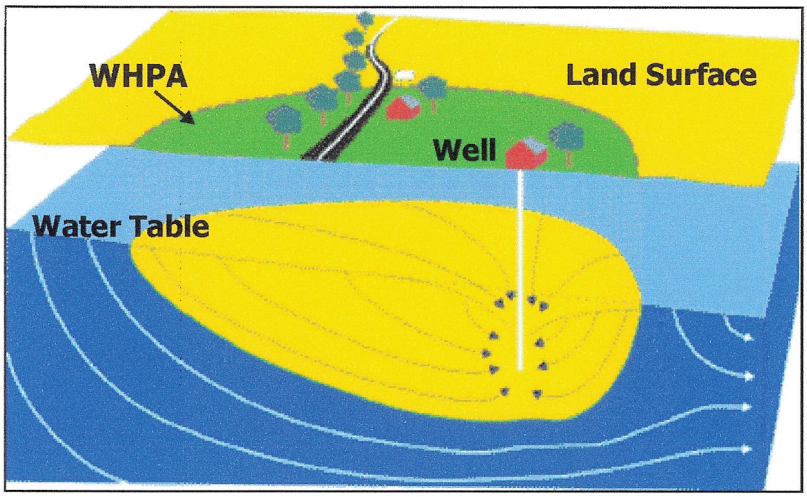
Source Water Assessments

for Small Community Water Systems

in Baltimore County



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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 eight small systems in Baltimore County. 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 water supply in Baltimore County outside of the Baltimore Metropolitan area are wells and springs drawing from unconfined fractured-rock aquifers and coastal plain sediments. The eight small water systems included in this report are currently using fourteen wells and three springs that draw from various formations throughout the county. Most of the Source Water Assessment areas were delineated for the Baltimore County Department of Environmental Protection and Resource Management in a wellhead protection study conducted in 1991. The remaining areas were delineated by the WSP. All source water assessment areas were delineated using U.S. EPA approved methods specifically designed for the type of source utilized.

Potential point sources of contamination within the assessment areas were identified from field inspections, contaminant inventory databases, and previous studies. The most common potential point sources of contamination identified are underground storage tanks. The Maryland Office of Planning's 1997 land use map for Baltimore County was used to identify non-point sources of contamination. The most common type of land use that presents a potential for contamination is agricultural cropland and pastureland. Charts showing land use, figures showing potential contaminant sources in the Source Water Assessment areas, and aerial photographs of well locations are included in the report.

The susceptibility analysis is based on a review of the existing water quality data for each water system, the presence of potential sources of contamination in the individual assessment areas, well integrity, and the inherent vulnerability of the aquifer. It was determined that some small water systems are susceptible to contamination by nitrate, radon, volatile organic compounds, and microbiological contaminants. No systems were determined susceptible to synthetic organic compounds.

EXECUTIVE SUMMARY
BAPTIST HOME OF MARYLAND

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for eight small systems in Baltimore County, including the Baptist Home of Maryland* community supply. 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 water supply wells in northern Baltimore County are unconfined fractured-rock aquifers. The Baptist Home water system, located in northwestern Baltimore County, is currently using three wells that draw water from the Loch Raven Schist formation. The Source Water Assessment area was delineated for the Baltimore County Department of Environmental Protection and Resource Management in a wellhead protection study conducted in 1991 using U.S. EPA approved methods.

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 1997 digital land use map for Baltimore County was used to identify non-point sources of contamination. An aerial photograph and a chart showing land use within the wellhead protection 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 individual assessment areas, well integrity, and the inherent vulnerability of the aquifer. It was determined that the Baptist Home water supply is susceptible to nitrate, radon, and volatile organic compounds. This water supply is not susceptible to other inorganic or radiological compounds, synthetic organic compounds, and microbiological contaminants.

**It should be noted that during the writing of this report, the Baptist Home facility was closed and put up for sale. If the new owners of this facility utilize the property such that it continues to be a public water supply system using the same wells, the source water assessment for this site is still applicable.*

INTRODUCTION

The Water Supply Program has conducted a Source Water Assessments for community water systems in Baltimore County. The large majority of the population of Baltimore County resides in the metropolitan Baltimore region, which is serviced by the Baltimore City water supply system. There are thirteen separate water systems outside the metropolitan service area of the county, and serve residential communities, boarding schools, and other facilities that are defined as community water systems under Safe Drinking Water Act definitions (Fig. 1). Eight of these community systems are considered "small systems," defined in Maryland's Source Water Assessment Plan (MDE, 1999) as a water system that has a ground water appropriation permit of less than 10,000 gallons average daily use. Source water assessments for these small systems are covered in a single report for the county. The remaining five larger systems are assessed in individual reports.

Seven of the eight small systems in Baltimore County obtain their water supply from unconfined fractured rock aquifers, for which a one thousand foot radial source water assessment area is defined in Maryland's SWAP. One system obtains its water supply from an unconfined coastal plain aquifer, for which a 1000-foot wedge shaped area is defined as the source water assessment area. However, in 1991 the Baltimore County Department of Environmental Protection and Resource Management conducted a wellhead protection study in which wellhead protection areas (WHPAs) were delineated for seven of the water systems covered in this document. For ground water systems, a WHPA is considered the source water assessment area for the system and, therefore the previously delineated WHPAs will be used as the source water assessment area.

WELL INFORMATION

Well information for each system was obtained from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports, and published reports. A total of 14 wells and 3 springs are used by the 8 systems assessed in this report. Based on a review of well construction permits and sanitary surveys, 10 of the wells were drilled after 1973 and comply with Maryland's well construction regulations. The remaining 4 wells were drilled prior to 1973 when regulations went into effect, may not meet the current construction standards. Three of the four older wells have well casings that terminate below ground. The three springs are constructed from either concrete or steel rings and are located within a springhouse. A summary of the source information is located in Table 1.

Based on site visits, a common shortcoming in well integrity is the construction of wells below grade or in pits. This was a common practice in well drilling 30 to 40 years ago, and many wells drilled then retain this construction. Wells with casings that terminate below grade can be prone to flooding, which exposes the water supply to a variety of contaminants in storm water runoff. Many of the wells that were constructed below grade did have either drains or pumps to prevent flooding. However, where

feasible, it is preferable to raise casings above grade to prevent the threat of flooding. Another common deficiency is noted in wells constructed with old style well cap, which presents a possible route of contamination through unscreened vents and electrical holes.

