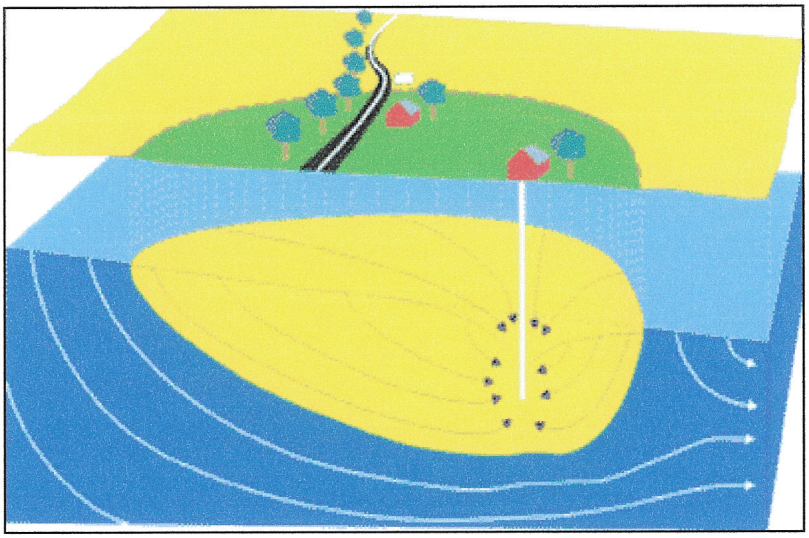
SOURCE WATER ASSESSMENT
for
BAIS YAAKOV SCHOOL AND VILLA JULIE COLLEGE
BALTIMORE COUNTY, MD



Prepared By
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SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for Bais Yaakov School for Girls and Villa Julie College. The required components of this report as described in Maryland's Source Water Assessment Plan (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 to the two systems are unconfined fractured rock aquifers known as the Loch Raven Schist and the Cockeysville Marble. The Cockeysville Marble is also a carbonate rock aquifer. The systems currently use five wells to obtain their drinking water. The Source Water Assessment Areas were delineated by the Water Supply Program using U.S. EPA approved methods specifically designed for each source.

Potential sources of contamination within the assessment area were identified based on site visits, database reviews and land use maps. Well information and water quality data were also reviewed. Figures showing land uses and potential contaminant sources within the Source Water Assessment Area and an aerial photograph of the well locations are enclosed at the end of the report.

The susceptibility analysis for the two water supplies is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that the Bais Yaakov School water supply is not susceptible to contamination by inorganic compounds, volatile organic compounds, synthetic organic compounds, or microbiological contaminants. The Villa Julie College water supply is susceptible to nitrate, and maybe to microbiological contaminants (Wells 1 and 2), but not to volatile organic compounds, synthetic organic compounds or other inorganic compounds.

INTRODUCTION

The Water Supply Program has conducted a source water assessment for Bais Yaakov School for Girls and Villa Julie College water systems in north central Baltimore County (figures 1 and 4). Since both these facilities are in the same vicinity and have similar water uses they were assessed together. Each of these water systems is considered a nontransient noncommunity (NTNC) water system, which is defined as a public water system that regularly serves at least 25 of the same individuals over six months per year. Both facilities own and operate their water supply system. Bais Yaakov School serves 940 persons and Villa Julie College serves 1,313 persons.

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. Bais Yaakov School is mainly served water by one well (No.1). Well 2 is a standby well and only used sparingly if needed. Villa Julie College is served by three wells (Nos. 1, 2 and 3). A review of well data and sanitary surveys of the two water systems indicates that all the wells were drilled after 1973, when the State's well construction regulations went into effect, and should be in compliance with current well construction standards. Only Well No 1could be located during a site visit on March 8, 2006, to Bais Yaakov School, but school staff were able to locate Well No. 2 later in the day. Well No. 1 looked to be in good condition and had a new well cap and casing about 1 ft above grade meet current standards. Villa Julie College's Well No 1 and 2 are in pits and Well No. 3 at the edge of a parking lot with casing 1.5 feet above grade. The casing is not protected from accidental damage from traffic. Well information for the two water systems is shown in Tables 1a and 1b. below.

