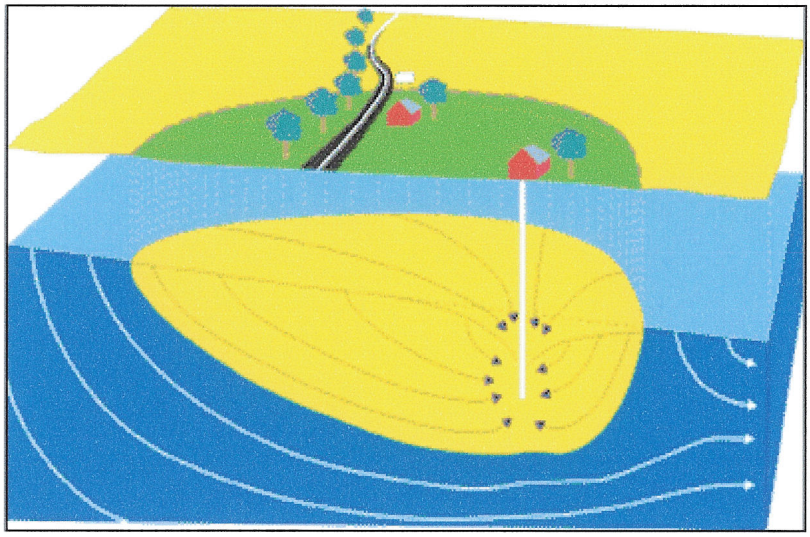
SOURCE WATER ASSESSMENT
for
BRETTON WOODS RECREATION CENTER
MONTGOMERY COUNTY, MD



Prepared By
Water Management Administration
Water Supply Program
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MDE

Robert L. Ehrlich, Jr.
Governor

Michael S. Steele
Lt. Governor

Kendl P. Philbrick
Secretary

Jonas A. Jacobson
Deputy Secretary

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SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for Bretton Woods Recreation Center. 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 of Bretton Woods Recreation Center's water supply is an unconfined fractured rock aquifer, known as the Upper Pelitic Schist. The system currently uses three wells to obtain its drinking water. The Source Water Assessment Area was 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 location are enclosed at the end of the report.

The susceptibility analysis for Bretton Woods Recreation Center's water supply is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that Bretton Woods' water supply is susceptible to contamination by nitrate and may be susceptible to mercury, but not to volatile organic compounds, synthetic organic compounds, microbiological contaminants, or other inorganic compounds. It is may be susceptible to naturally occurring radon if EPA adopts a maximum contaminant level for nontransient noncommunity water systems.

INTRODUCTION

The Water Supply Program has conducted a source water assessment for the Bretton Woods Recreation Center (Bretton Woods) water supply located approximately 6 miles southwest of Gaithersburg in Montgomery County (figure 1). The Bretton Woods water supply 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. Bretton Woods is owned by the International Monetary Fund and also the water system which is operated by the Maryland Environmental Service (MES). The facility has a golf course, three swimming pools, several ball fields and a soccer field, and about 100 employees.

WELL INFORMATION

Bretton Woods uses three wells for all of its potable water supply needs. Well information was researched from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports and published reports. Well Nos. 1 and 2 were drilled prior to 1973, when the State's well construction regulations went into effect, and may not be in compliance with current well construction standards. Well 3 was drilled in 1988 and should be compliance with current standards for grouting. Well information is shown in Table 1 below.

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH (ft)	CASING DEPTH (ft)	YEAR DRILLED
01	Well 1	MO680020	205	55	1967
02	Well 2	MO720002	175	42	1971
03	Well 3	N/A	200	100	1988

Table 1. Bretton Woods Well Information

Bretton Woods has a Water Appropriation Permit that allows it to use an average of 13,000 gallons per day (gpd) and 50,000 gpd in the month of maximum use of ground water. The ground water is used for potable supply, sanitary facilities and pool filling. Based on pumpage reports submitted to MDE the daily average for the past four years is 7,712 gpd. The facility also has two Water Appropriation Permits that allows it to use surface water from the Potomac River for golf course irrigation.

HYDROGEOLOGY

Bretton Woods is located in the Piedmont physiographic province and is underlain by the Upper Pelitic Schist of the Wissachikon Formation. The Upper Pelitic Schist is an unconfined, fractured rock aquifer and is composed of albite-chlorite-muscovite-quartz schist with sporadic thin beds of laminated micaceous quartzite (Nutter and Otton, 1969). 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 systems in crystalline rock tend to be localized and flow is within topographic divides towards the nearest perennial streams. (Bolton, 1998).