PWSID	PWS NAME	PLANT ID	SOURCE ID	SOURCE NAME	USE CODE[1]	WELL PERMIT NO.	TOTAL DEPTH (feet)	CASING DEPTH (feet)	CASING HEIGHT[2] (feet)	GAP	GAP AMT (gpd)	AQUIFER
0030010	STEVENSON	01	01	STEVENSON SPRING	P					n/a		COCKEYSVILLE MARBLE
0030016	VILLA JULIE INFIRMARY	01	01	VILLA JULIE	P	BA942605	200	30	1	BA1962G009	1500	COCKEYSVILLE MARBLE
0030017	PHOENIX	01	01	PHOENIX 1	P	BA816524	200	80	1	BA1987G021	4000	BALTIMORE GNEISS
		01	02	PHOENIX 2	P	BA816482	200	60	1			
0030023	KOINONIA PARTNERSHIP	01	01	KOINONIA 1	P	BA816633	400	43	1	BA1960G001	3500	LOCH RAVEN SCHIST
		02	02	KOINONIA 2	P	BA038932	161	20	P			
0030201	BAPTIST HOME OF MARYLAND	01	01	BAPTIST 2A	P	BA814577	300	43	1	BA1971G010	5200	LOCH RAVEN SCHIST
		01	04	BAPTIST 3	P	BA731755	250	25	1			
		01	07	BAPTIST 2B	P	BA942867			1			
0030202	CHAPEL HILL NURSING CENTER	01	01	CHAPEL HILL1	S	BA030295	76	50	P	BA1958G003	6500	ULTRAMAFIC AND GABBROIC ROCKS
		01	02	CHAPEL HILL2	P	BA817250	300	47	1			
		01	03	NEW WELL	P	BA943881	500	70	1			
0030204	GRANITE TRAILER COURT	01	01	SPRING 1	P					BA1982G020	9700	BALTIMORE GNEISS
		02	02	SPRING 2	P							
		02	03	WELL 1	P	BA810968	185	35	2			
0030207	HONEYGO MOBILE HOME PARK	01	01	HONEYGO MAIN WELL	P	BA025005	360	152	P	BA1956G020	5500	PATUXENT FORMATION
		01	02	HONEYGO BACKUP	P	n/a	n/a	n/a	n/a			

Table 1. Well Construction Information

[1] P = Production Well, S = Standby Well. [2] P = In Pit or Below Grade.

The owner of the Granite MHP has indicated to the WSP that the springs serving this water system will be abandoned in the future in favor of a well. A well application has been submitted to the county but to date the well has not been drilled. The site chosen for the well is located approximately 50 feet upgradient from Spring 1. If this well site is used, the delineated wellhead protection area will not need to be modified.

HYDROGEOLOGY

Approximately eighty percent of Baltimore County lies within the Piedmont physiographic province, which is characterized by gently rolling hills and valleys. The bedrock underlying the Piedmont is some of the oldest in the State and consists of Precambrian and Paleozoic metamorphic and igneous rocks. The Fall line cuts through the southeastern portion of the County and the unconsolidated sediments of Cretaceous age begin to outcrop there. All of the systems in this report are located within the Piedmont province except Honeygo MHP, which is just south of the Fall line.

The wells and springs in the Piedmont province obtain their water from unconfined, fractured-rock aquifers. The primary porosity and permeability are generally small due to the dense nature of the metamorphic rocks in this area. Ground water moves principally through secondary porosity, fractures and joint openings, and is recharged by precipitation percolating through soil and saprolite. The aquifers can be further differentiated by composition: silicic (Loch Raven Schist, Baltimore Gneiss), mafic (Ultramafic and Gabbroic Rocks), and carbonate (Cockeysville Marble). The silicic and mafic formations are generally low yielding aquifers due to low primary porosity, unless major fracture intersections are encountered. The carbonate formations can be very prolific aquifers due to dissolution of the carbonate minerals that enlarge fractures and joint openings thus increasing the storage and movement of ground water through the aquifer. 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 in Baltimore County (Nutter and Otton, 1969), and as a result wells drilled in draws and stream valleys tend to have higher yields than those on hilltops and slopes.

The Coastal Plain province is underlain by a series of southeasterly dipping layers of relatively unconsolidated sedimentary layers superimposed upon the eastward continuation of the crystalline rocks of the Piedmont Plateau (Vokes and Edwards, 1957). Near the Fall line, the sediments are the least thick and contain water under unconfined conditions. Primary porosity is high compared to the fractured rocks of the Piedmont, and ground water moves through the pore space between sand grains. The wells in the Coastal Plain in this report are drilled into the Patuxent formation, a gravelly and coarse-sand aquifer.

SOURCE WATER ASSESSMENT AREA DELINEATION

As defined in Maryland's SWAP, the source water assessment area for public water systems using an average of less than 10,000 gallons per day (gpd), in unconfined fractured-rock and carbonate aquifers is a fixed radius of 1,000 feet around the well. This radius is based on calculating the land area needed to provide a yield of 10,000 gpd assuming a 400 gpd per acre recharge rate (drought year recharge conditions) and a safety factor (MDE 1999). The plan allows for a more detailed or complex delineation method, provided that the method is reviewed and approved by the State. The Baltimore County Wellhead Protection Strategies (1992) report includes delineated wellhead protection areas for 7 of the 8 systems that were reviewed and approved by MDE. The WHPAs were delineated using the US EPA WHPA code which requires the following input parameters: direction of ground water flow, ground water gradient, transmissivity of the aquifer, porosity of the aquifer, and pumping rate of the wells. The data used for aquifer parameters was mostly obtained from published reports for the specific aquifers and the pumping rates were determined from the ground water appropriation permits. The WHPAs encompass the land area estimated to contribute water to the wells that represents a 10-year zone of transport. Since the information used to delineate the WHPAs has not changed and the wells are either the same or located within the original delineated area, the WHPAs delineated are considered the source water assessment areas for these systems.

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.

MDE staff inspected 25 facilities within all of the WHPAs in October 1998 for ground water discharge violations and one notice of violation was issued. The violation was issued to a veterinary clinic in Stevenson for improper discharge of x-ray effluent into its septic system. The facility has since added treatment to their waste-water disposal. MDE Ground Water Permits staff are currently working with the facility to ascertain that the disposal system is effective and to ensure protection of the ground water supply.

Point Sources

A review of MDE contaminant databases revealed only one notable point source of contamination **within** the WHPAs covered in this report, while other potential

contaminant point sources are located nearby WHPAs and deserve mention. An underground storage tank (UST) was identified in the WHPA of the Villa Julie Infirmary (Fig. 2b). The UST was a 10,000-gallon gasoline tank located on the Villa Julie College property that has been abandoned and designated permanently out of use by MDE's Oil Control Program. As mentioned above, one ground water discharge was identified in the Stevenson area, which is actually just outside the WHPA boundary (Fig. 2a). The Honeygo Run Rubble Landfill is located adjacent to the Honeygo MHP (Fig 2h), but its property does not fall within the WHPA for this water supply.

Potential sources of contamination were also identified in the original wellhead protection study (DEPRM, 1991). In the of Baptist Home of Maryland WHPA, a 6000 gallon underground fuel oil tank was identified north of the main building (Fig. (Appendix A, Fig 2.1.6). In the Granite Trailer Court, a "small disposal area" was noted in the southwestern part of the WHPA (Appendix A, Fig. 2.4.5). At the Honeygo Mobile Home Park, it was noted that "sodium concentrations indicate that there is a good hydraulic connection between the well and the highway", and therefore Interstate 95 was identified as a potential source of contamination due to the risk of accidents or spills.

Table 2 lists the potential contaminant sites identified and their associated contaminants. They have been classified as Underground Storage Tanks (USTs), Ground Water Discharge Permits (GWDP), or Solid Waste Landfills (SWLF). The contaminants associated with the types of facilities in Table 2 are based on generalized categories and often the potential contaminant depends on the specific chemicals and processes being used at the individual facility. The potential contaminants for an activity may not be limited to those listed in Table 2. Potential contaminants are grouped as Volatile Organic Compounds (VOC), Synthetic Organic Compounds (SOC), Heavy Metals (HM), Metals (M), Nitrate/Nitrite (NN), and Microbiological Pathogens (MP).

