SOURCE WATER ASSESSMENT

for

BRINTON WOODS NURSING AND REHABILITATION CENTER

Sykesville, Carroll County, MD

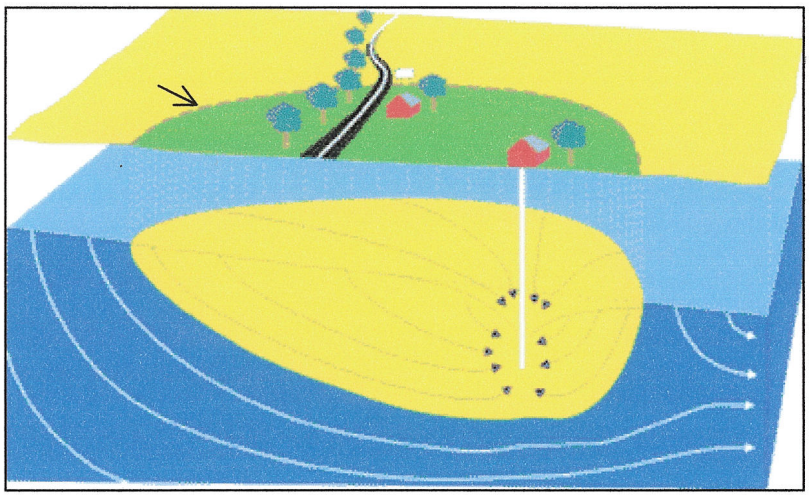

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The Maryland Department of Environment's Water Supply Program (WSP) has performed a Source Water Assessment for the Brinton Woods water system in Carroll County, Maryland. This water system is identified as Public Water System Identification (PWSID) 0060201 by the Maryland Department of the Environment (MDE). The required components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are:

- Delineation of the area that contributes water to the source
- Identification of potential sources of contamination
- Determination of the susceptibility of the water supply to contamination
- Recommendations for protecting the drinking water supply

The source of the Brinton Woods's water supply is the Upper Pelitic Schist of the Wissahickon Formation, which is an unconfined crystalline rock aquifer. The Source Water Protection Area (SWPA) for the two ground-water supply wells was delineated using the watershed delineation method for fractured bedrock wells. The area of the SWPA is based on land topography, and a calculation of the total ground-water contributing area during a drought. The SWPA is approximately 73 acres in area.

Potential point and non-point sources of contamination within the assessment area were identified based on site visits, a review of MDE's databases, and a review of land use maps. There are two underground storage tanks (USTs) on the property. Because residential areas and cropland account for a significant portion of the SWPA, with on-site wastewater disposal systems and nitrogen-based fertilizers in residential areas and farm fields can be considered potential sources of contamination. Well information and water quality data for the system were also reviewed.

The susceptibility analysis for the Brinton Woods Nursing and Rehabilitation Center 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 the Brinton Woods water supply is susceptible to nitrates and total coliform, may be susceptible to radon, but is not susceptible to other radionuclides, other microbiological contaminants, other inorganic compounds, and volatile organic and synthetic organic compounds.

1. INTRODUCTION

The Water Supply Program has conducted a Source Water Assessment for the Brinton Woods Nursing and Rehabilitation Center water system in Carroll County, Maryland.

The water treatment plant and the supply wells for the system are located on the 2.5 acre property. The Brinton Woods Nursing and Rehabilitation Center water system is owned by Gary Czapski and has two certified operators. It serves a current population of 59

people with 1 connection. The average daily flow is 4,300 gallons. The water is supplied by two wells (Figure 1).

GROUND WATER SUPPLY SYSTEM INFORMATION

A review of the well data and sanitary surveys of the system indicates that both wells were drilled in 1959 before the State's current well construction standards were put into place in 1973. Table 1 contains a summary of the well construction data.

