	1.1
18-Feb-98	1	Wet Set(repeat)	18-Feb-98	16.1	12
18-Feb-98	1	Wet Set(repeat)	21-Feb-98	3.6	3.6
9-Mar-98	0.6	Wet Sample	9-Mar-98	23.1	-1.1
9-Mar-98	0.6	Wet Sample(repeat)	9-Mar-98	16.1	-1.1
14-Jun-98	0.6	Wet Set	15-Jun-98	2.2	-1.1
14-Jun-98	0.6	Wet Set	16-Jun-98	1.1	-1.1
14-Jun-98	0.6	Wet Set	17-Jun-98	3.6	-1.1
14-Jun-98	0.6	Wet Set	18-Jun-98	-1.1	-1.1
14-Jun-98	0.6	Wet Set(repeat)	15-Jun-98	2.2	-1.1
14-Jun-98	0.6	Wet Set(repeat)	17-Jun-98	3.6	-1.1

Table 7a. GWUDI from the Original Spring

[1]Negative symbol indicates less than the detection limit

Samples taken from the Original Spring in Feb/Mar 1998 had persistent total (maximum 23 col./100 ml) and fecal (maximum 16 colo./100 ml) coliform bacteria concentrations. Repairs to the Original Spring lead to a reduction in total coliform to a maximum of 3.6 col./100 ml and to no detectable results for fecal coliform in June 1998.

Initial samples for Coxey Brown Springs (Dec 97-Mar 98) produced maximum concentrations of 23 col./100 ml for both total and fecal coliform. After repairs to the springs, the Main Receiver, total coliform dropped to a maximum of 9.2 col./100 ml. On 10-Dec-98, the initial sample results showed no detectable fecal coliform. Of three repeat samples on that date, two had no detectable fecal coliform and one had a level of 2.2 col./100 ml. For Coxey Brown spring boxes 2, 4, and 5, total and fecal coliform levels remained high after repairs (in the case of box 5, the sample concentrations were identical for both total and fecal coliform on three different dates, indicating a possible recording error). If the Administration records are complete, these data would indicate that Coxey Brown Springs need additional repairs. Additionally a recent on-site inspection indicated the need to repair the main receiver.

Rain Date	Rain Amt	Remarks	Sample Date	Total Coliform	Fecal Coliform[1]
	(inches)			(col./100 ml)	(col./100 ml)
		Dry sample	3-Dec-97	-1.1	-1.1
18-Feb-98	1	Wet Set	18-Feb-98	5.1	-1.1
18-Feb-98	1	Wet Set	19-Feb-98	23	6.9
18-Feb-98	1	Wet Set	20-Feb-98	3.6	1.1
18-Feb-98	1	Wet Set	21-Feb-98	-1.1	-1.1
18-Feb-98	1	Wet Set(repeat)	18-Feb-98	5.1	1.1
9-Mar-98	0.6	Wet Sample	9-Mar-98	23.1	1.1
9-Mar-98	0.6	Wet Sample(repeat)	9-Mar-98	23	-1.1
14-Jun-98	0.6	Wet Set	15-Jun-98	12	3.6
14-Jun-98	0.6	Wet Set	16-Jun-98	23.1	23
14-Jun-98	0.6	Wet Set	17-Jun-98	16.1	12
14-Jun-98	0.6	Wet Set	18-Jun-98	23.1	23.1
14-Jun-98	0.6	Wet Set(repeat)	15-Jun-98	23.1	12
14-Jun-98	0.6	Wet Set(repeat)	17-Jun-98	23.1	23
9-Dec-98	0.5	Wet Sample	10-Dec-98	9.2	-1.1
9-Dec-98	0.5	Wet Sample(repeat)	10-Dec-98	5.1	2.2
9-Dec-98	0.5	Wet Sample(repeat)	10-Dec-98	12	-1.1
9-Dec-98	0.5	Wet Sample(repeat)	10-Dec-98	9.2	-1.1

Table 7b. GWUDI from the Coxey Brown Springs (Main Receiver)

[1]Negative symbol indicates less than the detection limit

Samples taken from wells 1-16 produced no detectable levels of fecal coliform. The total coliform results were 1.1 and 3.6 col./100ml in wells 3-5, 4.6 col./100ml in well 14, and 1.1 or –1.1 col./100ml in all other wells.