PWS Name	Potential Contaminant Site Name	Potential Contaminant Type	Potential Contaminants	Reference Location	Status
Stevenson	Stevenson Veterinary Clinic	GWDP	MP,NN,VOC, SOC,M	Figure 2a	Permit review
Villa Julie Infirmary	Villa Julie College	UST	VOC	Figure 2b	Permanently out of use
Baptist Home of Maryland	Baptist Home of Maryland	UST	VOC	Appendix Figure 2.1.6	Unknown
Granite Trailer Court	Private Dumping Area	SWLF	VOC,HM,M,NN, MP,SOC	Appendix Figure 2.4.5	Unknown
Honeygo Mobile Home Park	Honeygo Run Rubble Landfill	SWLF	VOC,HM,M,NN, MP,SOC	Figure 2h	Active Facility

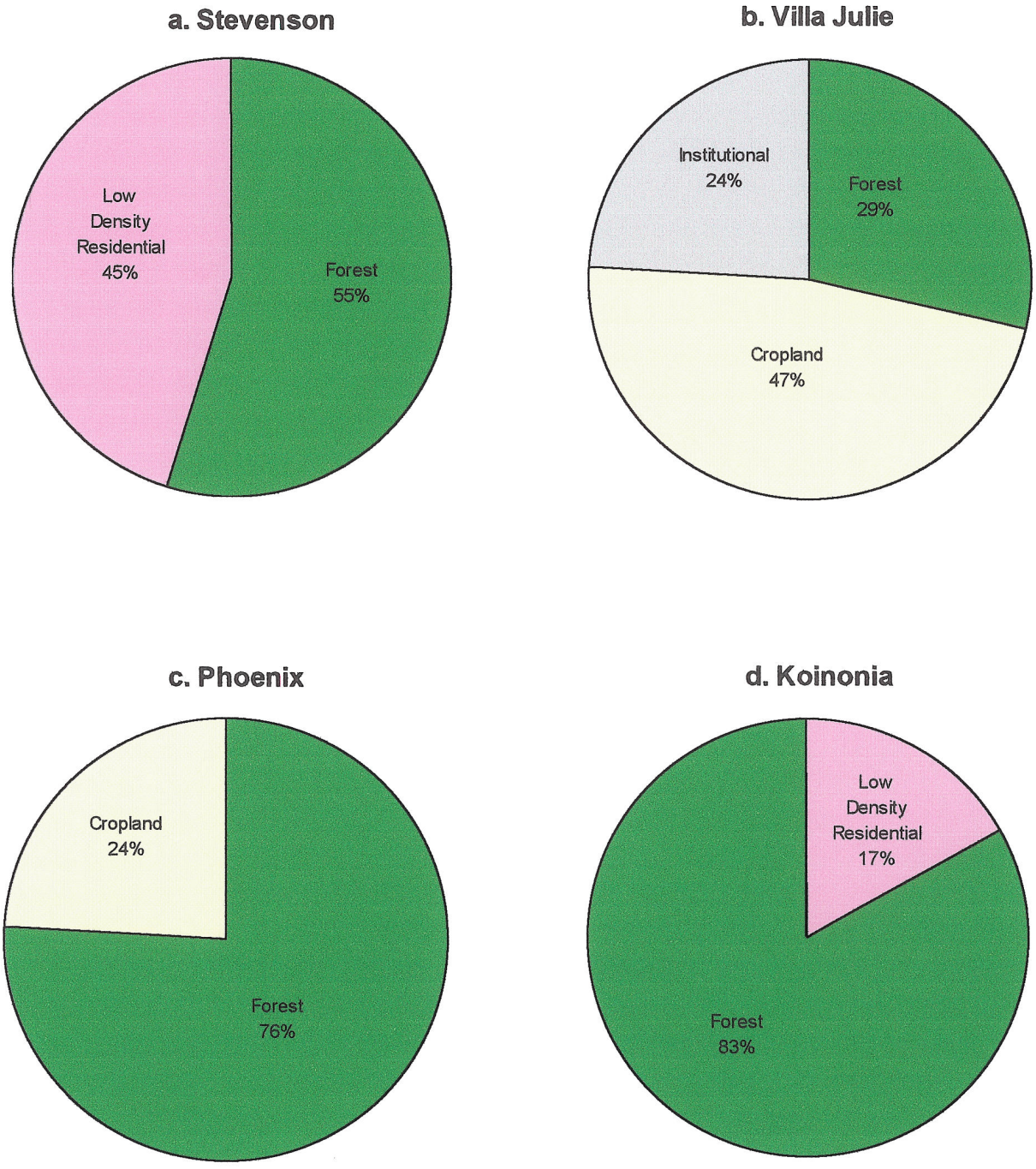
Table 2. Potential Contaminant Point Sources within or near Source Water Assessment Areas (see figures referenced for location)

Non-Point Sources

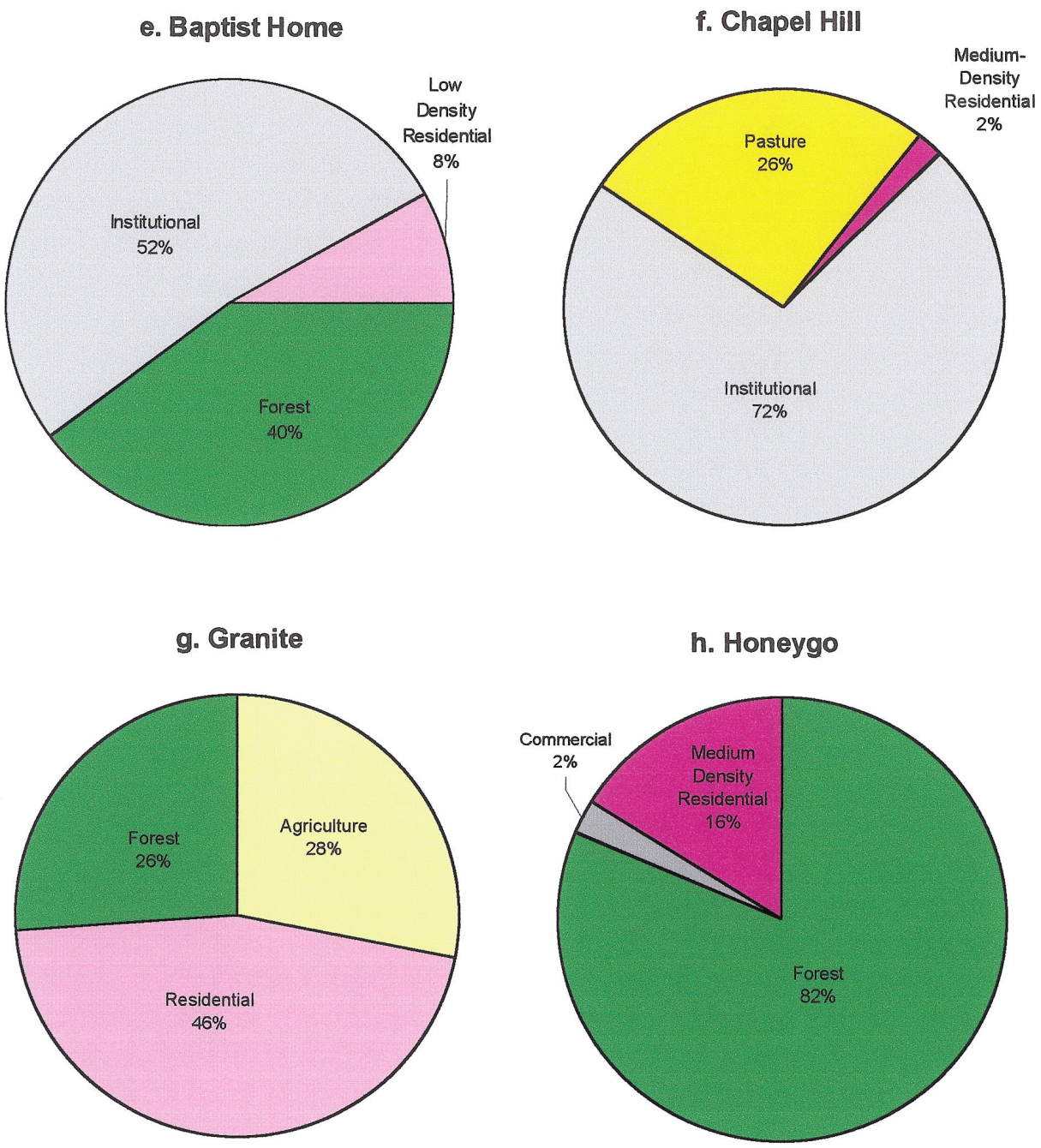
The Maryland Office of Planning's 1997 Land Use map for Baltimore County was used to determine the predominant types of land use in each WHPA. The land use of the northern portion of Baltimore County, where the systems in this report are located, is mostly forested (41%) and cropland (34%). There are also significant areas of residential land (14%), and pasture land (6%), and a variety of commercial and open space land uses make up the remaining 4%. The proportional land use within each of the WHPAs is shown in Charts 1a-h.