TABLE 1. Well Information

Source ID	Source Name	Permit No.	Total Depth (ft)	Casing Depth (ft)	Aquifer
01	Brinton Woods Nursing and Rehabilitation Center 1	N/A	70	N/A	Upper Pelitic Schist/Wissahickon Formation
02	Brinton Woods Nursing and Rehabilitation Center 2	N/A	70	N/A	Upper Pelitic Schist/Wissahickon Formation

Both wells are located near the entrance of the property where it runs parallel to Buckhorn Road. The wells are only about fifteen feet apart on the side of the main building. Both casings stick up less than a foot above the ground and considering the wells were drilled in 1959 it is possible they have been renovated since then. The wells are pumped alternately to a 2,500 gallon storage tank with a 200 gallon bladder tank. Well 2 lags well 1. That is, well 1 starts pumping first, followed by well 2. Both wells pump to a 2,500 gallon storage tank from which the sample is collected. The finished water is a mixture from both wells. An inspection of the wells revealed that both are fitted with old style well caps, allowing insects which can carry coliform organisms to enter the well.

1.2 Hydrogeology

The Brinton Woods wells are drilled in the Upper Pelitic Schist of the Wissahickon Formation. This rock unit makes up most of the Piedmont Physiographic province in Carroll County. The Upper Pelitic Schist is an unconfined, fractured rock aquifer composed of albite-chlorite-muscovite quartz schist with sporadic thin beds of laminated micaceous quartzite (Cleaves, et al, 1968).

A geologic base map is presented in Figure 4. The source of the ground water is from precipitation in the form of rainfall or snow melt. The water table in the aquifer generally mimics the surface topography. Most of the ground water available to a well exists in the

weathered rock zone and in the overlying saprolite. The fracture openings penetrated by the well also contribute ground water to the well.

2. SOURCE WATER ASSESSMENT AREA DELINEATION

For ground-water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment and protection area for the system. 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 aquifers is a fixed radius of 1,000 feet around the well. The 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.

For Brinton Woods Nursing and Rehabilitation Center, the current Water Appropriation Permit issued by the MDE Source Protection and Appropriation Division is for an average of 6,000 gpd for the two wells.

3. INVENTORY OF POTENTIAL CONTAMINANTS WITHIN THE DELINEATED AREA

MDE Water Supply Program staff conducted a field survey on April 20, 2005 to check for potential sources of contamination within and near the area surrounding the nursing home. Previously, the MDE database was queried for contaminant sources within and near the nursing home. The contaminant databases include the Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS), which includes National Priority List (Superfund) sites, Maryland Registered Underground Storage Tank (UST) sites, Maryland Leaking Underground Storage Tank (LUST) sites, landfills, pesticide dealers, ground-water discharge permits, Colonial Pipeline, and Controlled Hazard Substances (CHS) generator sites.

Beside the AST and UST mentioned below, none of the other potential contaminant sites mentioned above were within the delineated wellhead protection area.

3.1 Point Sources

There are two buried USTs on the premises. One is a 550 gallon diesel oil tank and the other is a 2500 gallon heating oil tank. Both are buried down gradient (about 150 feet) from the wells.

In addition to the buried storage tanks, there are two above ground storage tanks (AST) onsite, also located down gradient of the wells. Both are 275 gallon double walled fiberglass tanks. One is used for gasoline storage and the other is used for fuel oil

storage. Failure of an AST may impact the ground water with petroleum hydrocarbons if adequate safety features to contain any spills are not implemented.

3.2 Non-Point Sources

The Maryland Department of Planning's 2002 Land Use/Land Cover map for Carroll County was used to determine potential non-point sources within the wellhead protection area (WHPA). The evaluation was based on land use designation (Figure 3). A summary of the percent and acreage of each type of land use, using the 2002 map is presented in the table below:

TABLE 2. 2002 Percentage of Each Land Use Type within WHPA

MHP Name	Brinton Woods Nursing Home
Wells	1,2
Low Dens Res (acre)	39.3
Low Dens Res (%)	53.9
Medium Dens Res (acre)	5.4
Medium Dens Res (%)	7.4
Forest (acre)	1.6
Forest (%)	2.2
Cropland (acre)	26.6
Cropland (%)	36.5
TOTAL ACRE	73.0
TOTAL %	100.0

Residential and agricultural areas account for a significant portion of the total WHPA area. Septic systems and the use of fertilizers and pesticides are potential sources of pollution generally associated with residential and agricultural land uses.