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 is the watershed drainage area that contributes to the well. This area is modified by geological boundaries, ground water divides, and by annual average needed to supply the well (MD SWAP, 1999). Hydrogeologic mapping is the primary method used for water supplies at 10,000 gpd or greater, in fractured rock aquifers. Bretton Woods' three wells are located in two different small watersheds. As a result two WHPAs were delineated to for the three wells (figure 2). Well Nos. 1 and 2 have one WHPA with an area of 21.5 acres and Well No. 3 has a WHPA with an area of 25.2 acres. These areas are more than adequate to support Bretton Woods's permit of 13,000 gpd with even a drought recharge rate of 400 gpd/acre.

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 three point sources of contamination in the vicinity of the WHPAs. Figure 2 identifies two Underground Storage Tank (UST) sites and a Maintenance Shop (MNT). Table 2 lists the facilities identified and their potential types of contaminants. Potential contaminants are grouped as Volatile Organic Compounds (VOC), Synthetic Organic Compounds (SOC), Heavy Metals (HM), Nitrate (N), and Microbiological Pathogens (MP).

ID	Type	Site Name	Address	Potential Contaminant	Comments
1	UST	Boys/Girls Home	13411 Riley Ford Rd	VOC	1000 gallon heating oil tank
2	UST	Bretton Woods	15700 Rive Rd	VOC	1000 gallon heating oil tank
3	MNT	Bretton Woods	15700 River Rd	VOC, HM	Maintenance Bldg

Table 2. Potential Contaminant Point Sources within the Bretton Woods WHPAs (see figure 2 for locations).

Non-Point Sources

The Maryland Department of Planning's 2002 digital land use map for Montgomery County was used to determine the predominant types of land use in the WHPA (figure 3). Based on this land use map, the WHPAs for Wells Nos 1 and 2 and is entirely located in open urban land. Open urban land makes up the largest portion of the WHPA for Well No. 3, with cropland and residential properties making up the rest. The land use summary for the Well No.3 WHPA is shown in Table 3 below.

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	2.78	10.8
Open Urban Land	16.72	65.2
Cropland	6.16	24.0
Total	25.66	100.00

Table 3. Land Use Summary for the Wellhead Protection Area for Well No. 3

The entire Bretton Woods property is zoned open urban land. Since a golf course makes up the largest portion of the Bretton Woods property, landscaping and maintenance of the course can be sources of nitrate in the ground water. The application, storing and handling of pesticides and pesticide residuals represent a potential source of ground water contamination. While pesticides are often synthetic organic compounds, some pesticides contain heavy metals. Monitoring of ground water under golf courses around the country has revealed a wide range of potential contaminants (ca.water.usgs.gov/pnsp/golf.html).

Maryland Department of Planning's 2004 digital Montgomery County Sewer Map was used to determine the sewer service area categories in the WHPA. Based on this map, it was determined that the entire Bretton Wood property has existing sewer service. Wastes generated by the facility are treated at a wastewater treatment plant located downgradient of Wells 1 and 2. Bretton Woods had a surface water discharge permit (97-DP-2754) to discharge the treated wastewater into the Potomac River. The wastewater treatment and disposal does not pose a threat to the Bretton Wood WHPAs.

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. The Bretton Woods water system treats its raw water before distribution. The two treatment processes used are hypochlorination for disinfection and pH adjustment for corrosion control.

A review of the monitoring data since 1993 for Bretton Woods' water supply indicates that it meets the current drinking water standards. The water quality sampling results are summarized in Table 3.

	Nitrate		SOCs		VOCs		IOCs (except nitrate)		Radionuclides*	
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	No. of Samples Collected	No. of samples > 50% MCL
01	45	10	2	0	12	0	3	1	1	1*

Table 3. Summary of Water Quality Samples for Bretton Woods' Water Supply.

based on proposed lower MCL

Inorganic Compounds (IOCs)

Nitrate and mercury were the IOCs detected above 50% of the MCL in the Bretton Woods water supply. Table 4 lists the dates when these IOCs were detected at above 50% of the MCL. Mercury, which has an MCL of 0,002 ppm, was detected one time at 0.001 ppm. It was not detected again in subsequent sampling. Nitrate, which has an MCL of 10 ppm, has been detected above the MCL two times. These values are in bold print in table 4. As records do not indicate which of the wells were being used when the samples were collected, it is recommended that Bretton Woods sample each well separately for nitrates and mercury.

CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT (ppm)
NITRATE	10	8-Feb-93	7.5
MERCURY	0.002	25-Apr-95	0.001
NITRATE	10	28-Apr-97	8.5
NITRATE	10	30-Sep-98	7.8
NITRATE	10	25-Aug-99	5.9
NITRATE	10	29-Mar-01	**10.2**
NITRATE	10	26-Aug-02	5.11
NITRATE	10	7-Oct-03	**11.5**
NITRATE	10	30-Oct-03	6.3
NITRATE	10	6-Jul-04	5.38

Table 4. Inorganic Compounds detected above 50% of the MCL.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of the MCL have been detected in the Bretton Woods water supply. The only VOCs that have been detected are trihalomethanes (THMs). THMs are disinfection by-products that are the result of a reaction between chlorine used for disinfection and organic material found in the aquifer. The MCL for THMs is 80 ppb and is based on the total detections of four THMs. The total of the THMS detected in the water supply range from 2.4 ppb to 9 ppb.

Synthetic Organic Compounds (SOCs)

No SOCs above 50% of the MCL have been detected in the Bretton Woods water supply. The only SOC detected one time was di(ethylhexyl)phthalate in a sample collected on March 11, 2003 at 0.4 ppb. The MCL for this SOC is 6 ppb. This SOC was also detected in the laboratory blank on the same date and is not therefore believed to represent Bretton Woods' water quality.

Radionuclides

Nontransient noncommunity systems are currently not regulated for radionuclides. Radon-22 2 is the only radionuclide that has been sampled for this water supply. The sample collected on March 13, 2003 had radon-222 detected at 525 picoCuires/Liter (pCi/L). At present there is no MCL for radon-222, however EPA has proposed an MCL of 300 pCi/L and an alternate MCL 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.

Microbiological Contaminants

Ground water under the influence of surface water (GWUDI) testing was conducted for the Bretton Woods wells. The wells were classified as moderate risk to sources to surface water influence. As a result the system was required to collect raw water samples for bacteria (total and fecal coliform) 24 hours after at least 0.5 inches of rainfall. No coliform bacteria were detected in the raw water samples for any of the wells. 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. None of the forty-three routine bacteriological samples collected for the Bretton Woods water supply have shown any coliform detection.

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SUSCEPTIBILITY ANALYSIS

Bretton Woods' wells 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 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.

In the non-carbonate rocks of the Piedmont region, if a well is constructed properly with the casing extended to competent rock and with sufficient grout, the saprolite serves as a natural filter and protective barrier from microbial contamination. Properly constructed wells with no potential sources of contamination in their WHPA should be well protected from contamination. The susceptibility of the water supply to the various types of contaminants is summarized in Table 5.

Inorganic Compounds (IOCs)

Nitrate has been detected at levels above 50% of the MCL in the Bretton Woods water supply and exceeded the MCL of 10 ppm two times (table 4). A review of the nitrate data shows that nitrate levels appear to be dropping off (figure 4). The average of the past 12 samples is 2.8 ppm. Sources of nitrate can generally be traced to land use. Fertilizer applied to the golf course and the rest of the Bretton Woods property is a source of nitrate loading in ground water. Ina addition adjacent properties which use onsite septic systems for wastewater disposal may also be sources of nitrate in the ground water. Mercury was only detected one time at 50% of the MCL. Data from individual wells in needed to assess the susceptibility of the supply to mercury. Mercury compounds have been used at some golf courses as a fungicide.