Agricultural land use (cropland and pasture) is commonly associated with nitrate loading of ground water and also represents a potential source of SOCs depending on farming practices and use of pesticides. Residential septic systems may present a source of nitrate or microbiological contaminants. Additionally residential areas may be a source of nitrate or SOCs depending on gardening and lawn care practices.

The Maryland Office of Planning's 1996 Baltimore County Sewer map shows that all of the WHPAs in this report are within the area of the county that is not planned for service, with the exception of Honeygo Mobile Home Park, which is within the 10 year planned area. Residential areas may be a source of nitrate loading to ground water through septic systems. Commercial or industrial land uses without sewer service present a potential source of all types of contaminants if byproducts and wastes are not disposed of properly.



Charts 1a-d. Land Use within Baltimore County small systems WHPAs.



Charts 1e-h. Land Use within Baltimore County small systems WHPAs.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database for Safe Drinking Water Act (SDWA) contaminants. A list of contaminants regulated under the SDWA is included in Appendix B. All data reported is from the finished (treated) water unless otherwise noted. The treatment currently in use in the 8 systems includes disinfection, corrosion control, removal of iron and particulates, and softening. The Baptist Home of Maryland is the only system that currently has no treatment. Table 3 summarizes the treatment methods utilized by each system.

PWSID	PWS NAME	PLANT ID	TREATMENT TYPE	REASON FOR TREATMENT
0030010	STEVENSON	01	HYPOCHLORINATION, PRE	DISINFECTION
0030016	VILLA JULIE INFIRMARY	01	ION EXCHANGE	SOFTENING
			HYPOCHLORINATION, PRE	DISINFECTION
0030017	PHOENIX	01	PERMANGANATE	IRON REMOVAL
			pH ADJUSTMENT, PRE	IRON REMOVAL
			FILTRATION, GREENSAND	IRON REMOVAL
			pH ADJUSTMENT	CORROSION CONTROL
			HYPOCHLORINATION, PRE	DISINFECTION
			pH ADJUSTMENT, POST	CORROSION CONTROL
0030023	KOINONIA PARTNERSHIP	01	FILTRATION, CARTRIDGE	PARTICULATE REMOVAL
			pH ADJUSTMENT	CORROSION CONTROL
		02	pH ADJUSTMENT	CORROSION CONTROL
0030201	BAPTIST HOME OF MARYLAND	01	NO TREATMENT	
0030202	CHAPEL HILL NURSING CENTER	01	pH ADJUSTMENT	CORROSION CONTROL
0030204	GRANITE TRAILER COURT	01	HYPOCHLORINATION, POST	DISINFECTION
		02	HYPOCHLORINATION, POST	DISINFECTION
0030207	HONEYGO MOBILE HOME PARK	01	HYPOCHLORINATION, PRE	DISINFECTION

Table 3. Treatment Methods.

The threshold defined in Maryland's SWAP (MDE, 1999) for reporting water quality results is 50% of the Maximum Contaminant Level (MCL). Of the inorganic

compounds, nitrate was the only contaminant detected above the threshold level. Radon-222 was the only radiological contaminant present at a level of concern. Volatile organic compounds have not been detected in any systems above the threshold. No synthetic organic compounds, other than Di(2-ethylhexyl)Phthalate (which is commonly associated with laboratory blanks) were detected above 50% of the Maximum Contaminant Level (MCL) in any of the systems. A review of the monitoring data since 1993 indicates that the water supply for these eight systems meets drinking water standards with the few exceptions described below. The water quality sampling results are summarized in Table 4. The most recent monitoring schedule, which outlines the sampling requirements, due dates, and sampling frequencies for the water system, is included in Appendix B.

Inorganic Compounds (IOCs)

Nitrate was detected above the threshold level of 5 parts per million (ppm) in 5 of the 8 water systems. Table 5a lists all nitrate levels above the threshold. If an MCL was exceeded the result is in bold.

Stevenson had a nitrate sample result of 10.4 ppm in August, 1993. This sample appears to be anomalous, since 13 of 16 samples taken since 1993 have been below 4 ppm.

The Villa Julie Infirmary had only one sample exceed 5 ppm out of a total of 13 samples. The range of nitrate levels at Villa Julie for samples collected since 1993 is 0.9 to 3.8 ppm.

The Baptist Home of Maryland has had six samples exceed 5 ppm out of a total of 28 samples collected between 1993 and 2000. Nitrate levels range between 1 and 8 ppm and have never exceeded the MCL of 10 ppm.

Chapel Hill Nursing Center samples for nitrate quarterly due to the high levels present. A total of 32 sample results are available and of those 23 (72%) have exceed 5 ppm and 9 (28%) have exceed the MCL of 10 ppm. The last eight samples collected since 1996 have levels between 3.1 and 4.9 ppm.

The Granite Trailer Court had 4 samples exceed 5 ppm out of a total of 10 samples at plant 01. Plant 01 is the point of entry for Spring 1. Plant 02 did not have any of its nine nitrate samples exceed 5 ppm.

Radionuclides

There is currently no MCL for Radon-222, however EPA has proposed an MCL of 300 pCi/L or an alternate of 4000 pCi/L for community water systems if the State has a program to address the more significant risk from radon in indoor air. The EPA received many comments in response to their proposed rule, and promulgation may be delayed. Radon-222 levels in all of the systems range between 100 and 3340 pCi/L (Table 5b), levels commonly associated with the bedrock aquifers of the

Piedmont. Since an MCL has not yet been determined, all data for Radon-222 is reported.