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH (ft)	CASING DEPTH (ft)	YEAR DRILLED	AQUIFER
01	Bais Yaakov 1	BA733724	200	21	1976	Loch Raven Schist
02	Bais Yaakov 2	BA733662	200	N/A	1976	Loch Raven Schist

Table 1a. Well Information for Bais Yaakov School

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH (ft)	CASING DEPTH (ft)	YEAR DRILLED	AQUIFER
01	Villa Julie College 2	BA810564	200	42	1982	Cockeysville Marble
02	Villa Julie College 3	BA815471	200	45	1986	Cockeysville Marble
03	Villa Julie College 1	BA943047	200	46	1988	Cockeysville Marble

Table 1b. Well Information for Villa Julie College

Bais Yaakov has a Water Appropriation Permit that allows it to use an average of 10,3000 gallons per day (gpd) and 15,500gpd in the month of maximum use. Based on reported pumpage for the past three years, the facility has used an average of 3,700 gpd. Villa Julie College has a Water Appropriation Permit that allows it to use an average of 60,000 gpd and 100,000 gpd in the month of maximum use. Based on reported pumpage for the past three years the facility has used an average of 24,650 gpd.

HYDROGEOLOGY

Bais Yaakov School and Villa Julie College are located within the Piedmont physiographic province which is characterized by gently rolling hills and valley. The bedrock underlying the Piedmont is some of the oldest in the State and consists of Precambrian and Paleozoic metamorphic and igneous rocks. All the aquifers in the Piedmont are unconfined fractured-rock aquifers. Ground water systems in crystalline rock tend to be localized and flow is within topographic divides towards the nearest perennial streams. (Bolton, 1998). In this type of setting, the underlying crystalline rocks have negligible primary porosity and permeability and ground water is stored in and moves through fractures in the rocks. Ground water flow rates depend upon the openness of the fractures and their degree of interconnection. Unconsolidated overburden (saprolite) above the crystalline rock frequently has much greater primary porosity and permeability than the rock has, allowing additional ground water to be stored (Duigon, 1994). Ground water flow in carbonate rock is dominated by solution enlarged fractures and bedding planes. Soil cover and overburden is generally thin or non-existent, due to dissolution of the minerals that make up the rock, causing ground water to infiltrate rapidly from the surface to the water table. Usually the most productive wells are found in this type of aquifer due to flow through conduits formed by solution enlarged fractures. A brief description of the two aquifers used by these systems follows.

Loch Raven Schist

The Loch Raven Schist is the aquifer used by the Bais Yaakov School. It is a uniform, medium-grained biotite-plagioclase-muscovite-quartz schist with pods of vein quartz (Crowley, 1976). It is interpreted to be the metamorphosed equivalent of shale.

Cockeysville Marble

The Cockeysville Marble is the aquifer used by Villa Julie College. It is a completely crystalline marble, ranging from a poorly cemented, coarsely crystalline calcite to a fine-grained dense dolomite. The calcareous and dolomite phase are interbedded (Dingman, et al, 1956).

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment area for the system. The source water

assessment area for public water systems with an average appropriation amount of greater than 10,000 gpd and drawing from fractured-rock aquifers is the watershed area that contributes to the well. This area is modified by geological boundaries, ground water divides and by annual average recharge needed to supply the well (MD SWAP, 1999). The delineated WHPA represents the areas which contribute ground water to the wells. The total area for Bais Yaakov is 62 acres (fig. 2) and for Villa Julie (fig. 5) is 132 acres. Both these areas are more that sufficient to support the daily permitted average even under drought conditions.

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, ground water discharge permits, large scale feeding operations and Superfund sites. These sites are generally associated with commercial or industrial facilities that use chemical substances that may, if inappropriately handled, contaminate ground water via discrete point location. Non-point sources of contamination are associated with certain types of land use practices such as the 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 as well as a field survey revealed two point sources of contamination in the Bais Yaakov WHPA (fig 2) and one in the Villa Julie WHPA (fig. 5). A 10,000-gallon underground storage tank (UST) for heating oil, and an old dump site (DUMP) were identified in the Bais Yaakov WHPA. A science laboratory (LAB) was identified in the Villa Julie WHPA. Table 2 lists the facilities identified and their potential types of contaminants. Potential contaminants are grouped as Volatile Organic Compounds (VOC), Nitrate (NN), Metals (M) and Microbiological Pathogens (MP)

ID	Type	Site Name	Address	Potential Contaminant	Comments
A	UST	Bais Yaakov School	11111 Park Heights Ave	VOC	10,000 gallon –heating oil
B	DUMP	Bais Yaakov School	11111 Park Heights Ave	VOC, M	Former dump site for appliances and equipment
C	SEPT	Bais Yaakov School	11111 Park Heights Ave	MP, N	7 Onsite Septic Fields
D	LAB	Villa Julie College	1525 Greenspring Ave.	M	Located in Science Bldg

Table 2. Potential Contaminant Sources within Bais Yaakov and Villa Julie WHPAs (see figures 2 & 5 for locations).

