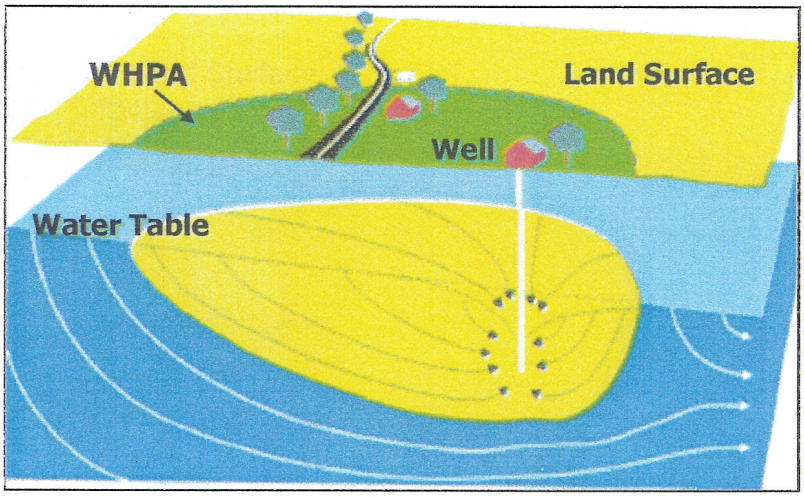
SOURCE WATER ASSESSMENT

FOR THE PERRYMAN WELL FIELD

HARFORD COUNTY, MD



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MDE

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SUMMARY

The Maryland Department of the Environment Water Supply Program (WSP) has conducted a Source Water Assessment for the Perryman Well Field. 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 source for the Perryman water supply is a semi-confined aquifer in the Coastal Plain known as the Potomac Group. The system currently uses seven wells to obtain their drinking water. Harford County also owns and operates Surface Water Plants at Abingdon and Havre De Grace. The three systems together provide the supply needed to meet the daily demands of the distribution. The source water assessment area for the Perryman wells was delineated for the Harford County Department of Public Works (DPW) using U.S. EPA approved methods specifically designed for each source.

Potential sources of contamination within the assessment area were identified from site visits, database reviews, and land use maps. Well information and water quality data were also reviewed. Figures showing land use 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 of Perryman's water supply was based on the review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that Perryman's water supply is susceptible to contamination by nitrates, volatile organic compounds (e.g. solvents and gasoline), and radionuclides, but is not susceptible to synthetic organic compounds, and microbiological contaminants.

INTRODUCTION

Perryman is located approximately 3 miles southwest of the City of Aberdeen in Harford County (Figure 1). The Perryman Well Field is the largest source of ground water in Harford County. Along with the Abingdon and Havre De Grace Surface Water Treatment Plants, it serves a population of 90,000 with about 32,000 connections. The Perryman Well Field supplies about 30% of the water demand to the total distribution system. The remainder of the supply is from the Abingdon and Havre De Grace Plants respectively. The well field area adjoins the Aberdeen Proving Ground (APG) Army Base to the southeast. This source water assessment is limited to the Perryman ground water supply only. The water is currently supplied by seven wells. Figure 1 shows the locations of the supply wells.

WELL INFORMATION

A review of the well completion reports and sanitary surveys indicate that all of the Perryman wells were drilled prior to the implementation of the State's well construction regulations in 1973. The completion reports indicate that wells 4, 5, 6, 8 and 9 were grouted to the depths of the main casing. Table 1 is a summary of the well construction data. The depth unit is in feet and the well yields are in gallons per minute (gpm).

PLANT	SOURCE NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	WELL YIELD*	AQUIFER
1	Perryman 1	HA-66-0814	103	70	130	Potomac Group
1	Perryman 2	HA-66-0813	133	80	164	Potomac Group
1	Perryman 3	HA-68-0657	146	85	201	Potomac Group
1	Perryman 4	HA-70-0086	144	92	450	Potomac Group
1	Perryman 5	HA-71-0619	107	52	915	Potomac Group
1	Perryman 6	HA-71-0613	89	50	1000	Potomac Group
1	Perryman 8	HA-71-0165	137	55	350	Potomac Group
1	Perryman 9	HA-71-0164	91	50	350	Potomac Group
* Based on pumping tests reported in Drummond & Johnston (1996) Table 5						

Table 1. Perryman Well Information

Wells 1 and 2 are located on Perryman Yard Road. Well 1 is inside the Treatment Facility and Well 2 is inside a pump house. Wells 3 and 4 are located in manhole vaults below ground surface. Well 3 has been inactive since 1992 due to elevated nitrate concentrations at this well. Wells 5, 6, 8 and 9 are in pump houses and are located along the APG fence-lined boundary. As indicated by the well yields from Table 1, Perryman Wells 4, 5, and 6 supply more than two-thirds of the total water volume from the wellfield.

HYDROGEOLOGY

Perryman's wells draw water from the Potomac Group which is a part of the Coastal Plain sediments of Harford County. The Potomac Group is of Cretaceous age and functions as a semi-confined aquifer in this area. It consists of highly variable, inter-bedded, light-colored sand, variegated silty clay, and very gravelly sand (Drummond and Blomquist, 1993). The regional ground water flow direction within the Coastal Plain sediments of Maryland is to the southeast.