Volatile Organic Compounds (VOCs)

A review of the data available since 1993 shows that VOCs have **not** been detected above the 50% MCL threshold in any samples from the eight systems in this report.

Synthetic Organic Compounds (SOCs)

The only SOC detected above the 50% threshold was Di(2-Ethylhexyl)Phthalate (Table 5c). The contaminant was detected once in one system, and has not been found in subsequent samples. This contaminant is commonly found in laboratory blank samples. It should also be noted that the method for analyzing this contaminant was just starting to be used in 1995 and had many false positive results.

Microbiological Contaminants

Raw water bacteriological data is available for five systems that have completed their evaluation for ground water under the direct influence of surface water (Table 5d). The Granite Trailer Court has not yet completed these sampling requirements, and thus raw water bacteriological data is not available for these systems. Raw water data was not available for the Koinonia Partnership and Chapel Hill Nursing Center (except Well 3), but because these systems do not have disinfection treatment that would remove microbiological contaminants, their finished water was reviewed and included in Table 5d.

PWSID	PWS NAME	PLANT ID	Nitrate		SOCs		VOCs		IOCs (Except Nitrate)		Radiological	
			No. of Samples	No. of Samples > 50% MCL	No. of Samples	No. of Samples > 50% MCL	No. of Samples	No. of Samples > 50% MCL	No. of Samples	No. of Samples > 50% MCL	No. of Samples	No. of Samples > 50% MCL
0030010	STEVENSON	01	16	2	2	0	8	0	3	0	3	0
0030016	VILLA JULIE INFIRMARY	01	13	1	3	0	9	0	3	0	3	2
0030017	PHOENIX	01	11	0	2	0	13	0	6	0	6	1
0030023	KOINONIA PARTNERSHIP	01	4	0	2	0	7	0	3	0	3	1
		02	2	0	0	0	2	0	1	0	1	0
0030201	BAPTIST HOME OF MARYLAND	01	28	7	3	0	7	0	3	0	3	1
0030202	NURSING CENTER	01	32	23	3	0	8	0	4	1	5	1
0030204	GRANITE TRAILER COURT	01	10	4	4	0	8	0	4	0	4	1
		02	9	0	3	0	8	0	3	0	3	1
0030207	HONEYGO MOBILE HOME PARK	01	11	0	3	0	8	0	3	0	3	1

Table 4. Summary of Water Quality Samples.

PWSID	PWS NAME	PLANT ID	SAMPLE DATE	RESULT (PPM)
0030010	STEVENSON	01	24-Feb-93	7.80
			24-Aug-93	**10.40**
0030016	VILLA JULIE INFIRMARY	01	30-Sep-97	5.22
0030201	BAPTIST HOME OF MARYLAND	01	17-May-94	8.03
			19-May-94	5.67
			22-Aug-94	5.33
			21-Feb-95	6.36
			11-Feb-97	7.92
			10-Apr-97	6.69
0030202	CHAPEL HILL NURSING CENTER	01	25-Feb-93	**15.00**
			21-Mar-93	**12.30**
			22-Mar-93	9.90
			10-May-93	**14.20**
			20-Sep-93	8.80
			28-Sep-93	**12.90**
			28-Oct-93	7.44
			05-Jan-94	6.82
			16-Feb-94	7.10
			25-Apr-94	9.16
			10-May-94	**14.20**
			16-May-94	8.56
			15-Jun-94	9.00
			05-Jul-94	6.85
			17-Aug-94	**10.90**
			22-Aug-94	5.33
			10-Oct-94	5.22
			08-Feb-95	6.94
			15-May-95	7.59
			17-Aug-95	**12.40**
			22-Aug-95	9.92
			13-Nov-95	**13.50**
			30-Nov-95	**11.60**
0030204	GRANITE TRAILER COURT	01	18-Sep-96	5.70
			14-Dec-98	5.80
			13-Dec-99	6.60
			18-Dec-00	6.40

Table 5a. Nitrate results greater than 50% of MCL. (MCL for Nitrate is 10 ppm)

PWSID	PWS NAME	PLANT ID	SAMPLE DATE	RESULT (pCi/L)
0030010	STEVENSON	01	19-Jan-99	100
0030016	VILLA JULIE INFIRMARY	01	13-Feb-96	295
			30-Sep-97	499.8
0030017	PHOENIX	01	28-May-96	500
0030023	KOINONIA PARTNERSHIP	01	07-Jun-00	3190
0030201	BAPTIST HOME OF MARYLAND	01	06-Feb-96	3340
0030202	CHAPEL HILL NURSING CENTER	01	13-Jan-99	755
0030204	GRANITE TRAILER COURT	01	13-Jan-99	1465
		02	13-Jan-99	2275
0030207	HONEYGO MOBILE HOME PARK	01	16-Jan-99	445

Table 5b. Radon-222 results.
(Note there is currently no MCL for Radon-222, see text for further explanation.)

PWSID	PWS NAME	PLANT ID	CONTAMINANT	MCL	SAMPLE DATE	RESULT (PPB)
0030208	GLEN MEADOWS RETIREMENT COMMUNITY	01	DI(2-ETHYLHEXYL) PHTHALATE	6	23-Mar-95	4.37

Table 5c. Synthetic Organic Compounds greater than 50% of the MCL.

PWSID	PWS Name	Source Id	Source Name	No. of Samples	No. of Total Coliform Positive	No. of Fecal Coliform Positive
0030010	STEVENSON	01	STEVENSON SPRING	10	10	2
0030016	VILLA JULIE INFIRMARY	01	VILLA JULIE	10	0	0
0030017	PHOENIX	01	PHOENIX 1	1	0	0
		02	PHOENIX 2	1	0	0
0030023	KOINONIA PARTNERSHIP	01& 02	POE SAMPLES (WELL 1 & WELL 2 COMIBINED)	50	3	0
0030201	BAPTIST HOME OF MARYLAND	01	BAPTIST 2A	1	0	0
		04	BAPTIST 3	9	1	0
		07	BAPTIST 2B	1	0	0
0030202	CHAPEL HILL NURSING CENTER	01& 02	POE SAMPLES (WELL 1 & WELL 2 COMIBINED)	48	1	0
		03	NEW WELL	1	0	0
0030204	GRANITE TRAILER COURT	01	SPRING 1	0	0	0
		02	SPRING 2	0	0	0
		03	WELL 1	0	0	0
0030207	HONEYGO MOBILE HOME PARK	01	HONEYGO MAIN WELL	1	1	0
		02	HONEYGO BACKUP	0	0	0

Table 5d. Summary of Raw Water Bacteriological Samples.

SUSCEPTIBILITY ANALYSIS

The wells serving the small water systems included in this report all draw water from unconfined 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. Vulnerability will vary based on the specific rock type comprising the aquifer. For example, wells that draw water from limestone formations are generally more vulnerable to activity on the land surface due to thin soil cover and development of karst

features. 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 each of the eight systems in this report 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. A common threat to wells constructed below grade is flooding from stormwater runoff. Agricultural land use presents the most common threat of non-point source contamination from overuse of fertilizer that leads to nitrate loading in ground water.