Non-Point Sources

The Maryland Department of Planning's 2002 digital land use map for Baltimore County was used to determine the predominant types of land use in the WHPAs (figures 3 and 6). Table 3a and 3b show the land use categories within the WHPAs for Bais Yaakov School and Villa Julie College, respectively. The

largest portion of the Bais Yaakov WHPA is institutional land (school property) followed by residential properties. The major portion of the Villa Jullie College WHPA is cropland.

LAND USE CATEGORIES	TOTAL AREA (Acres)	PERCENTAGE OF WHPA
Low Density Residential	21.02	34.0
Institutional	35.12	56.7
Pasture	5.76	9.3
Total	61.90	100.00

Table 3a. Land Use Summary for the Bais Yaakov School WHPA.

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	1.29	0.9
Institutional	45.35	34.4
Cropland	70.07	53.1
Forest	15.26	11.6
Total	131.97	100.00

Table 3b. Land Use Summary for the Villa Julie College WHPA

Agricultural land (cropland and pasture) is a common source of nitrates in ground water. Cropland represents a potential source of SOCs depending on use of pesticides and herbicides. Commercial properties may be a source of nitrates and SOCs if fertilizers (nitrates) and pesticides (SOCs) are not used carefully for landscaping activities. Residential areas also may be sources of nitrates and SOCs if fertilizers and pesticides are not used carefully for lawns and gardens

A review of the Maryland Department of Planning's 2002 Baltimore County Sewer Map indicates that there is no planned sewer service for the either of the two WHPAs. Bais Yaakov School has seven on-site septic fields located in front of the school upgradient of the supply wells (figure 2). Residential properties surrounding the school also have on-site septic systems for waste disposal. Onsite septic systems may be potential sources of the nitrates to the supply wells. Villa Julie College has a wastewater treatment plant that discharges treated wastewater to a stream located outside the WHPA. Residential and farms surrounding the College use on-site septic systems for waste disposal.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database and system files for Safe Drinking Water Act 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 at or greater than 50% of a MCL, this assessment will describe the sources of such a contaminant and, if possible, locate the specific sources which may be the cause of the elevated

contaminant level. All data reported is from the finished (treated) water unless otherwise noted. The only treatment that the Bais Yaakov School water system currently uses ph adjustment is for corrosion control. The Villa Julie College water system uses ion exchange for softening water, ph adjustment for corrosion control and hypochlorination for disinfection.

A review of the monitoring data since 1993 for Bais Yaakov School and Villa Julie College indicates that both systems meet the current drinking water standards. The water quality sampling results are summarized in Table 4a and 4b.

	Nitrate		SOCs		VOCs		IOCs (except nitrate)	
PLANT NO	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL
01	47	0	3	0	10	0	5	0

Table 4a. Summary of Water Quality Samples for the Bais Yaakov School Water Supply.

	Nitrate		SOCs		VOCs		IOCs (except nitrate)	
PLANT NO	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL
01	25	6	6	0	7	0	10	0

Table 4b. Summary of Water Quality Samples for the Villa Julie College Water Supply.

Inorganic Compounds (IOCs)

Nitrate was the only IOC detected above 50% of the MCL in the Villa Julie College water system. No IOCs above 50% of the MCL were detected in Bais Yaakov water system. The MCL for nitrate is 10 ppm and table 5 displays the nitrate results above 50% of the MCL. A review of the data shows a slight decreasing trend in the nitrate levels. Nitrate has been detected in Bais Yaakov's water supply but at levels below the MCL. The average of 45 samples for nitrate is 1.7 mg/l.

PWSID	PLANT ID	CONTAMINANT	SAMPLE DATE	RESULT (mg/l)
1030042	01	NITRATE	2-Jan-98	7.5
1030042	01	NITRATE	2-Jan-98	8.2
1030042	01	NITRATE	7-Jan-99	5.1
1030042	01	NITRATE	17-Jul-00	7.2
1030042	01	NITRATE	28-Jan-05	6
1030042	01	NITRATE	28-Jan-05	5.9

Table 5. IOCs detected above 50% of the MCL for the Villa Julie College Water Supply

Volatile Organic Compounds (VOCs)

No VOCs above 50% of the MCL have been detected in either Bais Yaakov School or Villa Julie College Center's water supply. The only VOCs detected in Villa Julie College's water supply were low levels of trihalomethanes (THMs). THMs are disinfection byproducts that are formed as a result of the reaction between chlorine used for disinfection and natural organic matter in the water supply.