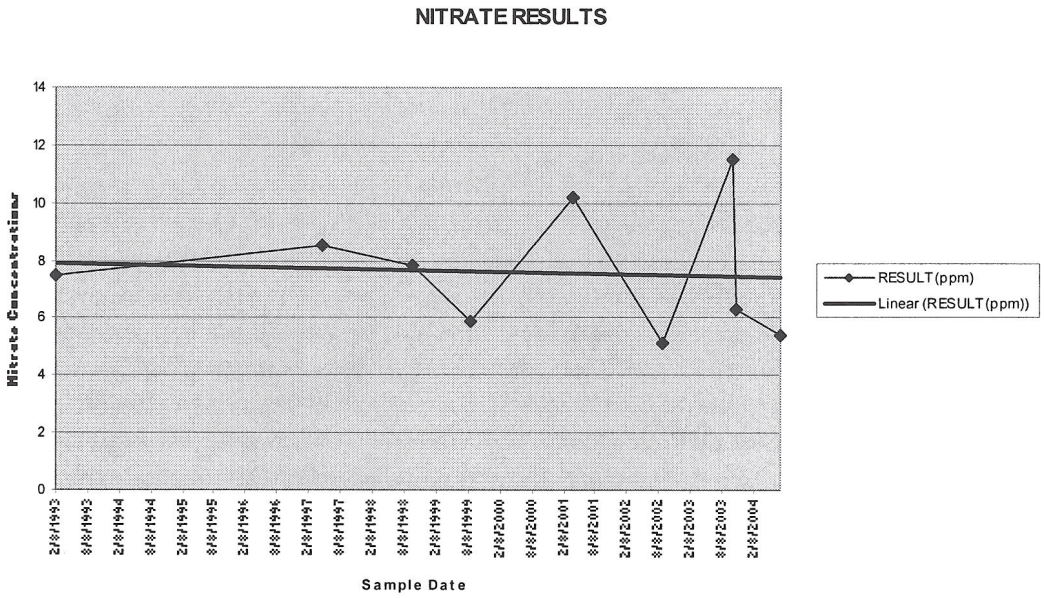

Figure 4. Nitrate Results for the Bretton Woods Supply

Based on above analysis the Bretton Wood water supply **is** susceptible to contamination by nitrate, and may be susceptible to mercury but **not** to other inorganic compounds.

Volatile Organic Compounds (VOCs)

No VOCs have been detected above 50% of the MCL in the Bretton Wood water supply. There are three potential sources of VOC contamination shown on the Bretton Woods property. These sites are not believed to in a location that would affect the water quality. VOCs from these potential sources of contamination have not been detected in the water supply.

Based on the above discussion, the Bretton Woods water supply **is not** susceptible to VOC contamination.

Synthetic Organic Compounds (SOCs)

No SOCs have been detected above 50% of the MCL is the Bretton Woods water supply. Application of pesticides for golf course maintenance may be source of SOCs. But so far, due to combination of proper application, aquifer and well characteristics the water quality has not been affected by SOCs.

Based on the above analysis, the Bretton Woods water supply is **not** susceptible to SOC contamination regulated under the Safe Drinking Water Act.

Radionuclides

Nontransient noncommunity systems are currently not regulated for radionuclides. The only radionuclide that has been sampled is radon-222, which was detected at 525 pCi/L, which is above the EPA proposed lower MCL of 300

pCi/L for community water systems. Radon is a naturally occurring compound and is prevalent in ground water due to the radioactive decay of uranium bearing minerals in the bedrock (Bolton, 1996). High levels of radon are prevalent in fractured rock aquifers like the Upper Pelitic Schist.

Based on the above analysis, the Bretton Woods water supply maybe **susceptible** to radon. No information is available to determine its susceptibility to other radionuclides.

Microbiological Contaminants

Based on raw water bacteriological data the Bretton Woods wells were determined not to be GWUDI. In addition, no bacteria have been detected in any of the routine bacteriological samples collected for the Bretton Woods water supply.

Based on the above discussion, the Bretton Woods water supply **is not** 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	YES	YES	NO	YES	YES
Mercury	UNKNOWN	YES	NO	YES	MAYBE
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
Radon-222	YES	YES	NO	YES	MAYBE*
Microbiological Contaminants	NO	NO	NO	YES	NO

Table 5. Susceptibility Summary for the Bretton Woods water supply.

*based on what proposed MCL is adopted

MANAGEMENT OF THE WHPA

Contaminant Source Inventory/Well Inspection

- Bretton Woods's owners should review the potential sources of contaminants within the WHPA and update them if necessary, including a consideration of historical uses.
- Periodic inspections and a regular maintenance program for the supply well will ensure their integrity and protect the aquifer from contamination.
- Ensure that pesticide and fertilizer application in gold course and other areas in the property areas are according to best management practices and label requirements.
-

Cooperative Efforts with Other Agencies

- Determine if there are any unused wells in the WHPA and ensure that they are abandoned and sealed in compliance with the State's well construction standards.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.
- Carefully monitoring the nitrate data to determine whether the decreasing levels continue or increase with time.
- Test individual wells for mercury.
-

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.

REFERENCES

Bolton, David 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 p.

Dingman, R. J., and Meyer G. M., 1954, The Water Resources of Howard and Montgomery Counties: Maryland Department of Geology, Mines and Water Resources Bulletin 14, 260p.

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

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 Permit: MO1967G016
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles: Seneca-NW & SW (1993)
USGS Topographic 7.5-Minute Seneca Quadrangle
Maryland Department of Planning 2002 MontgomeryCounty Land Use Map
Maryland Department of Planning 2004 Montgomery County Sewer Map

FIGURES

Figure 2. Wellhead Protection Areas for Bretton Woods with Potential Contaminant Sources

Base Map: USGS 7.5 minute Topographic Quadrangle - Germantown

Figure 3. Land Use within the Bretton Woods Wellhead Protection Areas

LEGEND

Land Use Categories

- Low Density Residential
- Commercial
- Open Urban Land
- Cropland
- Pasture
- Forest
- Water
- Wellhead Protection Area
- Supply Well

N

1000 0 1000 Feet

Base Map: Maryland Dept. of Planning Land Use Map - Montgomery Co. (2004)