The septic system drain fields serving the Brinton Woods Nursing and Rehabilitation Center were observed on-site but they were located down gradient of the wells, yet within this 1000 feet radius. Homes located along Buckhorn Road up-gradient of and at the same elevation as the Brinton Woods wells are also served by septic systems. Septic system discharges contain contaminants of concern such as pathogenic microorganisms and inorganic compounds such as nitrogen. The removal of pathogenic microorganisms is dependent on the filtration capacity of the soil and saprolite matrix around the drain field. Negative impacts from excessive nitrate-nitrogen are controlled by large lot zoning to ensure adequate dilution. Septic system discharge could also contain contaminants that the systems were not designed to treat, such as solvents and fuels.

4. REVIEW OF WATER QUALITY DATA

Water quality data was obtained from the MDE Water Supply Program database of Safe Drinking Water Act (SDWA) contaminants. The results reported are for finished

(treated) ground water (unless otherwise noted). Currently, the raw ground water is treated with sodium hypochlorite (bleach) for disinfection and soda ash for pH adjustment. The finished water is stored in one 2,500 gallon tank and a 200-gallon bladder tank prior to distribution.

A review of the water quality data from Brinton Woods Nursing and Rehabilitation Center covers the period 1993 onward through 2004. The nursing home was operating well before 1993 but MDE's database only contains information from 1993. All detected compounds from ground water samples collected are shown in the tables. Ground water analytical results were evaluated to establish susceptibility to contaminants.

4.1 VOLATILE ORGANIC COMPOUNDS (VOCS)

No volatile organic compounds (VOCs) were reported in the ground water samples above 50 percent of the USEPA Maximum Contaminant Level (MCL). Table 3 lists all detections of volatile organic compounds. The presence of chloroform is due to the reaction of chlorine from the water treatment plant with naturally occurring organic compounds. The concentrations observed are well below the maximum allowable level of 80 parts per billion. No other VOCs have been detected in the ground water samples collected.

TABLE 3. VOC Detects Data

PWSID	Plant ID	Contaminant ID	Contaminant Name	MCL (ppb)	Sample Date	Result (ppb)
0060201	1	2941	Chloroform	80	08-Apr-96	1
0060201	1	2941	Chloroform	80	11-Dec-97	1
0060201	1	2941	Chloroform	80	15-Nov-00	1.8
0060201	1	2941	Chloroform	80	08-Dec-03	1.8

4.2 Synthetic Organic Compounds (SOCs)

Di (2-Ethylhexyl)phthalate was detected in the finished water on several occasions as shown in Table 4. In 2002, one sample tested at 85% of the MCL but a retest yielded a result of only 20% of the MCL. This contaminant is commonly found in laboratory blank samples accompanying these detections and therefore should not be presumed to represent the water quality of the system.

TABLE 4. SOC Detects Data

PWSID	Plant ID	Contaminant ID	Contaminant Name	MCL (ppb)	Sample Date	Result (ppb)
0060201	1	2039	DI (2 ETHYLHEXYL)PHTHALATE	6	02/22/1999	0.9
0060201	1	2039	DI (2 ETHYLHEXYL) PHTHALATE	6	10/21/2002	5.1
0060201	1	2039	DI (2-ETHYLHEXYL) PHTHALATE	6	10/21/2002	1.2

4.3 INORGANIC COMPOUNDS (IOCS)

Nitrate levels have consistently exceeded 50% of the MCL for water samples tested from the wells since 1993. This is due to multiple sources of nitrate-nitrogen in the WHPA such as on-site septic systems, and residential and agricultural use of fertilizer. In 2002, IOC tests carried out on the water sample from the wells indicated a high level of beryllium. A second sample tested later in the year and previous samples did not detect the contaminant. This leads to the conclusion that the high reading was an error. A summary of all detected IOC concentrations in the ground water samples collected is shown in Table 5.