Rain Date	Rain Amt	Remarks	Sample Date	Total Coliform	Fecal Coliform[1]
	(inches)			(col./100 ml)	(col./100 ml)
		Dry sample (Box 2)	3-Dec-97	23.1	12
		Dry sample (Box 3A)	3-Dec-97	1.1	-1.1
		Dry sample (Box 3)	3-Dec-97	2.2	-1.1
		Dry (Box 3)(repeat)	3-Dec-97	2.2	2.2
All other samples (59 total) – fecal coliform = -1.1 col./100 ml; except as follows:					
14-Jun-98	0.6	Wet Set (Box 2)	16-Jun-98	23.1	1.1
14-Jun-98	0.6	Wet Set (Box 3)	15-Jun-98	12	3.6
14-Jun-98	0.6	Wet Set (Box 3)	16-Jun-98	5.1	1.1
14-Jun-98	0.6	Wet Set (Box 3)	17-Jun-98	12	5.1
14-Jun-98	0.6	Wet (Box 3)(repeat)	17-Jun-98	12	5.1
14-Jun-98	0.6	Wet Set (Box 4)	17-Jun-98	23.1	16.1
14-Jun-98	0.6	Wet Set (Box 4)	18-Jun-98	9.2	6.9
14-Jun-98	0.6	Wet Set (Box 5)	17-Jun-98	6.9	6.9
		Dry sample (Box 2)	1/291999	9.2	2.2
		Dry (Box 2)(repeat)	1/291999	9.2	2.2
		Dry sample (Box 5)	1/291999	6.9	6.9
		Dry (Box 2)(repeat)	1/291999	23.1	16.1
18-Feb-99	0.6	Wet Set (Box 2)	18-Feb-99	23.1	23
18-Feb-99	0.6	Wet Set (Box 2)	19-Feb-99	23.1	2.2
18-Feb-99	0.6	Wet (Box 2)(repeat)	18-Feb-99	23.1	16.1
18-Feb-99	0.6	Wet Set (Box 3,3A)	18-Feb-99	3.6	-1.1
18-Feb-99	0.6	Wet (Box 3,3A)(repeat)	18-Feb-99	5.1	1.1
18-Feb-99	0.6	Wet Set (Box 5)	19-Feb-99	1.1	-1.1
18-Feb-99	0.6	Wet Set (Box 5)	19-Feb-99	2.2	2.2
Other rain dates (12 samples)					
9-Dec-98	Box 3	All fecal coliform = -1.1 col./100ml			
22-Mar-99	Box 3	All fecal coliform = -1.1 col./100ml			

Table 7c. GWUDI from the Coxey Brown Springs (Boxes 2,3,3A,4,&5)

[1]Negative symbol indicates less than the detection limit

Wells 1-16	All samples fecal coliform = -1.1 col./100 ml				
	Total coliform: wells 3-4=1.1&3.6 col/100ml; well 14=4.6 col/100ml; all others=1.1 or -1.1 col/100ml				
Rain Date	18-Feb-99	22-Mar-99	22-Sep-99	14-Feb-00	12-Mar-00
Well(s)	3-10	6-10	13	1	2
Rain Date	18-May-01	14-Jun-02	27-Oct-03	1-Apr-04	2-Apr-04
Well(s)	14	15	16	12	11

Table 7d. GWUDI from Middletown wells 1-16

[1]Negative symbol indicates less than the detection limit

Susceptibility Analysis

The wells and springs serving the Middletown 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 9 summarizes the susceptibility of Middletown's water supply to each of the groups of contaminants.