The lithology of the Coastal Plain sediments in Harford County is extremely variable and aquifer boundaries do not coincide with formation boundaries. Hence, in a recent Maryland Geological Survey (MGS) study of the Coastal Plain aquifers of Harford County, the Coastal Plain sedimentary sequence was divided into four aquifers and three confining units (Drummond & Blomquist, 1993). From the shallowest to the deepest the aquifers were designated numbers 1, 2, 3 and 4. They are separated by confining units 1, 2 and 3. Based on their depths and locations the Perryman wells were determined to be in Aquifers 2 and 3.

The thickness of Aquifer 2 ranges from 0 to about 105 feet. Estimated transmissivity values from aquifer tests range from 270 to 35,000 ft^2/day (Drummond & Blomquist, 1993). Perryman Wells 1, 5, 6, 8, and 9 are screened in Aquifer 2, and wells 3 and 4 are screened across both Aquifers 2 and 3. Confining Unit 1, consisting of silt and clay with some sand lenses, overlies Aquifer 2. Based on well log data, the thickness of Confining Unit 1 in the Perryman Well Field ranges from approximately 20 feet to 77 feet. Confining Unit 1 is very thin or absent at Perryman Wells 5, 6 and 9, and in these areas, Aquifers 1 and 2 are hydraulically connected (CH2M Hill, 1997).

The thickness of Aquifer 3 ranges from 0 to about 75 feet. Transmissivity values estimated from aquifer tests range from 20 to 6500 ft^2/day (Drummond & Blomquist, 1993). Aquifer 3 supplies water to Perryman Wells 2, 3 and 4. Confining Unit 2 overlies Aquifer 3 at Perryman Well 2. It consists of silt and clay with some isolated pockets of sand and gravel. The thickness of Confining Unit 2 ranges from 0 feet near the Bush River to more than 100 feet north of Phillips Field at APG. At Perryman Wells 3 and 4, Confining Unit 2 is very thin or absent, and thus, Aquifers 2 and 3 are hydraulically connected in these areas (CH2M Hill, 1997).

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. According to Maryland's Source Water Assessment Plan document approved by EPA (MDE, 1999), systems using > 10,000 gallons per day (gpd) located in semi-confined Coastal Plain aquifers are to be delineated using MODFLOW-MODPATH three-dimensional numerical modeling. A ground water flow modeling study was conducted by the Maryland Geological Survey (MGS) within the Perryman Well Field area (Drummond & Johnston, 1997). MGS used the numerical flow

model (MODFLOW) and a semi-analytical particle-tracking code (MODPATH) to determine the ground water contribution areas to the wells.

Thirteen pumping scenarios were simulated in the MGS study including an average pumping rate of 4.2 million gallons/day (mgd) as per the current Water Appropriation and Use Permit. The results of this simulation were used in delineating the protection zones for the Perryman Well Field as part of a Harford County DPW funded Wellhead Protection Plan. Specific details concerning the ground water modeling, study area and delineation methods as well as maps showing the contributing areas and particle tracking for each well can be found in the document entitled "Perryman, Maryland Wellfield Well Head Protection Plan" (CH2M Hill, 1997).

Delineation Zones **(see Figure 2)**

Zone 1: Zone 1 is the WHPA delineated using a 3-year time-of travel (TOT) criterion. Zone 1 serves as the first zone of protection. A 1-year time of travel is generally used for source water assessments based on the maximum survival times of microbial organisms in ground water. The three-year criterion was selected for Perryman based on the first significant appearance of particles that reach Wells 4-9 from the ground surface. Zone 1 does not include contributing areas for Wells 1 and 2 because the model indicates that recharge does not reach these wells within 3 years (CH2M Hill, 1997). WHPA Zone 1 is irregularly shaped and has an area of 503.5 acres (Figure 2).

Zone 2: Zone 2 is the WHPA delineated using a 20-year TOT criterion. The conventional Zone 2 TOT used in source water assessments is 10 years. For Perryman, a 20-year travel time was selected because there is a known source of chemical contamination at APG that lies within the 20-year TOT and outside the 10-year zone. Additionally, it is important to include Well 2 within the Zone 2 WHPA. The model results indicate that the contributing area for Well 2 lies outside a 10-year TOT zone (CH2M Hill, 1997).

Any contaminant present at the Perryman Zone 2 WHPA boundary would take 20 years to reach the well (if it moves at the same rate as the ground water), and the wells are pumped at the permitted quantity. Zone 2 provides adequate time for facilities to address chemical contamination before it reaches the wells. The Zone 2 WHPA is irregularly shaped, is oriented to the northeast, and has an area of 2,535.6 acres (Figure 2).

Zone 3: Zone 3 is the WHPA that lies within the total contributing area of the well field. The area represents the model simulation where particles ultimately reach the wells after 20 years and up to 400 years. Additionally, the Zone 3 WHPA provides protection for Well 1, whose contributing area falls outside of Zones 1 and 2 (CH2M Hill, 1997). The Zone 3 WHPA is irregularly shaped and extends northeast to the City of Aberdeen's WHPA (Figure 2). The total area of the Zone 3 WHPA is 3,443.3 acres.