TABLE 5. Summary of IOC Detects & Radionuclides at 50% MCL

PWSID	PL	CONTAMINANT NAME	MCL	SAMPLE DATE	RESULT
60201	1	NITRATE	10	9-Feb-93	8.1
60201	1	NITRATE	10	19-May-93	8.3
60201	1	NITRATE	10	11-Oct-93	**11.8**
60201	1	NITRATE	10	24-Jan-94	8
60201	1	NITRATE	10	17-Jan-95	7.9
60201	1	NITRATE	10	26-Apr-95	7.5
60201	1	NITRATE	10	26-Jul-95	7
60201	1	NITRATE	10	28-Oct-95	6.9
60201	1	NITRATE	10	4-Dec-95	7.4
60201	1	NITRATE	10	30-Jan-96	7.4
60201	1	RADON-222	N/A	8-Apr-96	**3460**
60201	1	NITRATE	10	30-Apr-96	7.9
60201	1	NITRATE	10	23-Jul-96	8.4
60201	1	NITRATE	10	14-Oct-96	7.4
60201	1	NITRATE	10	14-Oct-96	7.4
60201	1	NITRATE	10	14-Jan-97	8.8
60201	1	NITRATE	10	22-Apr-97	7.5
60201	1	NITRATE	10	30-Jul-97	6.4
60201	1	NITRATE	10	3-Oct-97	7.8
60201	1	NITRATE	10	29-Jan-98	6.8
60201	1	NITRATE	10	13-Apr-98	6
60201	1	NITRATE	10	29-Sep-98	6.7
60201	1	NITRATE	10	30-Oct-98	5.9
60201	1	NITRATE	10	12-Dec-98	6.5
60201	1	NITRATE	10	28-Jan-99	7.4
60201	1	NITRATE	10	26-Apr-99	6.9
60201	1	NITRATE	10	22-Oct-99	6.8
60201	1	NITRATE	10	22-Oct-99	6.8
60201	1	NITRATE	10	18-Jan-00	7.2
60201	1	NITRATE	10	31-Jul-00	6
60201	1	NITRATE	10	2-Jan-01	6.3
60201	1	NITRATE	10	30-Apr-01	6.1
60201	1	NITRATE	10	15-Aug-01	6.4
60201	1	NITRATE	10	31-Jan-02	6
60201	1	BERYLLIUM	0.004	20-Feb-02	**0.004**
60201	1	NITRATE	10	29-Apr-02	6
60201	1	NITRATE	10	21-Oct-02	5.9
60201	1	NITRATE	10	27-Jan-03	6.2
60201	1	NITRATE	10	29-Jan-04	6.1

4.4 Microbiological Contaminants

To assess the potential of Ground Water Under the Direct Influence (GWUDI) of surface water, ground water sampling records were reviewed. Ground water supplies are tested for surface water influence to determine their susceptibility to surface water microorganisms such as *giardia* and *cryptosporidium*. These microorganisms are resistant to simple disinfections treatment. Water samples taken from the wells in 2000 (see Table 6) tested positive for total coliform but negative for fecal coliform. The concentrations for total coliform were not high enough to indicate a significant source of microbiological contamination in the wells. The negative fecal concentrations suggests that the wells are not susceptible to surface water microorganisms.

If surface water directly recharges an aquifer through major fractures in rock that do not pass through the soil overburden then the aquifer is likely to have elevated levels of coliform bacteria. These values would be particularly high following a significant rainfall event. Sampling carried out following such events is used to determine the potential for a water supply well to be under the direct influence of surface water. Given the positive total coliform results under dry weather conditions and the significant well usage (44 yrs), it is recommended that additional raw water samples be collected following chlorination of the well and installation of insect proof caps. The relatively elevated turbidity in both wells may indicate a break in the well casing.

TABLE 6. GWUDI Test Results

	Rainfall			Field Test			Lab Results		
	Date	**Rain Amount (in)**	**Location**	**Sampling tap location**	**Temp (°C)**	**pH**	**Turbidity (NTU)**	**Total Coliform (concentration)**	**Fecal Coliform**
1	16-Feb 2000	0	Brinton Woods Nursing and Rehabilitation Center	Raw Tap #1	16.0	5.4	2.1	8.0 MPN/100mL	<1.1
2	16-Feb 2000	0	Brinton Woods Nursing and Rehabilitation Center	Raw Tap # 2	16.3	5.6	5.5	2.6 MPN/100mL	<1.1

4.5 Radionuclides

Radon-222 was detected in the finished water sample in April 1996 (table 5). 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.