In the non-carbonate areas of 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 for some contaminants. Properly constructed wells with no potential sources of contamination in their WHPA should, generally, be well protected from contamination. There are, however, dozens of cases in Maryland (such as Taneytown well 13, Poolesville well 2, Mt. Airy wells 5 and 6, Fountaindale well A and Oaks Landfill) where detailed studies were completed and the contamination that occurred could not be directly related to well construction. In these cases, the saprolite did not provide an adequate filter for the contamination that entered the affected wells.

Inorganic Compounds

All results were less than 50% the MCL for all inorganic compound levels. The one possible inorganic compound of concern is nitrate. Sources of nitrate can generally be traced back to land use. Fertilization of agricultural fields, golf course playing areas and residential lawns, residential septic systems, and areas with high concentrations of livestock are common sources of nitrate loading in ground water. The residential areas within the WHPA that have existing or planned sewer service are immediately upgradient of wells 15 and 16, and the proposed Brookridge wells. There are areas of low-density residential land upgradient of wells 1-14, 17 and the Brookridge wells that are on individual septic systems, or for which there is no planned sewer service. Agricultural land makes up approximately 2/3 of the WHPA and presents another source of nitrate to the water supply.

Levels of nitrate in the water supply would suggest that it is **not** susceptible to this contaminant. However, due to the vulnerability of the aquifer to land activity, and the presence of nitrate sources in the WHPA, the nitrate levels should be monitored closely to ensure that they do not rise.

The water supply is **not** susceptible to other inorganic compounds other than nitrate, based on water quality data and lack of potential contaminant sources within the WHPA. The Fountaindale and Middletown wastewater treatment plants discharge treated sewage, and the Hollow Creek Golf Course plans to use effluent for irrigation, all that may contain other inorganic contaminants just upstream from or in the immediate vicinityof Well 15. Based on water quality from Well 15, the WWTPs and golf course have not presented a source of IOC's thus far.

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 **not** presently susceptible to contamination by VOC's, but there is the presence of contaminant sources in the WHPA. VOC's have not been detected at a level of concern. The proximity of the contaminant sources to the wells does present a possible threat and VOC's should be monitored regularly.

Synthetic Organic Compounds

The wells are **not** presently susceptible to synthetic organic compounds. Potential sources of SOCs in the WHPA may be pesticide or herbicide use in agricultural and residential areas or the Hollow Creek golf course. The level of SOCs were detected were significantly below MCLs and are not likely to rise due to long term trends of reduced herbicide usage.

Microbiological Contaminants

Based on data contained in MDE files, the Coxey Brown Springs may be vulnerable to microbiological contaminants due to past presence of fecal coliform bacteria in their raw water samples. It was not clear from the data in MDE files if these sources were all repaired and tested to be free of fecal contamination after the repairs were completed. A recent site inspection showed that repair was needed for the main reveiver. Retesting and repair of the Coxey Brown springs should be carried out by the Town.

The remaining wells and springs were determined not under the direct influence of surface water. 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. Well and spring construction may be a factor in the positive total coliform results if, for example, the grout seal is not intact or is not completed to the bottom of the casing or a spring has significant defects. Several of the wells predate construction standards. Other factors could be shallow casing, loose caps, or unscreened vents that would allow insects or other organisms to carry coliform into a well.

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?[1]
Nitrate	YES	NO	NO	YES	NO
Inorganic Compounds (except nitrate)	YES	NO	NO	YES	NO
Radiological Compounds	NO	NO	NO	NO	NO
Volatile Organic Compounds	YES	NO	NO	YES	NO
Synthetic Organic Compounds	YES	NO	NO	YES	NO
Microbiological Contaminants	YES	YES	YES	YES	YES[2.]

Table 8. Susceptibility Analysis Summary.

[1] At present time.

[2] Last samples for Coxey Brown Springs had detectable levels of fecal coilform bacteria.