Inorganic Compounds

Nitrate is present in the wells of 5 systems at 5 ppm or greater (Table 5a). 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, animal waste in pasturelands, and residential septic systems are all sources of nitrate loading in ground water. Four systems, Stevenson, Baptist Home of Maryland, Chapel Hill Nursing Center and Granite Trailer Court, had nitrate levels exceed 5 ppm in more than 10% of their samples. Due to the levels and persistence of nitrate found, the vulnerability of the fractured rock aquifers to land activity, and the presence of nitrate sources in the source water assessment areas, five systems were determined susceptible to nitrate as outlined in Table 6a. It should be noted, however, that the nitrate levels have decreased significantly at the Chapel Hill Nursing Center since 1995. Due to nitrate violations, horses were removed from the field adjacent to the wells, and this appears to have helped reduce nitrate levels. In addition, the Nursing Center recently installed a new well that, by blending, may have also reduced nitrate concentrations.

All of the systems were determined **not** susceptible to inorganic compounds other than nitrate, based on water quality data and lack of potential contaminant sources within WHPAs.

Radionuclides

There is currently no MCL for Radon-222, however EPA has proposed an MCL of 300 pCi/L or an alternate of 4000 pCi/L if the State has a program to address the more significant risk from radon in indoor air. The EPA received many comments in response to their proposed rule, and promulgation may be delayed. Radon is present in the water supply of all of the systems included in this report. Seven of eight of the systems have radon levels above 50% of the lower proposed MCL of 300 pCi/L. The source of radon in ground water can be traced back to the natural occurrence of uranium in rocks. Radon is prevalent in ground water of crystalline rock aquifers, such as those in the Piedmont Region of Baltimore County, due to radioactive decay of uranium bearing minerals in the bedrock (Bolton, 1996). The

PWSID	PWS Name	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected In WQ Samples?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible to Nitrate?
0030010	STEVENSON	YES	YES	NO	YES	YES
0030016	VILLA JULIE INFIRMARY	YES	YES	NO	YES	YES
0030017	PHOENIX	YES	NO	NO	YES	NO
0030023	KOINONIA PARTNERSHIP	YES	NO	NO	YES	NO
0030201	BAPTIST HOME OF MARYLAND	YES	YES	NO	YES	YES
0030202	CHAPEL HILL NURSING CENTER	YES	YES	NO	YES	YES
0030204	GRANITE TRAILER COURT	YES	YES	NO	YES	YES
0030207	HONEYGO MOBILE HOME PARK	NO	NO	NO	YES	NO

Table 6a. Susceptibility Chart for Nitrate.

PWSID	PWS Name	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected In WQ Samples?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible to Radiological Compounds?
0030010	STEVENSON	YES (NATURALLY OCCURRING)	YES	NO	YES	NO
0030016	VILLA JULIE INFIRMARY	YES (NATURALLY OCCURRING)	YES	NO	YES	YES
0030017	PHOENIX	YES (NATURALLY OCCURRING)	YES	NO	YES	YES
0030023	KOINONIA PARTNERSHIP	YES (NATURALLY OCCURRING)	YES	NO	YES	YES
0030201	BAPTIST HOME OF MARYLAND	YES (NATURALLY OCCURRING)	YES	NO	YES	YES
0030202	CHAPEL HILL NURSING CENTER	YES (NATURALLY OCCURRING)	YES	NO	YES	YES
0030204	GRANITE TRAILER COURT	YES (NATURALLY OCCURRING)	YES	NO	YES	YES
0030207	HONEYGO MOBILE HOME PARK	YES (NATURALLY OCCURRING)	YES	NO	YES	YES

Table 6b. Susceptibility Chart for Radiological Compounds.

EPA also has information on proposed regulations for radon in indoor air and drinking water on their web site (http://www.epa.gov/OGWDW/radon.html).

Currently, it appears that seven of the eight systems are susceptible to radon (Table 6b). If the higher MCL of 4000 pCi/L is adopted, three systems (Koinonia Parntership, Baptist Home of Maryland, and Granite Trailer Court) will still be considered susceptible to radon.

Other radiological contaminants were not detected in the water supply of the eight systems, and no sources of these contaminants were identified. Therefore the eight systems are **not** susceptible to radiological contaminants other than Radon-222.

Volatile Organic Compounds

The predominant sources of VOCs are point sources of contamination outlined in Table 2. All of the systems that have potential VOC sources within or near their source water assessment area have not detected VOCs in monitoring samples (Table 4). However due to the vulnerable nature of unconfined aquifers coupled with a potential source, the Villa Julie Infirmary, the Baptist Home of Maryland, the Granite Trailer Court, and the Honeygo MHP are considered susceptible to VOCs. The remaining systems have been determined not susceptible to VOCs (Table 6c).

PWSID	PWS Name	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected In WQ Samples?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible to VOCs?
0030010	STEVENSON	NO	NO	NO	YES	NO
0030016	VILLA JULIE INFIRMARY	YES	NO	NO	YES	YES
0030017	PHOENIX	NO	NO	NO	YES	NO
0030023	KOINONIA PARTNERSHIP	NO	NO	NO	YES	NO
0030201	BAPTIST HOME OF MARYLAND	YES	NO	NO	YES	YES
0030202	CHAPEL HILL NURSING CENTER	NO	NO	NO	YES	NO
0030204	GRANITE TRAILER COURT	YES	NO	NO	YES	YES
0030207	HONEYGO MOBILE HOME PARK	YES	NO	NO	YES	YES

Table 6c. Susceptibility Chart for Volatile Organic Compounds.

Synthetic Organic Compounds

All of the systems in this report have been determined to be **not** susceptible to SOCs. The source of SOCs to ground water include point (Table 2) and non-point sources such as pesticide application. Although several systems have cropland make up some proportion of the land use in their WHPA, the fact that SOCs have not been detected in the water supply shows that chemicals are not being over applied to these areas. A potential point source of SOCs was identified within the source water assessment area of the Granite Trailer Court, however, it is a small dumping area that is unlikely to be exposed to these types of chemicals. This coupled with the fact that this system has had no SOC detects makes it not susceptible to SOC contamination.

PWSID	PWS Name	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected In WQ Samples?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible toSOCs?
0030010	STEVENSON	YES	NO	NO	YES	NO
0030016	VILLA JULIE INFIRMARY	NO	NO	NO	YES	NO
0030017	PHOENIX	YES	NO	NO	YES	NO
0030023	KOINONIA PARTNERSHIP	NO	NO	NO	YES	NO
0030201	BAPTIST HOME OF MARYLAND	NO	NO	NO	YES	NO
0030202	CHAPEL HILL NURSING CENTER	NO	NO	NO	YES	NO
0030204	GRANITE TRAILER COURT	YES	NO	NO	YES	NO
0030207	HONEYGO MOBILE HOME PARK	YES	NO	NO	YES	NO

Table 6d. Susceptibility Chart for Synthetic Organic Compounds.