Radionuclides have primary drinking water standard parameters. Gross alpha particles and Radium 226 & 228 were not detected at levels of concern in any of the samples collected since 1993.

5. SUSCEPTIBILITY ANALYSIS

To evaluate the susceptibility of the ground-water source to contamination, the following criteria were used:

1. available water quality data
2. presence of potential contaminant sources in the WHPA
3. aquifer characteristics
4. well integrity
5. the likelihood of change to the natural conditions

Wells drilled at the Brinton Woods Nursing and Rehabilitation Center withdraws water from an unconfined fractured rock aquifer. Wells using unconfined aquifers are in general more susceptible to contamination from surface activities. Table 7 summarizes the susceptibility of Brinton Woods Nursing and Rehabilitation Center water supply to the various classes of contaminants.

5.1 Volatile Organic Compounds (VOCs)

Several point sources of VOCs were identified within the WHPA. Although there has not been any detect of VOCs in any of the water samples taken to date, if a spill occurs from any of the ASTs or USTs on the property, it is possible that VOCs could enter the ground water and make its way to the wells. Alternatively, a leak from the tanks may never occur.

Based on the water quality data reviewed, the location of the wells in the front of the property up-gradient of all potential VOCs sources in the WHPA, the water supply at Brinton Woods Nursing and Rehabilitation Center is not susceptible to VOCs.

5.2 Synthetic Organic Compounds (SOCs)

There were no identified point sources containing SOCs within the WHPA and SOC levels for contaminant other than di (2 ethylhexyl)phthalate which was lower than 50% of the applicable MCL. The levels of di (2 ethylhexyl)phthalate were associated with detections in laboratory blank samples that were run concurrently and therefore not believed to represent actual water quality. In addition, from the well information, there is approximately 50 to 80 ft of soil overburden above the bedrock aquifer. Based on the water quality data reviewed, the water supply at Brinton Woods Nursing and Rehabilitation Center is not susceptible to SOCs.

5.3 Inorganic Compounds (IOCs)

Water from the treatment plant has been tested on several occasions from 1993 to 2004 for the presence of IOCs. Nitrate has been detected at levels greater than 50% of the MCL in all water samples since 1993. Based on the water quality data reviewed and the current nitrate concentrations, the water supply at Brinton Woods Nursing and

Rehabilitation Center is susceptible to nitrate contamination but not to other regulated inorganic compounds (IOCs).

5.4 Radionuclides

Radon-222 has been detected at levels higher than 50% of the higher proposed MCL. Radon is prevalent in ground water due to radioactive decay of uranium bearing minerals in the bedrock (Bolton, 1996).

Based on the water quality data, the water supply at Brinton Woods Nursing and Rehabilitation Center is susceptible to radon-222 but not susceptible to other radionuclides.

5.5 Microbiological Contaminants

The data available to MDE for wells 1 and 2 suggest that the sources are not under the direct influence of surface water. Based on the water quality review and the condition of the wells, the water supply at Brinton Woods Nursing and Rehabilitation Center is not susceptible to protozoan contaminants present on the surface such as *giardia & cryptosporidium*. The age of the wells and previously identified deficiencies indicate that further improvements and re-sampling of the wells are needed.

TABLE 7: Susceptibility Logic Chart

Contaminant Name	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected in WQ Samples at Levels of Concern?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible?
VOC	YES	NO	NO	NO	NO
SOC	NO	NO	NO	NO	NO
IOC	YES (nitrate)	Yes (nitrate)	NO	YES (nitrate)	YES (nitrate)
RADIONUCLIDES	YES (Radon-222)	YES (Radon-222)	NO	YES (Radon-222)	YES (Radon-222)
MICROBIOLOGICAL PATHOGENS	YES	NO	YES	NO	NO-protozoa YES-bacteria

6. RECOMMENDATIONS FOR PROTECTING THE WATER SUPPLY

With the information contained in this report, Brinton Woods Nursing and Rehabilitation Center has a basis for better understanding of the risks to its drinking water supply. Being aware of the WHPA, knowing potential contaminant sources, evaluating current and future development, working with agricultural producers and soil conservation agencies, and effective outreach and education are examples of management practices that will help protect the water supply.