MANAGEMENT OF THE SOURCE WATER ASSESSMENT AREA

With the information contained in this report the Town of Middletown is in a position to protect the Middletown 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 Town of Middletown should continue to work with the County Planning Department and Wellhead Protection committee to implement a County Wellhead Protection Strategy. 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 Town 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 residents of the community focusing on activities that may present potential contaminant sources. Important topics include: (a) compliance with MDE and federal guidelines for gasoline and heating oil UST's, (b) monitoring well installation and maintenance of 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 samples are a good test for well and spring integrity. Wet weather sampling is recommended for the springs.
- Coxey Brown Springs and receiver need repair and retesting for microbiological contaminants.

Local Ordinance

- Middletown should compare its current ordinance with MDE's updated model ordinance for discrepancies and update it where needed.
- Continue to work with Frederick County to encourage their adoption of an ordinance comparable to the Town's.

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

- Middletown's Contingency Plan was submitted to MDE for a review and approval in September 1995. 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 Middletown 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 and springs will ensure their integrity and protect the aquifer from contamination.
- Through tracer or other tests, the Division may want to determine if the wastewater discharge into the tributary to Hollow Creek may impact Well 15.

Changes in Use

- Middletown 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, 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 Permits FR1974G025 & FR1974G225
(FR1974G125-pending)
Public Water Supply Sanitary Survey Inspection Reports
MDE Water Supply Program Oracle® Database
MDE Waste Management Sites Database
USGS Topographic 7.5 Minute Quadrangles for Middletown
Maryland Office of Planning 2002 Frederick County Digital Land Use Map
Maryland Office of Planning 2002 Frederick County Digital Sewer Map