POTENTIAL SOURCES OF CONTAMINATION

For this assessment, MDE Waste and Water Management databases were reviewed, staff consulted, and field inspections conducted, to identify potential sources of contamination in and around the Perryman WHPA. In addition, on July 12, 2000, MDE staff completed a field survey of the Perryman WHPA and wells, and interviewed the Chief of Operations at the Perryman Water Treatment Plant, Mr. Wayne Ludwig regarding any water quality concerns and potential ground water contamination sources in the area. The primary water quality concern discussed for this system is from known chemical contamination at APG. This will be discussed later in the report.

Potential contamination sources that were investigated for this WHPA include: ground water contamination sites (GWC), underground storage tanks (USTs), leaking underground storage tanks (LUSTs), controlled hazardous substance generators (CHS), discharge permits (DP) that may potentially affect ground water, solid waste facilities (SWF), and sludge application sites (SAS). Miscellaneous sites (MISC) include commercial buildings with chemical storage, vehicle maintenance facilities, and pesticide dealers. Table 2 lists the applicable sites identified within the Perryman WHPA and their potential sources of contaminants. The potential contaminant groups shown in Table 2 are volatile organic compounds (VOCs), synthetic organic compounds (SOCs), heavy metals (HM), nitrate/nitrite (NN), and microbiological pathogens (MP).

ID	TYPE	SITE NAME	ADDRESS	POTENTIAL CONTAMINANT
1	GWC	Aberdeen Fire Training Ctre.	APG	VOC,SOC,HM
2	LUST,UST,CHS,SWF,DP	Price Brothers	1501-1521 Perryman Rd.	VOC,HM,SOC
3	LUST	Perryman Grocery	1551 Perryman Rd.	VOC
4	LUST, UST	Anderson Automotive	1615 Perryman Rd.	VOC
5	UST,MISC	R&K Automotive	819 S. Philadelphia Blvd.	VOC, HM
6	UST	Ryder Trucks	911 Old Philadelphia Rd.	VOC
7	CHS	Clorox	1319 Perryman Rd.	VOC, HM
8	SWF	Perryman Landfill	Perryman Rd.	VOC,HM,SOC,NN,MP
9	SAS	Mitchell Agricultural Fields	NE of Michaelsville Rd.	MP,NN,HM
10	MISC	Beaver's Auto Body	S. Philadelphia Blvd.	VOC, HM
11	MISC	Wal-Mart	645 S. Philadelphia Blvd.	VOC, HM
12	MISC	Price Trucking	823 Old Philadelphia Rd.	VOC, HM
13	MISC	Fowler Distributing Co.	921 Old Philadelphia Rd.	VOC,HM
14	MISC	Tool & Die Specialties	1005 Old Philad. Rd.	VOC,HM,SOC
15	MISC	Super-Valu Warehouse	504 Advantage Ave.	VOC, MP
16	MISC	Rite-Aid Warehouse	Chelsea Rd.	VOC,HM

Table 2. Potential Contaminant Point Sources Within or Near the Perryman WHPA (see Figure 2)

The groups are based on generalized categories and often the potential contaminant depends on the specific chemicals and processes being used at the facility. The potential contaminants for an activity may not be limited to those listed. There may be additional unidentified sites within the WHPA that are currently not inventoried. The sites that have

had known contaminant releases are described below. Brief descriptions of other relevant sites can be found in Appendix A. For additional information on any of the facilities listed, the reader may contact the specific programs within the MDE Waste Management Administration.

Perryman Wells 5 and 6 have been contaminated with trichloroethylene (TCE). The probable contaminant source is from the Aberdeen Fire Training Center (AFTC). The AFTC is located at APG, approximately 1.5 miles to the northeast of Wells 5 and 6, and is in the Perryman WHPA Zone 2 (Figure 2). The U.S. Army installed a granular activated carbon (GAC) treatment system in 1993 to remove TCE from the distribution system for Wells 5, 6, 8 and 9 (Figure 1).

An open LUST case (No. 91-0533HA) is currently under investigation by the MDE Oil Control Program at the Perryman Grocery at 1551 Perryman Road. A former petroleum tank field was removed and four monitoring wells were installed. Several years ago, high dissolved levels of petroleum product were detected in one of the wells. Reports indicate that the contaminants are localized on-site. The case remains open to date and is still under MDE review.

The Oil Control Program investigated a LUST site (Case No. 92-2195HA) at the Price Brothers Facility at 1521 Perryman Road. Several petroleum USTs and LUSTs were removed from the site and a ground water monitoring well was installed. Contaminated soils on-site were excavated and removed. Recent monitoring well results showed no detects of VOCs. Therefore, the Oil Control Program closed the case on 4/27/99.

LUST Case No. 91-1198HA at the Anderson Automotive (1615 Perryman Road) was also investigated and reviewed by the Oil Control Program. Seven underground storage tanks were removed and one monitoring well was installed and sampled. Based on low-levels of petroleum hydrocarbons in sampling results, the Oil Control Program closed the case on 8/6/98.