Microbiological Contaminants

Sources of microbiological pathogens in surface water are improperly treated wastewater (discharge to surface water or failing septic systems), waste material from mammals, and urban runoff in developed areas. Ground water is generally thought to be not susceptible to contamination by pathogenic microorganisms due to the natural filtration ability of soil and aquifer material. The exceptions to this are 1) wells that are classified as "Ground water under the direct influence of surface water" (GWUDI) and 2) wells that may be sensitive to viruses due to a short travel time of water from the source of viral contamination to the well and 3) septic

systems that are improperly installed or designed can be a source of microbial contamination in fractured rock aquifers.

Five of eight of the systems have completed their GWUDI testing and all of their sources have been determined not under direct influence of surface water and are therefore not susceptible to pathogens such as *Giardia, Cryptosporidium*. The Stevenson Spring had some total coliform present in their raw water samples and thus may be susceptible to viruses that have a longer survival time than the protozoa. The susceptibility to microbiological contaminants cannot be determined for systems in which raw water data is not available. This report will have to be revised if raw water data collected in order to determine the GWUDI status of the remaining sources indicates that they are susceptible to microbial contamination. The susceptibility analysis for microbiological pathogens is summarized in Table 6e.

PWSID	PWS Name	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected In WQ Samples?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible to Microbiological Pathogens?
0030010	STEVENSON	YES	YES	YES	YES	YES (Viruses and Bacteria ONLY)
0030016	VILLA JULIE INFIRMARY	NO	NO	NO	YES	NO
0030017	PHOENIX	NO	NO	NO	NO	NO
0030023	KOINONIA PARTNERSHIP	YES	YES	NO	NO	YES (Viruses and Bacteria ONLY)
0030201	BAPTIST HOME OF MARYLAND	YES	YES	NO	NO	NO
0030202	CHAPEL HILL NURSING CENTER	YES	YES	YES	NO	YES (Viruses and Bacteria ONLY)
0030204	GRANITE TRAILER COURT	YES	NOT AVAILABLE	NO	NO	UNKNOWN
0030207	HONEYGO MOBILE HOME PARK	YES	YES	YES	NO	NO

Table 6e. Susceptibility Chart for Microbiological Pathogens.

MANAGEMENT OF THE SOURCE WATER ASSESSMENT AREA

With the information contained in this report, the individual water system owners as well as the Baltimore County government have a basis for protecting the drinking water supplies for ground water users. Staying aware of the area delineated for source water protection, keeping track of potential contaminant sources, and evaluating future development and land planning are examples of management practices that will protect the water supply. Specific management recommendations for consideration are listed below. The following recommendations are intended for 1) a county-wide source water protection effort, and 2) for individual water systems.

RECOMMENDATIONS FOR COUNTY AGENCIES:

Form a Local Planning Team

- A local planning team should be formed to begin to implement a source water protection plan. The team should represent all the interests in the community, such as the water suppliers, home association officers, the County Health Department, local planning agencies, local businesses, developers, farmers and residents within and near source water assessment areas. The team should work to reach a consensus on how to protect the water supplies.

- The "Baltimore County Ground Water management and Protection Strategy" (1992) includes many recommendations for ground water protection that should be implemented.

Public Awareness and Outreach

- Conducting education outreach to the facilities listed in Table 2. Important topics include: (a) in ground storage of materials in tanks and piping, (b) waste streams that may go into dry wells, septic tanks or other ground water discharge points, (c) reporting of spills, (d) material and chemical storage, and (e) monitoring well installation.

- Road signs at the boundaries of source water assessment areas 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.

Planning/ New Development

- Baltimore County should adopt an ordinance for wellhead protection. As stated in the 1991 wellhead protection study, this could be in the form of an amendment to the County Zoning Regulation and as a general regulation within the Baltimore County Code. The MDE recommends that the County work to finalize and adopt an ordinance for protecting source water assessment areas.

- Planning for new commercial development should consider placement of water supply wells a priority when planning for such facilities as gas stations, and dry cleaners. Additionally, ensuring the adequacy of the well to supply water for the

facilities in the long term will ensure that additional wells in less desirable locations are not necessary.

Land Acquisition/Easements

- The availability of loans for purchase of and or easements for the purpose of protecting water supplies is available from MDE for community water systems and for non-transient non-community water systems owned by non-profit organizations. Loans are offered at zero percent interest and zero points.

Contingency Plan

- Develop a spill response plan in concert with the Fire Department and other emergency response personnel.

RECOMMENDATIONS FOR INDIVIDUAL SYSTEMS:

Public Awareness and Outreach

- The Consumer Confidence Report should list that this report is available to the general public by contacting MDE.

Planning/New Development

- MDE recommends that water supply system owners within Baltimore County encourage the County to adopt a wellhead protection ordinance.

Monitoring

- Systems should continue to monitor for contaminants that have been previously detected to ensure public health protection.

- Systems should continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.

Contingency Plan

- All water system owners should have a Contingency Plan for their 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.

Contaminant Source Inventory Updates/ Inspections

- Water system owners should conduct their own field survey of the source water assessment area to ensure that there are no additional potential sources of contamination.

- Water system owners with facilities listed as potential contaminant sources within their source water assessment area should consider regular inspections of certain high-risk facilities.

- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.

- Wells and springs that do not meet current construction standards should be upgraded to protect them from contamination associated with poor construction.

Changes in Use

- Water system owners are required to notify MDE if new wells are to be put into service. Drilling a new well outside the current source water assessment area would modify the area, therefore the Water Supply Program should be contacted if a new well is being proposed.

REFERENCES

Baltimore County Department of Environmental Protection, 1992, Baltimore County Ground Water Management and Protection Strategy, 76 pp.

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).

Cross, F.T., N.H. Harley, and W. Hofmann, 1985, Health effects and risks from ^{222}Rn in drinking water: Health Physics, vol. 48, no.5, p. 649-670.

Maryland Association of Counties, 1999/2000 Directory of County Officials, 412 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

Nutter, L.J., 1973, Hydrogeology of the Carbonate Rocks, Frederick and Hagerstown Valleys, Maryland: Maryland Geological Survey Report of Investigations No. 19, 70 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
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
USGS Topographic 7.5 Minute Quadrangles
Maryland Office of Planning 1997 Baltimore County Digital Land Use Map
Maryland Office of Planning 1996 Baltimore County Digital Sewer Map