FIGURES

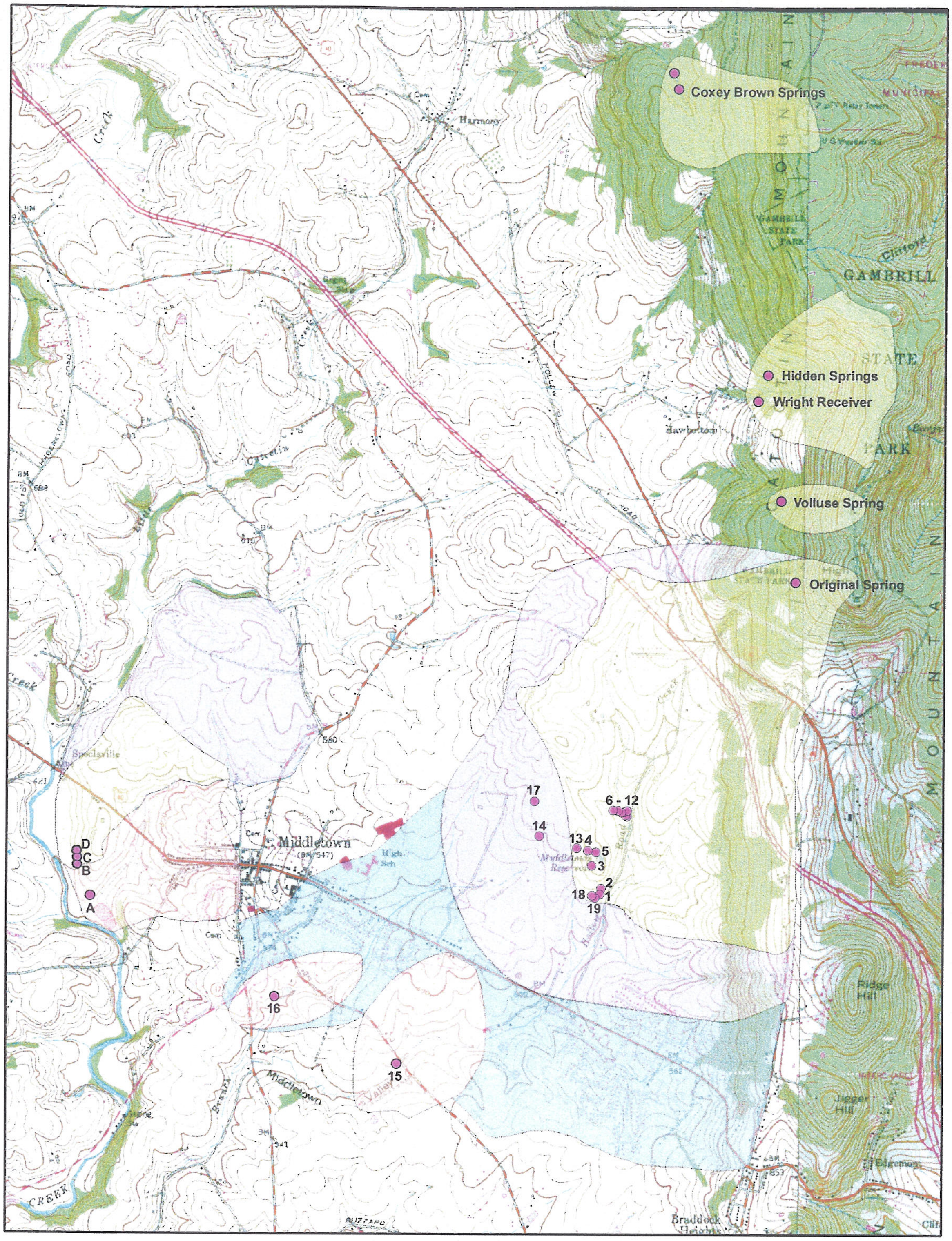


Figure 1. Middletown Wellhead Protection Area

Legend

Wellhead Protection Areas

Acer Zone 1	MDE Zone 1
Acer Zone 2	MDE Zone 2

Wells and Springs

0 1,300 2,600 5,200 Feet

Base Map: USGS Topographic 7.5 Minute Quadrangle for Middletown