Other sources within the WHPA that may potentially contaminate the Coastal Plain aquifers are unregulated residential heating oil USTs, the application of deicing chemicals on roads, and the AMTRAK railroad line that runs through Perryman. Transportation lines are a concern in the event of a petroleum or chemical spill that occurs within the WHPA. The weapons and munitions testing activities and USTs at the military base also pose a potential contaminant risk to the water supply since most of the WHPA lies within the APG property limits (see Appendix A). Additionally, fertilizers and sludge applied to nearby cropland and residences with on-site septic systems are potential non-point sources of nitrates. Pesticides and herbicides used in agriculture and lawn maintenance are potential non-point sources of synthetic organic compounds (SOCs).

A field inspection was conducted within and near the WHPA to determine the potential of any unpermitted ground water discharges (e.g. open floor drains) to the Coastal Plain aquifers. Facilities located within and near the WHPA were inspected. They include a pre-stressed concrete pipe manufacturer, 2 auto repair/maintenance service centers, a

warehouse, a marina, an electrical power plant, and the Sod Run Waste Water Treatment Plant. No violations were found or issued to any of the facilities visited.

Based on the Maryland Office of Planning's 1997 Land Use Map, the land use within WHPA Zones 1 and 2 is as follows:

LAND USE	TOTAL AREA (Acres)	PERCENT OF WHPA
Low Density Residential	66.9	3
Medium Density Residential	20.8	1
Commercial	1415.4	56
Industrial	132.6	5
Open Urban Land	53.0	2
Cropland	656.0	26
Pasture	5.3	< 1/4
Forest	182.6	7
Wetlands	3.0	< 1/8

Table 3a. Land Use Summary Within WHPA Zones 1 & 2

The land use within WHPA Zone 1 only is as follows:

LAND USE	TOTAL AREA (Acres)	PERCENT OF WHPA
Low Density Residential	14.2	3
Commercial	374.6	74
Industrial	0.1	< 1/16
Cropland	114.6	23

Table 3b. Land Use Summary Within WHPA Zone 1 Only

The breakdown of land use within the WHPA is shown in Figure 3. Note that the large percentage of commercial lands shown in Tables 3a and 3b is primarily from the federal facility property at APG (Figure 3).

A review of the Maryland Office of Planning 1994 Harford County Sewerage Coverage Map shows that 66% of the land area within WHPA Zones 1 and 2 have no plans for public sewerage. Figure 4 indicates that these areas are primarily on the APG property. The remaining 34% of land area is in the existing or planned service area (Figure 4). Due to a change in Harford County's zoning ordinance, development is expected to increase for a portion of the area within the Perryman WHPA from agricultural to industrial land use (CH2M Hill, 1997). Figure 4 shows that present agricultural areas near Wells 5, 6, 8, and 9 are within the planned sewer service area. New development may introduce additional potential contaminant sources to the water supply, will increase the amount of paved surface in the area, and may reduce recharge to the wells.

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 data described is from the finished (treated) water and raw water as noted. The treatment currently used at Perryman is gaseous chlorination for disinfection, soda ash for pH adjustment, phosphoric acid for corrosion control, and fluoridation. The GAC system removes TCE from contaminated Wells 5, 6, 8 and 9 (Figure 1). Note that production Wells 1-4 are currently not connected to the GAC system.

In accordance with Maryland's SWAP, data from the treatment plant was compared with the Maximum Contaminant Levels (MCLs). If the monitoring data is greater than 50% of a MCL, the written 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. A review of the monitoring data since 1992 for Perryman's finished water indicates that the system's water supply meets the drinking water standards

Inorganic Compounds (IOCs)

The only IOC that has been detected above 50% of the MCL since 1993 is nitrate. Table 4 summarizes the nitrate detects above 50% of the MCL for the Perryman Wells.

CONT. ID	CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT
1040	NITRATE	10	26-Jul-93	9.9
1040	NITRATE	10	26-Aug-93	5.1
1040	NITRATE	10	28-Oct-93	9.3
1040	NITRATE	10	29-Jun-95	5.3
1040	NITRATE	10	30-Apr-96	5.1
1040	NITRATE	10	16-May-96	5
1040	NITRATE	10	05-Feb-97	5.4
1040	NITRATE	10	25-Mar-98	5.3
1040	NITRATE	10	06-May-98	5.3
1040	NITRATE	10	14-Jul-98	5.2
1040	NITRATE	10	03-Nov-98	5.1
1040	NITRATE	10	15-Jul-99	5
1040	NITRATE	10	15-Feb-00	5.6
1040	NITRATE	10	09-May-00	5.59

Table 4. IOC Results Above 50% of the MCL for the Perryman Wells Since 1993

The MCL for nitrate is 10 ppm. The nitrate detections range from 1.1 - 9.9 ppm respectively. The average nitrate value since 1993 is 4.5 ppm.