Synthetic Organic Compounds (SOCs)

Di(ethylhexyl)phthalate was the only SOCs that was detected one time above 50% of the MCL in the Village Julie College water supply. It was detected at 3.38 ppb in a sample collected on June 28, 1995. Phthalate was also detected in the laboratory blank collected that same day. Hence the phthalate detection is not believed to represent the water quality. No SOCs above 50% of an MCL were detected in the Bais Yaakov School water supply. The only SOCs detected one time were di(ethylhexyl)phthalate at 0.8ppb (2/6/96) and pentachlorophenol at 0.07 ppb (11/21/00). The phthalate was also found in the laboratory blank and is not believed to represent the water quality. Pentachlorophenol has an MCL of 1 ppb.

Microbiological Contaminants

Ground water under the influence of surface water (GWUDI) testing was conducted for the Bais Yaakov School Well No. 1 and all the Villa Julie College wells. GWUDI testing requires collection and analysis of raw water samples for bacteria (total and fecal coliform0, temperature, pH and turbidity at any time for wells with low risk to surface water influence and after rainfall of at least 0.5 inches for high-risk wells. Bais Yaakov School's sources are considered low risk and Villa Julie College's sources high risk. No coliform bacteria were detected in any of the raw water samples collected. All nontransient noncommunity systems are required to conduct quarterly routine bacteriological sampling for their water supply as required by the Safe Drinking Water Act. These samples are generally collected from finished (treated) water, which may not be indicative of the source water conditions. There were only two total coliform bacteria detections out of the forty bacteriological samples collected for Bais Yaakov School. No detections were found in the repeat samples. There were only two total coliform bacteria detections out of the 105 bacteriological samples collected for Villa Julie College. No detections were found in the repeat samples.

SUSCEPTIBILITY ANALYSIS

The wells supplying Bais Yaakov School and Villa Julie College obtain water from an unconfined fractured-rock aquifer. Wells in unconfined aquifers are generally vulnerable to any activity on the land surface that occurs within the WHPA. Therefore, managing this area to minimize the risk to the supply and continued routine monitoring of contaminants is essential in assuring a safe drinking water supply. The susceptibility of the wells to contamination is determined for each

water supply. The susceptibility of the wells to contamination is determined for each group of contaminants based on the following criteria: (1) available water quality data, (2) presence of potential contaminant sources in the WHPA, (3) aquifer characteristics, (4) well integrity, and (5) the likelihood of change to the natural conditions.

Vulnerability will vary based on the specific rock type comprising the aquifer. Wells that draw water from carbonate formations are generally more vulnerable to activity on the land surface due to thin soil cover and development of karst features. 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 However, in carbonate formations, the saprolite may not provide sufficient natural filtration because dissolution of minerals comprising the bedrock often leaves little overburden above the bedrock. The susceptibility of the two water supplies to the various types of contaminants is summarized in Table 6a and 6b.

Inorganic Compounds (IOCs)

Nitrate was the only IOC detected above 50% of the MCL in Villa Julie College's water supply. A review of the nitrate data shows a slight decreasing trend in nitrate levels. Sources of nitrate can generally be traced to land use. Fertilizer applied to agricultural fields, and the Villa Julie property for landscaping, are source of nitrate loading in ground water. The entire WHPA is in an area not planned for public sewer. The college has a wastewater treatment plant for waste disposal but other properties have onsite septic systems for waste disposal. Onsite septic systems in the WHPA are also sources of nitrate in ground water. No IOCs above 50% of an MCL were detected in Bais Yaakov School's water supply. There are seven on site septic fields in Bais Yaakov's WHPA, but nitrate levels at Bais Yaakov have stayed steady at levels well below 50% of the MCL. There is considerable distance, about 1000 feet, between these potential sources and the production wells, and a lot of forested land around the wells to reduce the potential impact from on-site disposal activity.

Based on above discussion Bais Yaakov's water supply **is not** susceptible to inorganic compounds. Villa Julie College's water supply **is** susceptible to nitrates, but not to other inorganic compounds.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of an MCL have been detected in either Bais Yaakov School or Villa Julie College water supplies since 1993. There are two potential sources of VOC contamination in the WHPA for Bais Yaakov School (figure 2), and one for the Villa Julie WHPA. A review of the water quality data indicates that these sources have not had an impact on the water supply.