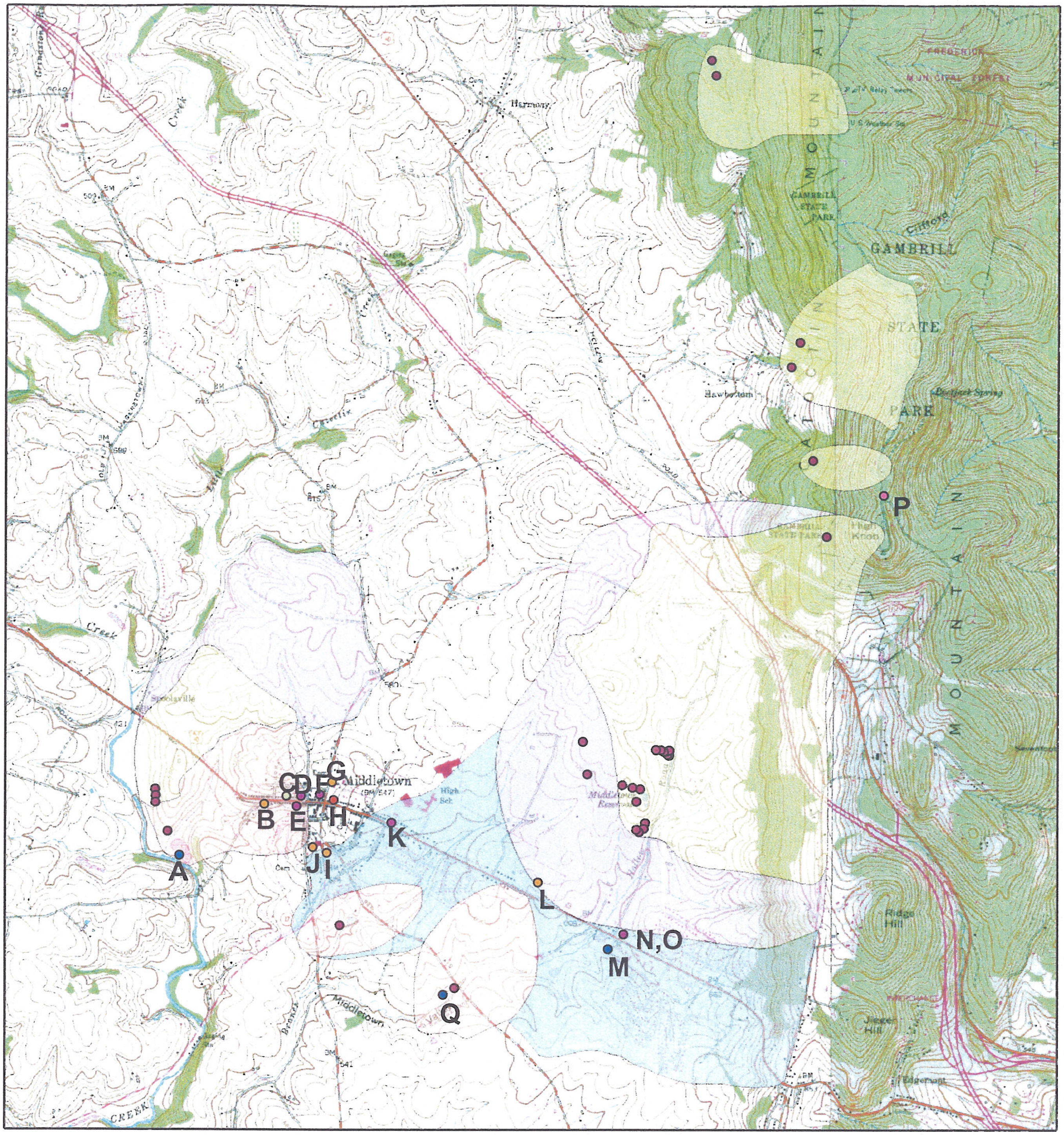


Figure 2. Middletown WHPA with Potential Contaminant Sources

Legend

- Wells and Springs

Contaminants

- UST
- UST- in use
- Municipal NPDES
- CHS Generator
- Pesticide Dealer
- Bad UST