Volatile Organic Compounds (VOCs)

The system has had numerous detects of volatile organic compounds (VOCs), particularly TCE, in ground water samples from Wells 5 and 6 since 1992. TCE detects above 50% of the MCL in finished water occurred in 1992 and 1993. MDE issued

letters in 1992 prior to the installation of the GAC system requiring the County to begin quarterly monitoring for VOCs as a result of detections above 0.5 parts per billion (ppb). Table 5a summarizes the VOC results above 50% of the MCL for Perryman's finished water since 1992.

CONT. ID	CONTAMINANT NAME	MCL (ppb)	SAMPLE DATE	RESULT (ppb)
2984	TRICHLOROETHYLENE	5	13-Oct-92	3.4
2984	TRICHLOROETHYLENE	5	09-Dec-92	3.0
2984	TRICHLOROETHYLENE	5	19-May-93	2.5

Table 5a. Finished Water VOC Results Above 50% of the MCL for the Perryman Wells Since 1992

Other finished water VOCs that have been periodically detected below the 50% MCL threshold since 1992 are trichloroethylene (TCE), methylene chloride, and 1,2,4-trichlorobenzene.

Harford County has also continued special annual raw water VOC sampling for the Perryman Wells due to the ongoing TCE detects exceeding the MCL at Wells 5 and 6. Continued routine GAC performance sampling is also performed. Table 5b shows raw water TCE results for Perryman Wells 4, 5, and 6 since 1995.

CONT. ID	CONTAMINANT NAME	MCL (ppb)	SAMPLE DATE	Well 4 (ppb)	Well 5 (ppb)	Well 6 (ppb)
2984	TCE	5.0	18-Dec-95	ND	2.2	1.4
2984	TCE	5.0	17-Jan-96	ND	2.5	
2984	TCE	5.0	01-May-96	ND	2.9	12.0
2984	TCE	5.0	28-Jan-97	ND	2.4	9.7
2984	TCE	5.0	19-Feb-97	ND	2.3	9.2
2984	TCE	5.0	23-Jan-98	ND	2.5	7.6
2984	TCE	5.0	19-Jan-99	ND	2.5	7.4
2984	TCE	5.0	08-Feb-99		2.7	8.9
2984	TCE	5.0	06-Jul-99		3.6	8.0
2984	TCE	5.0	03-Sep-99		3.5	7.4
2984	TCE	5.0	18-Jan-00	ND	4.1	7.8
2984	TCE	5.0	01-Feb-00		4.6	7.7

Table 5b. Raw Water TCE Results for Perryman Wells 4,5 and 6 since 1995

Other VOCs that have been detected periodically in sampling results are the disinfection by-products known as trihalomethanes (THMs). Disinfection by-products are the result of a reaction between chlorine used for disinfection and organic material in the water supply. Elevated levels of THMs are typically detected in finished water at Surface Water Plants. Since Harford County uses surface water to supplement their supply, the periodic total THM detects that are above 50% of the MCL likely are attributed to the surface water in the distribution.

Synthetic Organic Compounds (SOCs)

DI (2-Ethylhexyl) phthalate was detected above 50% of the MCL on 1/23/98 at 3.3 ppb. The MCL for this SOC is 6 ppb. Other periodic detects of DI(2-Ethylhexyl) phthalate were well below the 50% MCL threshold. Low levels of phthalate ester are often found in the laboratory blanks and therefore probably do not represent actual water quality of the system.

The only other SOC finished water detection from previous sets of samples since 1993 was dalapon. The result was well below the 50% MCL threshold.

A pesticide survey was conducted by MDE in February 1994 for Perryman Wells 2, 4, 5, 6, 8, and 9. Heptachlor and heptachlor epoxide was detected in raw water results for Well 2. The results were well below 50% of the MCL for these SOCs. Atrazine and heptachlor epoxide was detected in raw water samples for Well 9. These results were also well below the 50% MCL threshold for these contaminants. SOCs were not detected in any of the other wells tested for this survey.

Radionuclides

Gross alpha was detected at 3 picocuries per Liter (pCi/L) on 5/23/00. The MCL for gross alpha is 15 pCi/L. Gross beta was detected on the same day at 3 pCi/L. The MCL for gross beta is 50 pCi/L. Radon-222 was detected at 195 pCi/L (5/9/94) and at 190 pCi/L (5/22/97). There is currently no MCL for radon-222, however EPA has proposed a MCL of 300 pCi/L or an alternate MCL of 4,000 pCi/L. MDE is waiting for EPA's final rule to determine how radon will be regulated for public water systems.

A radium study was conducted by MDE in August 1998 for Perryman Well 2. This was part of a seven county survey of the occurrence and distribution of radium in specific Coastal Plain aquifers. Well 2 was tested for short-term and long-term gross alpha and gross beta activity. Short-term gross alpha was detected at 15.65 pCi/L, which is slightly above the MCL for finished water of 15 pCi/L. Short-term gross beta was detected at 18.99 pCi/L, which is well below the MCL for finished water of 50 pCi/L.

Microbiological Contaminants

Raw water sampling was conducted on 1/21/99 for the Perryman Wells to determine the sensitivity of these wells to surface water. The wells at Perryman were classified as low risk sources to surface water influence. Therefore, 1 dry weather raw water sample was collected for each production well. All results were negative for the presence of total and fecal coliform.