Based on the above discussion, both Bais Yaakov School and Villa Julie College water supplies **are not** susceptible to VOC contamination.

Synthetic Organic Compounds (SOCs)

No SOCs above 50% of an MCL have been detected in either Bais Yaakov School or Villa Julie College water supplies. Pentachlorophenol was detected one time in Bais Yaakov School's water supply. There are no potential sources of SOCs located in the WHPAs (figure 2). Application of pesticides on the school and college properties, residential properties and cropland can be potential nonpoint sources of SOCs.

Based on the above discussion, both Bais Yaakov School and Villa Julie College water supplies **are not** susceptible to SOC contamination.

Microbiological Contaminants

Based on raw water bacteriological data the wells supplying Bais Yaakov School and Villa Julie College were determined not to be GWUDI. In addition, routine bacteriological sampling results for both systems have not shown any presence of total coliform bacteria for the past 5 years. Two of Villa Julie's College are in pits and may be subject to flooding.

Based on the above discussion both Bais Yaakov School water supplies **is not** susceptible to microbiological contaminants, but two of Villa Julie College's wells (1 and 2) **maybe** susceptible to microbiological contaminants.

CONTAMINANT TYPE	Are Contaminant Sources present in the WHPA?	Are Contaminants detected in WQ samples at 50% of the MCL	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible to the Contaminant
Nitrate	NO	YES	NO	YES	NO
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Volatile Organic Compounds	YES	NO	NO	YES	NO
Synthetic Organic Compounds	YES	NO	NO	YES	NO
Microbiological Contaminants	YES	NO	NO	YES	NO

Table 6a. Susceptibility Summary for Bais Yaakov School's water supply.

CONTAMINANT TYPE	Are Contaminant Sources present in the WHPA?	Are Contaminants detected in WQ samples at 50% of the MCL	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible to the Contaminant
Nitrate	YES	YES	NO	YES	YES
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Volatile Organic Compounds	YES	NO	NO	YES	NO
Synthetic Organic Compounds	YES	NO	NO	YES	NO
Microbiological Contaminants	YES*	NO	YES*	YES	MAYBE*

Table 6b. Susceptibility Summary for Villa Julie College's water supply.

*Wells 1 & 2 in pit

MANAGEMENT OF THE WHPA

Contaminant Source Inventory/Well Inspection

- The system owners should review the potential sources of contaminants within the WHPA and update them if necessary, including a consideration of historical uses.
- Bais Yaakov School should cleanup the former dumpsite near Well No.1 to prevent potential contaminants from getting to the well. Placing a "no dumping" sign might prevent future dumping at this site.
- Bais Yaakov School should maintain the onsite septic fields located upgradient of the wells, to ensure that they are functioning properly.
- Villa Julie College has two wells (1and 2) in pits which may be subject to flooding. It is recommended that flood-proof well caps be installed to these wells to prevent surface water from getting into the wells. Well No. 3 is in a parking lot area and the college should consider bollards should be protect the well casing from damage from vehicular traffic.
- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.

Cooperative Efforts with Other Agencies

- Work closely with Baltimore County Department of Environmental Protection and Resource Management to identify any unused wells in the WHPA and to ensure that they are abandoned and sealed in compliance with the State's well construction standards.

Bais Yaakov should locate unused Well No. 3 and abandon and seal it according to State well construction regulations.

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Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.
- Bais Yaakov should complete the GWUDI testing for Well No. 2.
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Changes in Use

- Any increase in pumpage or addition of new wells to the system may require revision of the WHPA. The system is required to contact the Water Supply Program when an increase pumpage is applied for or when new wells are being considered.

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

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

OTHER SOURCES OF DATA

Water Appropriation and Use Permits: BA1976G052 and BA1982G003
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles: Cockeysville
USGS Topographic 7.5-Minute Towson Quadrangle
Maryland Department of Planning 2002 Baltimore County Land Use Map
Maryland Department of Planning 2002 Baltimore County Sewer Map