Wellhead Protection Areas

- Acer Zone 1
- Acer Zone 2
- MDE Zone 1
- MDE Zone 2

N W E S

0 1,200 2,400 4,800 Feet

Base Map: USGS Topographic 7.5 Minute Quadrangle for Middletown

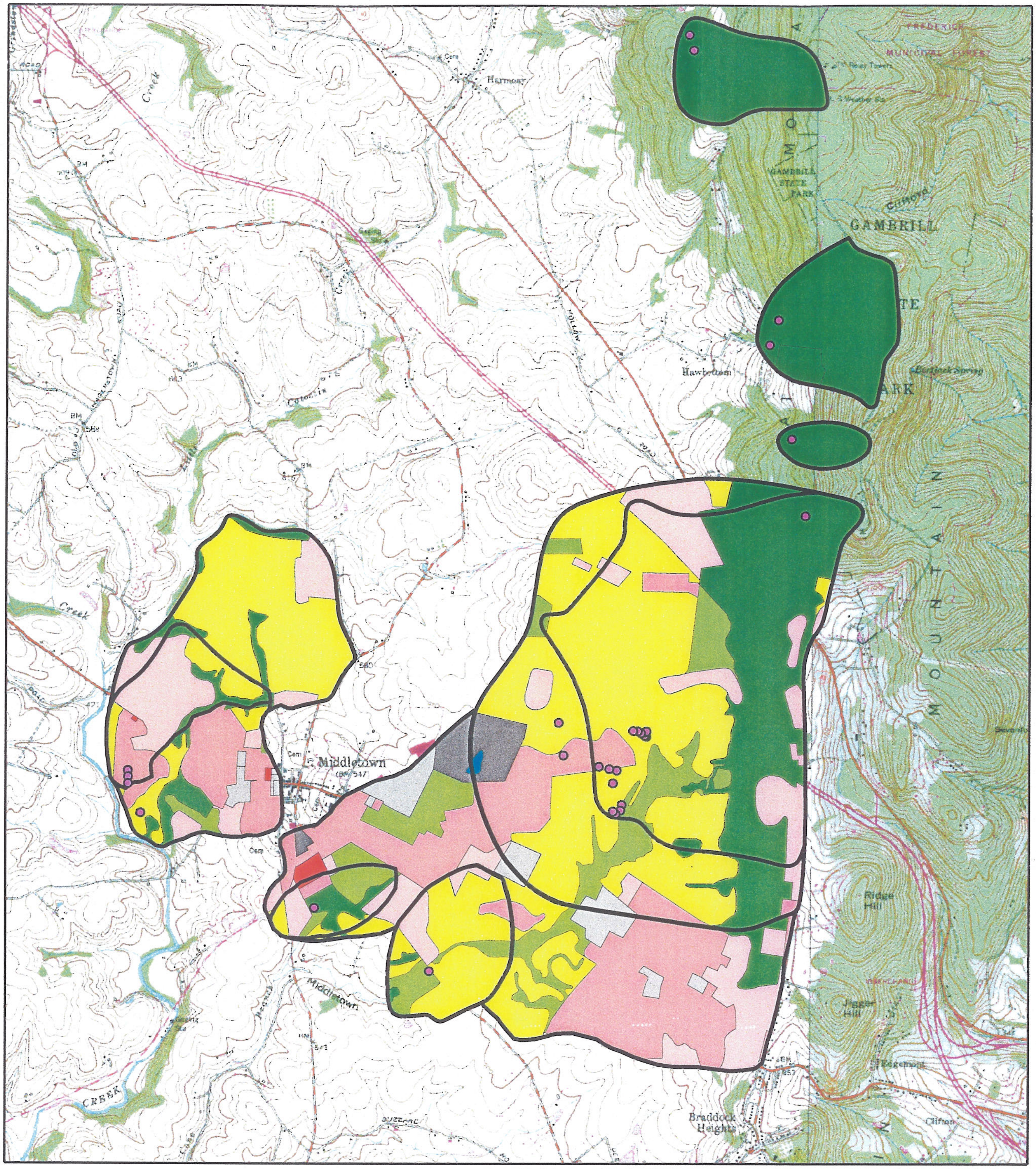
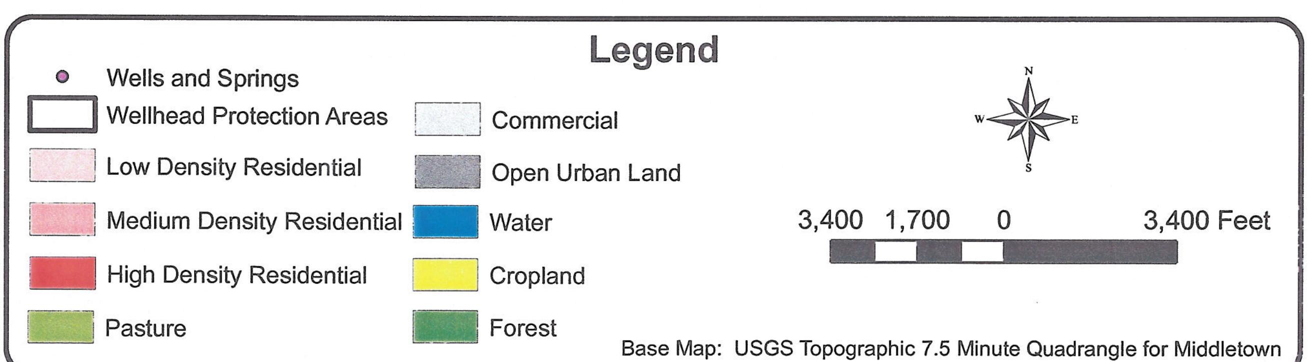