SUSCEPTIBILITY ANALYSIS

The criteria that was used to conduct the susceptibility analysis is as follows: (1) evaluation of available water quality data, (2) review of the contaminant sources within the WHPA, (3) evaluation of the aquifer characteristics, (4) evaluation of the well integrity, and (5) evaluation of the likelihood of change to the natural conditions.

Inorganic Compounds (IOCs)

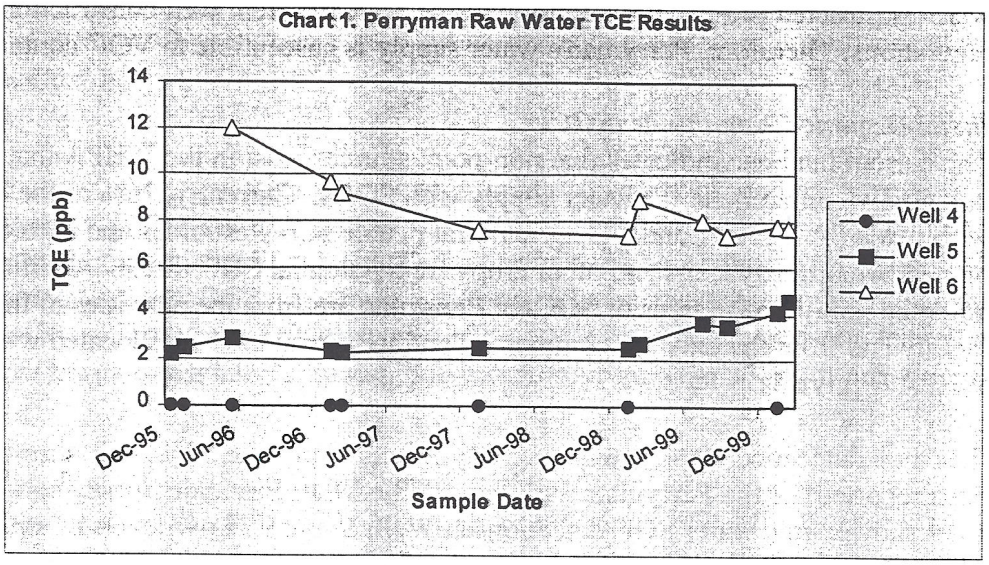
Perryman's water supply is susceptible to nitrate contamination. Nitrate levels have periodically exceeded the 50% MCL threshold since 1993 (Table 4). Sources of nitrate can generally be traced back to land use. Fertilizer applied to nearby agricultural fields and residential lawns, and effluent from on-site septic systems are non-point sources of nitrate in ground water. Additionally, the subsurface and surface application of sludge onto the nearby agricultural fields is another potential nitrate source (Figure 2). A review of Table 3a indicates that 26% of WHPA Zones 1 and 2 is cropland (Figure 3). Excess nitrate from manure and fertilizer that is not used by the nearby corn and soybean crops can leach into the ground water during recharge periods.

Raw water nitrate concentrations are generally higher in Wells 1, 2, 3, 4, and 9 than in water from Wells 5, 6, and 8. In order to meet applicable drinking water standards, the water from wells containing higher nitrate concentrations are blended with water containing nitrate at levels below the MCL.

The map showing the contributing areas for each well (CH2M Hill, 1997) was overlaid onto Figures 3 and 4. The primary land use within the contributing areas of Wells 1, 2, 3, 4, and 9 is agricultural. The contributing areas also include some residential lands that currently utilize private septic systems. Based on these observations, nitrates present in Perryman Wells 1, 2, 3, 4, and 9 are likely related to fertilizers and manure/sludge applications and to a lesser extent, from on-site septic systems. Additionally, the contributing areas of Wells 5, 6, and 8 are primarily to the east-northeast on APG property that is heavily forested. This may account for the lower nitrate results at these wells.

Volatile Organic Compounds (VOCs)

A review of Tables 5a and 5b shows VOC detects of trichloroethylene (TCE) at the Perryman Wells since 1992. Finished water results that exceed 50% of the MCL are summarized on Table 5a. Raw water TCE results have exceeded the MCL at Wells 5 and 6 (Table 5b). No evidence of TCE is present in the remaining production wells. Chart 1 shows the trend of the TCE detections at Wells 4 - 6 since 1995.



Note that TCE concentrations have been steadily declining at Well 6 and have slowly been on the rise at Well 5 over time. Well 4 has shown no TCE detections to date. Based on investigations by the U.S. Army, one source of these contaminants was determined to be the APG AFTC (Drummond & Johnston, 1997). The Army installed a GAC system in 1993 to remove TCE from Wells 5, 6, 8 and 9. However, the current GAC system configuration does not include Wells 1 - 4. If the pumps are turned off at Wells 5 and 6, the TCE plume could affect other Perryman Wells (Drummond & Johnston, 1997).

Other VOCs have been detected in finished water at levels below the 50% MCL threshold. There is currently an open LUST case located within the WHPA that is still under investigation by the Oil Control Program. The other LUST cases shown on Figure 2 are now closed and thus are no longer considered a potential ground water threat.