FIGURES

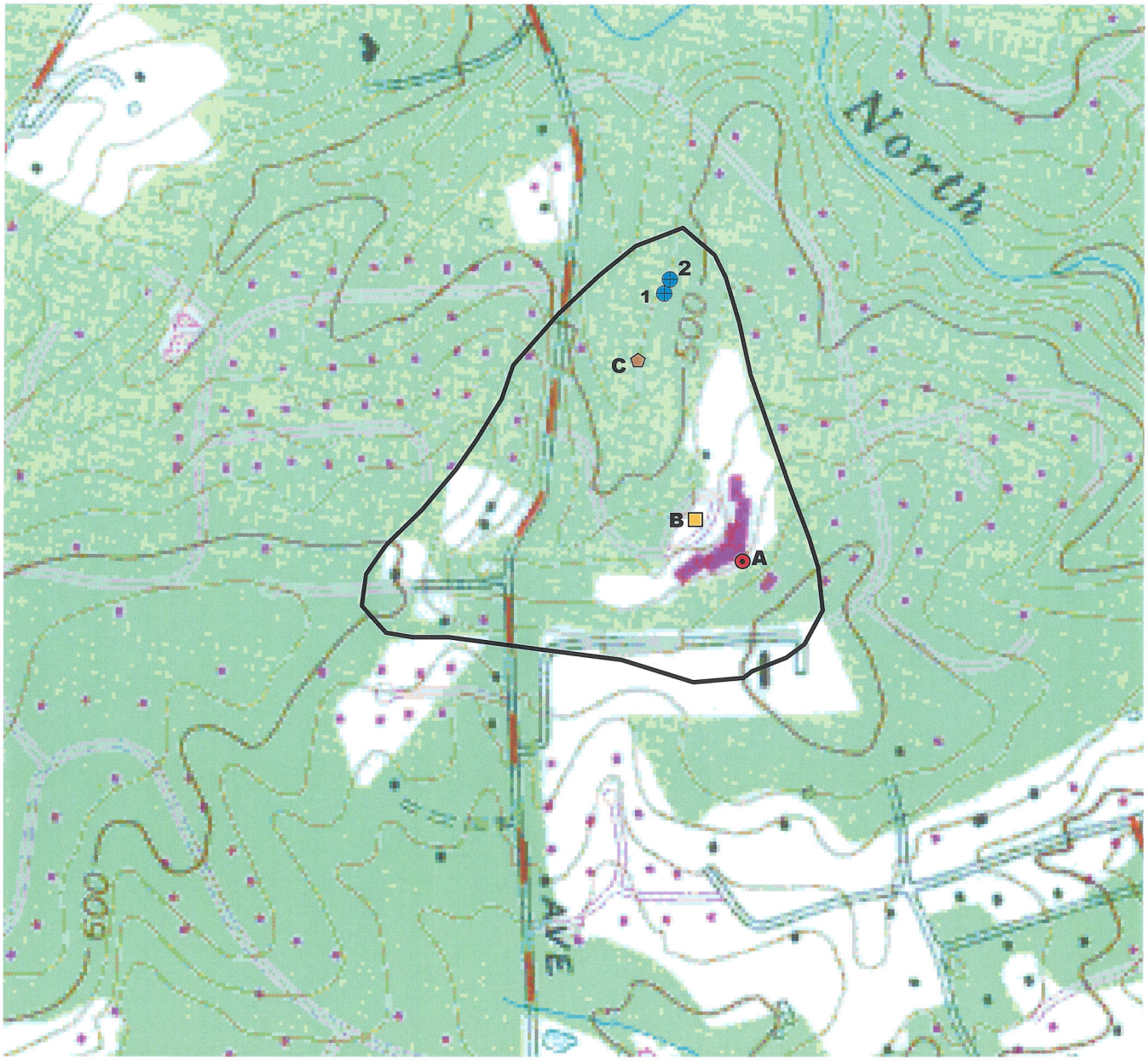

Figure 2. Wellhead Protection Area for Bais Yaakov School with Potential Contaminant Sites

LEGEND

- Underground Storage Tank
- Supply Well
- Onsite Septic
- Wellhead Protection Area
- Dump Site

500 0 500 Feet

N

Base Map: USGS 7.5 Minute Topographic Quadrangle - Towson

Figure 3. Land Use within the Bais Yaakov School Wellhead Protection Area

LEGEND

Supply Well

Land Use Categories

Low Density Residential

Institutional

Pasture

Wellhead Protection Area

500 0 500 1000 Feet

N

Base Map: USGS 7.5 Minute Topographic Quadrangle - Towson
Sourc: MD Dept. of Planning Land Use Map (2002)

Figure 6. Land Use within the Villa Julie College Wellhead Protection Area

LEGEND

- Supply Well
- Land Use Categories
  - Low Density Residential
  - Institutional
- Cropland
- Forest
- Wellhead Protection Area

500 0 500 1000 Feet

N

Base Map: USGS 7.5 Minute Topographic Quadrangle - Towson
Source: MD Dept. of Planning Land Use Map (2002)