Figure 3. Land Use in the Middletown WHPA



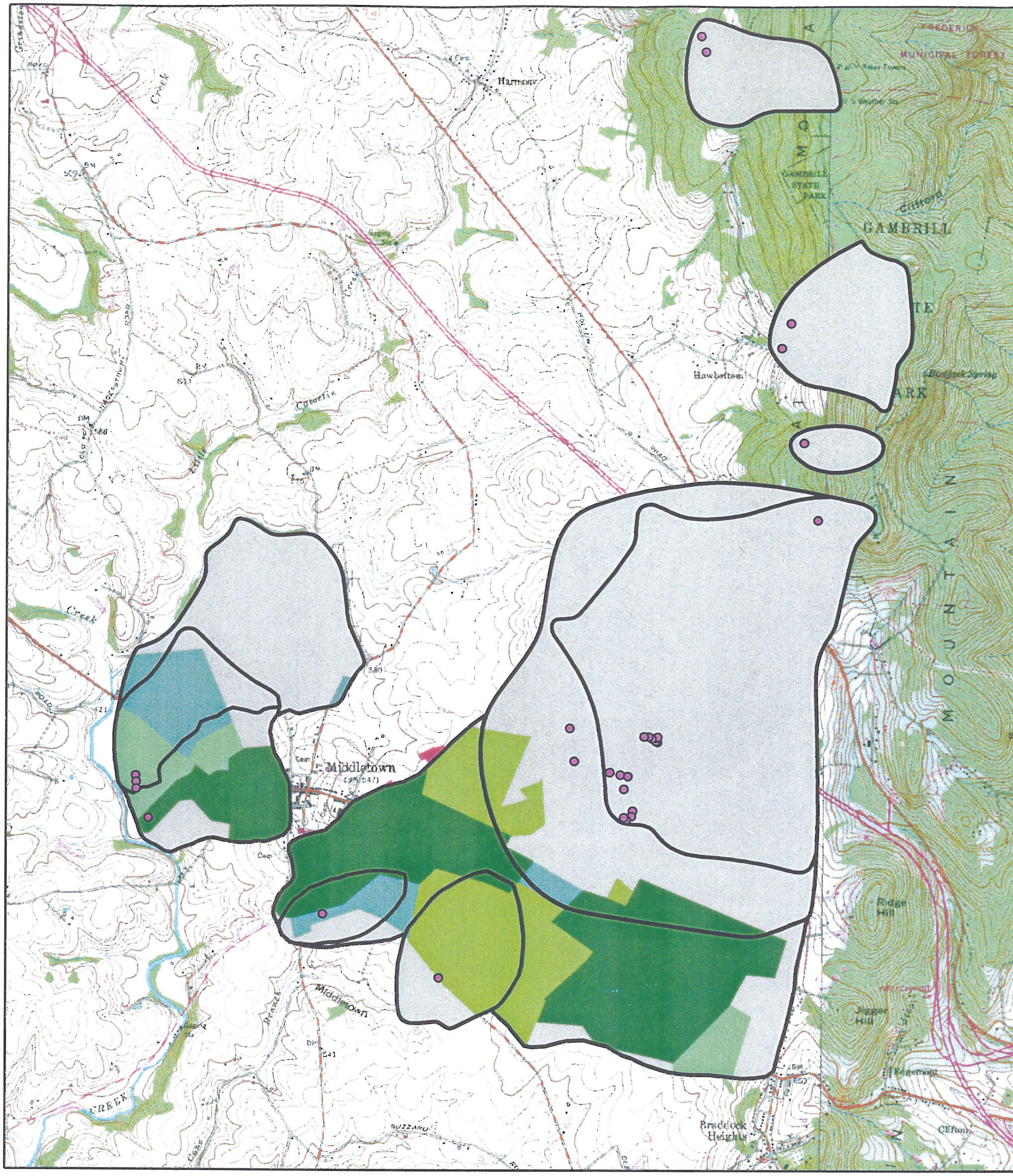


Figure 4. Sewer Service Areas in Middletown WHPA (1999)