Wells 5, 6, 8, and 9 are located adjacent to the APG property limits. The nature of the activities at this facility also poses a potential VOC threat to the wells. Chemicals associated with compounds used for explosives were detected in APG monitoring wells near the Perryman Well Field in October 1995 and March 1996. The explosives that were detected are as follows: 2,4 - dinitrotoluene, 2,4,6 - trinitrotoluene (TNT), 3 - nitrotoluene, HMX, RDX, 4 - amino 2,6 dinitrotoluene, and nitrobenzene. The levels of these unregulated VOCs are below relevant drinking water health advisories and are not part of the monitoring requirements of the Safe Drinking Water Act.

In addition, the proposed change in the Harford County's zoning ordinance may promote further industrial development within the Perryman WHPA. This may result in additional VOC threats to the nearby wells.

Currently, there is a known VOC contaminant source located within the WHPA. TCE continues to be detected in Wells 5 and 6. Additionally, all of the Perryman Wells

were constructed prior to the initiation of the State's current well construction regulations. Therefore, Perryman's water supply **is** susceptible to VOC contamination.

Synthetic Organic Compounds (SOCs)

The current land use indicates that non-point sources exist in the WHPA that could potentially contaminate the water supply with SOCs. Currently, 26% of the land within WHPA Zones 1 and 2 is agricultural (Table 3a). Pesticides and herbicides used on nearby corn, soybeans and other crops are a potential SOC threat. Additional potential non-point sources of SOCs at Perryman are from the activities of the APG facility and from the existing commercial and industrial land uses located within the WHPA (Figure 3).

Based on data since 1994, low-level SOC detects below the 50% MCL threshold have been reported for the Perryman Well Field. The MDE Pesticide Survey conducted in 1994 showed raw water SOC detections at Wells 2 and 9. Low-levels of atrazine, heptachlor, and heptachlor epoxide were detected in sampling results at these wells. In 1995, low levels of dalapon well below 50% of the MCL were detected in finished water at Perryman. Atrazine is a herbicide used on corn. Heptachlor and heptachlor epoxides are insecticides for the removal of termites, and dalapon is a herbicide used on cropland and along roadsides and railway lines. Since 1995, there has not been any SOC detects relating to water quality in several sets of data at Perryman. Therefore, based on the available repeat sampling data, Perryman's water supply is **not** susceptible to SOC contamination. However, since there are potential non-point sources within the WHPA, periodic sampling for SOCs should be continued.

Radionuclides

Gross alpha and gross beta radiation was detected at low levels in finished water samples at Perryman. The results are less than 50% of the 15 pCi/L and 50 pCi/L MCLs respectively. Radon-222 was detected at 195 pCi/L (5/9/94) and 190 pCi/L (5/22/97). These results are over 50% of the 300 pCi/L currently under consideration by EPA. Additionally, short-term gross alpha was detected above the MCL in raw water results for Well 2 during a radium study conducted by MDE in 1998. The source of radon in ground water can be traced back to the natural occurrence of uranium in rocks. Based on the limited available sampling data, Perryman's water supply **is** susceptible to radiological contaminants.

Microbiological Contaminants

The nearest natural surface water body to the Perryman's Well Field is an unnamed tributary off of Church Creek located about 1,500 feet to the north of Well 1. Within the APG property, there is an unnamed stream that flows southward into Romney Creek that is located about 1,600 feet to the east of Well 9. Based on dry weather coliform sampling data, the wells were determined **not** to be susceptible to protozoans or bacteriological contaminants. The wells may be susceptible to viral contaminants, as these are much smaller, can survive longer, and may not be as effectively filtered by the aquifer as protozoans and bacteria. Future monitoring will be needed to determine susceptibility to viruses.

MANAGEMENT OF THE WHPA

Local Planning Team

- Harford County recognized the need to protect the Perryman Well Field from contamination and funded a Wellhead Protection (WHP) Plan for this supply in 1996. The WHP was developed and reviewed by a Technical Advisory Committee (TAC) that includes representatives from Harford County government, the Department of Public Works, the Department of Planning and Zoning, the Harford County Health Department, the Office of Economic Development, the Division of Environmental Affairs, the U.S. Army Corps of Engineers, the City of Aberdeen, MGS, MDE, APG and CH2M Hill, Inc.

Wellhead Protection Plan Implementation

- Several management strategies were recommended in the Perryman Well Field WHP Plan (CH2M Hill, 1997). The management strategy topics from the plan are summarized in Appendix B. The reader may contact the Harford County Department of Public Works to obtain additional detailed information concerning the management plan, or the Perryman WHP Plan document. It is recommended that these strategies be implemented to protect the well field from contamination.

Ordinance

- The County is currently working on establishing a Wellhead Protection Overlay district to manage land use and development activities within the WHPA Zones. The County expects to pass this land use ordinance in 2001. We encourage the County to move forward in protecting this important ground water resource.

Change in Uses

- Any changes in pumpage at the Water Treatment Plant or the addition of new wells will require revision of the WHPA since it is affected by pumpage. Harford County is required to contact the MDE Water Supply Program when an increase in pumpage is applied for and when proposed new wells are being considered.