FIGURES

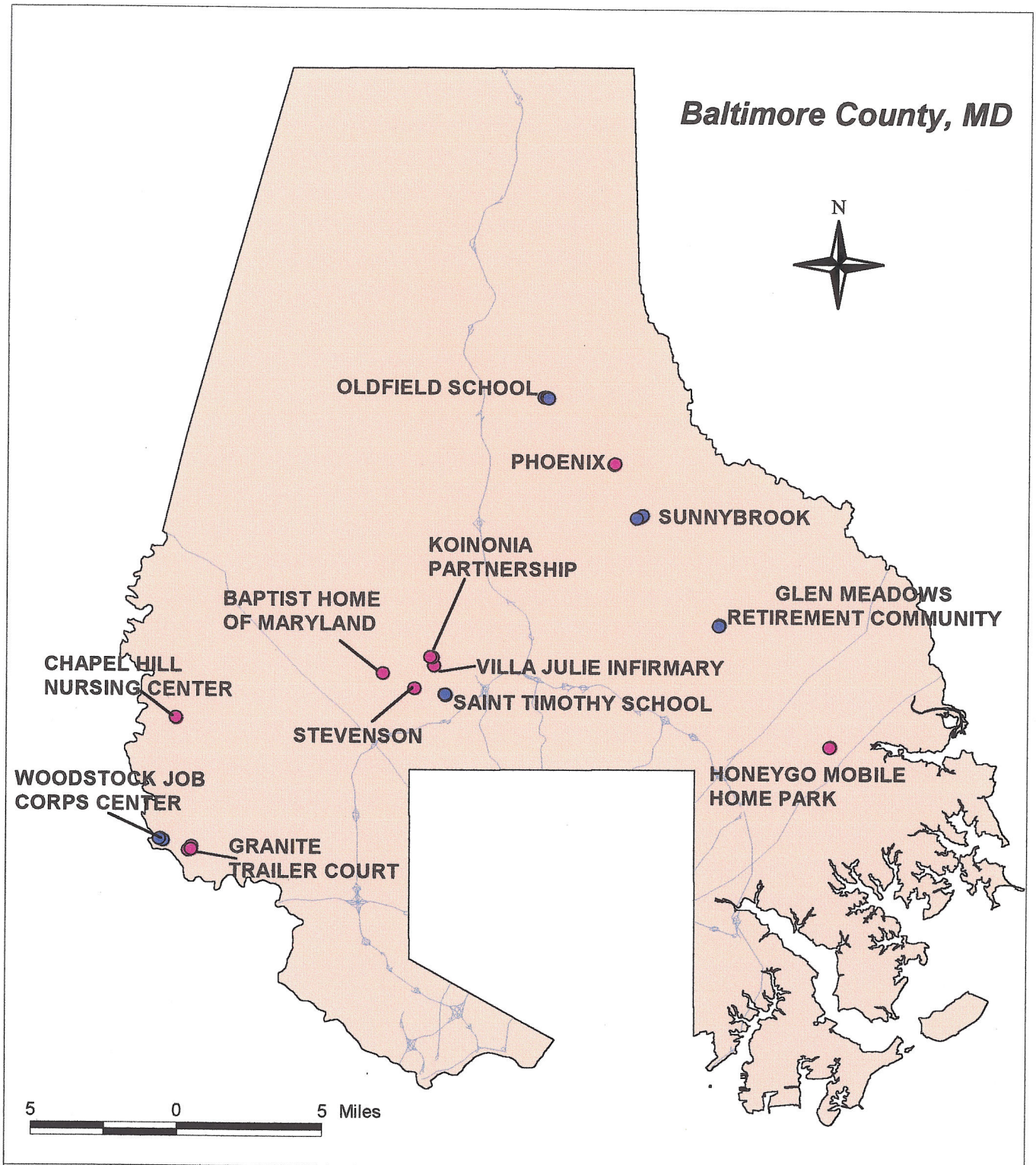
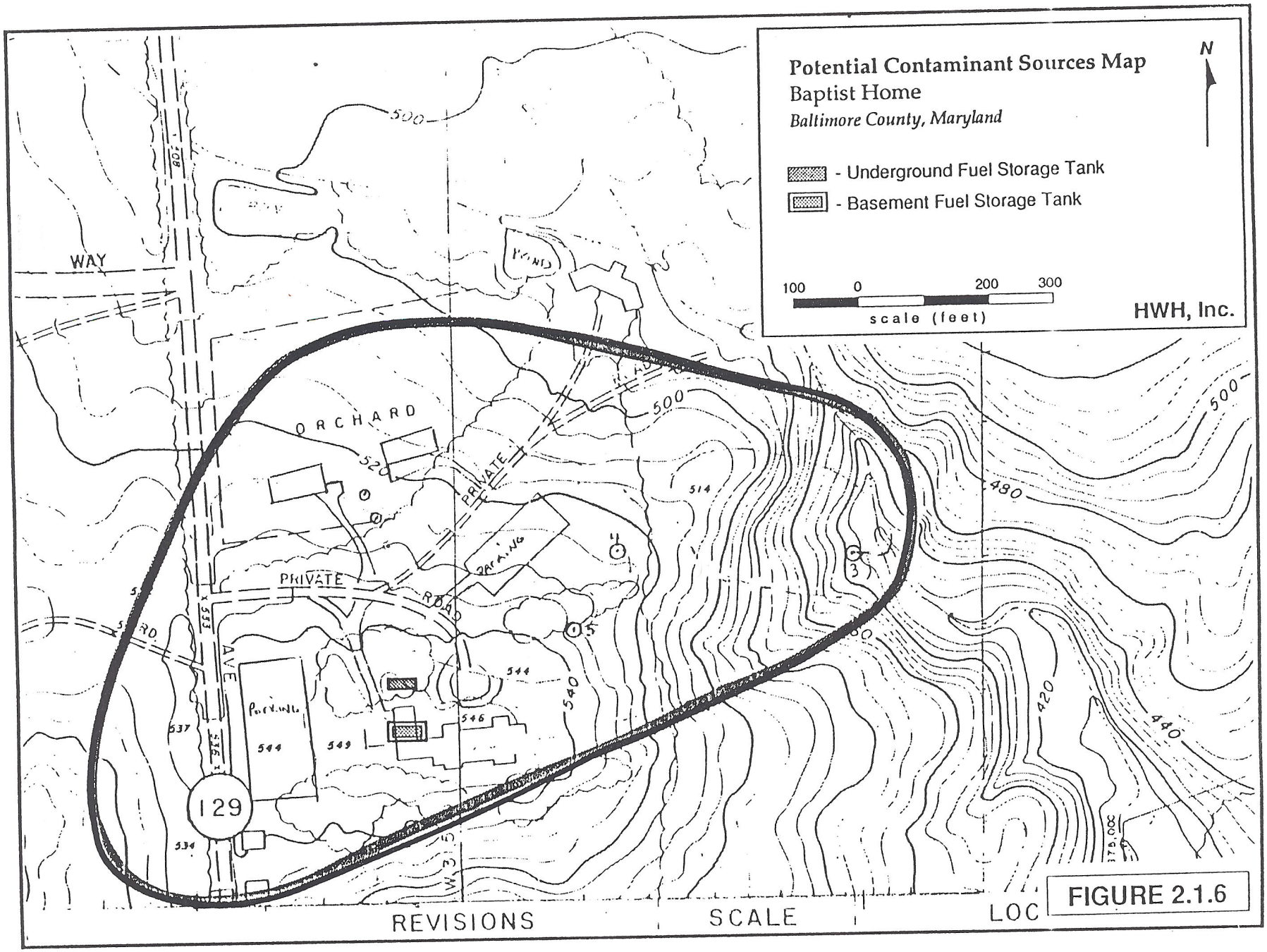


Figure 1. Location Map of Baltimore County Community Water Systems.

- Small Water Systems - SWAPs covered in this report
- Larger Water Systems - SWAPs covered under individual reports

APPENDIX A


Potential Contaminant Sources Map
Baptist Home
Baltimore County, Maryland
N
- Underground Fuel Storage Tank
- Basement Fuel Storage Tank
100 0 200 300
scale (feet)
HWH, Inc.
WAY
ORCHARD
PRIVATE
PRIVATE
ROAD
AVE
129
500
520
514
480
420
440
540
544
546
549
537
534
REVISIONS
SCALE
LOC
FIGURE 2.1.6