Contaminant Source Inventory Updates/ Inspections

- Harford County should conduct its own detailed survey to ensure that there are no other potential sources of contamination within the WHPA. Updated records of new facilities within the WHPA should be maintained.
- Harford County should continue its annual inspection and maintenance program for the supply wells to ensure their integrity and to protect the aquifer from surficial contamination.
- Harford County should ensure that all unused wells are properly abandoned and sealed as per COMAR 26.04.04.11.

APPENDICES

APPENDIX A

Price Brothers Perryman Plant manufactures pre-stressed concrete cylinder pipe. The potential for contaminant discharges at this facility is from the use of cements, oils and paints. A State discharge permit (No. 93-DP-0010) was issued to this facility to contain and treat these potential contaminants. The wash water from the manufacturing process is diverted through a series of 2 settling ponds. The sediment from these ponds is removed and stored on-site in a landfill area. The discharge water and stormwater runoff is diverted to settling and retention ponds, where they are treated and released through an outfall pipe.

An industrial rubble fill is located on the Price Brothers Property for storing sediments and waste from the manufacturing process.

The Perryman Landfill located near MD Route 159 and the AMTRAK railway line is an ancient, non-permitted county-operated refuse fill. No data is available from the MDE Solid Waste Program as to the ground water quality near this site.

A permit was granted in 1979 and 1983 for subsurface and surface application of sludge from the Sod Run Wastewater Treatment Plant onto the Mitchell agricultural fields near Perryman Wells 8 and 9 (CH2M Hill, 1997).

Aircraft and aircraft parts are stockpiled on bare earth at the Test Range for Advanced Aerospace Vulnerability at APG. Potential VOC threats exist due to the leakage and spills of solvents and fuels during the assembly and disassembly of aircraft parts. An UST was removed from near the site in 1994. The site is currently under investigation by the MDE Oil Control Program (URS Greiner Woodward Clyde, 1999).

Testing of various aircraft parts, experimental aircraft, and sighting equipment has been and presently is conducted at the Phillips Army Airfield (PAA) at APG. An UST is located to the east of the PAA hanger. Petroleum hydrocarbons were detected in routine monitoring well sampling. The site has been remediated and is currently being monitored (URS Greiner Woodward Clyde, 1999).

Eight stormwater infiltration facilities are located within WHPA Zones 2 and 3. Three of the facilities serve as detention basins for storm water management purposes. The remaining five facilities located adjacent to Perryman Road function as infiltration trenches (CH2M Hill, 1997). Surface water runoff entering these facilities eventually reaches the aquifers. Therefore, the quality of the infiltrating surface water is important to the ground water supply. In addition, it is imperative that these facilities continue to operate effectively due to the increased surface water runoff that will result from new development in the WHPA.

APPENDIX B

Recommended Management Strategies (from CH2M Hill, 1997)

- Wellhead Protection Overlay Zones
- Land Use Prohibitions
- Toxic, Hazardous, and Other Materials Handling Regulations
- Stormwater Management
- Industrial Best Management Practices and Implementation Inspections
- Underground Storage Tank and Line Regulations
- Above Ground Storage Tank and Line Regulations
- Roadway Runoff Controls
- Construction Management Standards
- Landscaping
- Household Hazardous Waste Collection Program
- Evaluation of Source Nitrates
- Agricultural Best Management Practices
- Conservation Easements
- Memorandum of Agreement
- Public Education
- Signs

REFERENCES

Blandford, T.N., and Huyakorn, P.S., 1991, WHPA: A Modular Semi-analytical Model for the Delineation of Wellhead Protection Areas, Version 2: U.S. Environmental Protection Agency, Office of Ground Water Protection, Washington, D.C.

CH2M Hill, Inc., 1997, Perryman, Maryland Wellfield Well Head Protection Plan

Drummond, D.D., and Blomquist, J.D., 1993, Hydrogeology, Water Supply Potential, and Water Quality of the Coastal Plain Aquifers of Harford County, Maryland: Maryland Geological Survey Report of Investigations No. 58, 160 p.

Drummond, David D., and Johnston, P.B., 1997, Hydrogeology And Estimation of Ground-Water Contributing Areas Of The Perryman Well Field, Harford County, Maryland: Maryland Geological Survey Report of Investigations No. 63, 143 p.

Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 p.

Nutter L.J., 1977, Ground-Water Resources of Harford County Maryland: Maryland Geological Survey Bulletin No. 32, 44 p.

URS Greiner Woodward Clyde, 1999, Remedial Investigation of the Western Boundary Study Area in the Aberdeen Area of Aberdeen Proving Ground, Maryland

OTHER SOURCES OF DATA

Water Appropriation and Use Permit No. HA69G003
Water Treatment Plant Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Department of Natural Resources 1994 Digital Orthophoto Quarter Quadrangles for Perryman NE & NW
USGS 7.5 Minute Series Topographic Maps, Aberdeen & Perryman Quadrangles
Maryland Office of Planning 1997 Harford County Land Use Map
Maryland Office of Planning 1994 Harford County Sewerage Coverage Map