Recommendations for the protection of the ground water supply are intended for the rehabilitation center owner and its residents. Specific management recommendations for consideration are listed below.

6.1 Well Inspection and Rehabilitation

A regular inspection and maintenance program of the supply wells should be considered to prevent a failure in the well's integrity, which may provide a pathway for contaminants to the aquifer.

Inspection of the wells indicates opportunity for microbiological contaminants to enter wells. Replacement of the caps, chlorination, and re-sampling is recommended. If the resampling shows positive coliform, then inspection of the well casing integrity is recommended. MDE may be able to assist in the videotaping of the well. If the video indicates a hole in the casing, repair or replacement is recommended.

6.2 Maintenance / Inspection of Petroleum Product Storage

Fuel storage containers should be carefully monitored to prevent spillage when fuel is withdrawn for use in yard machines. Preferably withdrawal should be made in a location with a catchment basin to capture any spillage.

6.3 Public Awareness And Outreach

The management of the nursing home should consider discussing with property owners and businesses located within the WHPA of the activities that may have impacts to the ground water and its quality.

The management of the nursing home should also consider sending pamphlets, flyers, or bill stuffers to its residents to educate them about the WHPA. The staff should also be encouraged to notify the nursing home management of any significant spills from gasoline or any other potentially hazardous substances. Placing signs at the WHPA boundaries is an effective way to make the public aware of protecting their source of water supply and to help in the event of spill notification and response.

6.4 Planning/New Development

The management of the nursing home should be aware of the WHPA limits and evaluate the possible effects to the quality of the ground water prior to building or making any changes. The nursing home should also inform the Carroll County Planning Department of any concerns to future development or zoning changes of properties that are within the WHPA.

6.5 Monitoring

The management of the nursing home should continue to monitor the ground water for all SWDA contaminants as required by MDE.

Annual raw water sampling for microbiological contaminants is a good way to check the integrity of the well. Previous sampling indicated positive total coliform results that should be followed up.

6.6 Contigency Plan

As required by the Code of Maryland Regulations (COMAR) 26.04.01.22, all water system owners are required to prepare and submit for approval a plan to provide safe drinking water under emergency conditions.

6.7 Changes In Use

The management of the nursing home should inform the Water Supply Program at MDE of any changes to pumping rates and when a change in the number of wells used is anticipated. Any changes to the pumping rate and/or the number of supply wells will affect the size and shape of the WHPA.

6.8 Contaminant Source Inventory Updates/Inspections

The management of the nursing home should conduct its own survey of the WHPA to ensure that there are no additional potential sources of contamination.

7. REFERENCES

The following sources of information were consulted as a part of this investigation:

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2. Cleaves, E.T., Edwards, Jr., and Glaser, J.D., 1968, Geology Map of Maryland, Maryland Geological Survey
3. Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36. p.
4. Meyer, G., and Beall, R.M., 1958 The Water Resources of Carroll and Frederick Counties: Department of Geology, Mines and Water Resources Bulletin 22, 355p
5. Nutter, L. J., and Otton, E. G. 1969, Ground Water Occurance in the Maryland Piedmont: Maryland Geological Survey Report of Investigation No. 10, 56p
6. United States Environmental Protection Agency (USEPA). 1999. *Proposed Radon in Drinking Water Rule.* Office of Water. EPA 815-F-99-006. October.
7. United States Environmental Protection Agency (USEPA). 2001. *A Small Systems Guide to the Total Coliform Rule.* Office of Water. EPA 816-R-01-017A. June.

Sources of Data

Water Appropriation and Use Database
Public Water Supply Inspection Reports
Monitoring Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Maryland Office of Planning 2002 Carroll County Land Use Map
USGS Topographic 7.5 minute Quadrangle Map – Winfield Quad

FIGURES

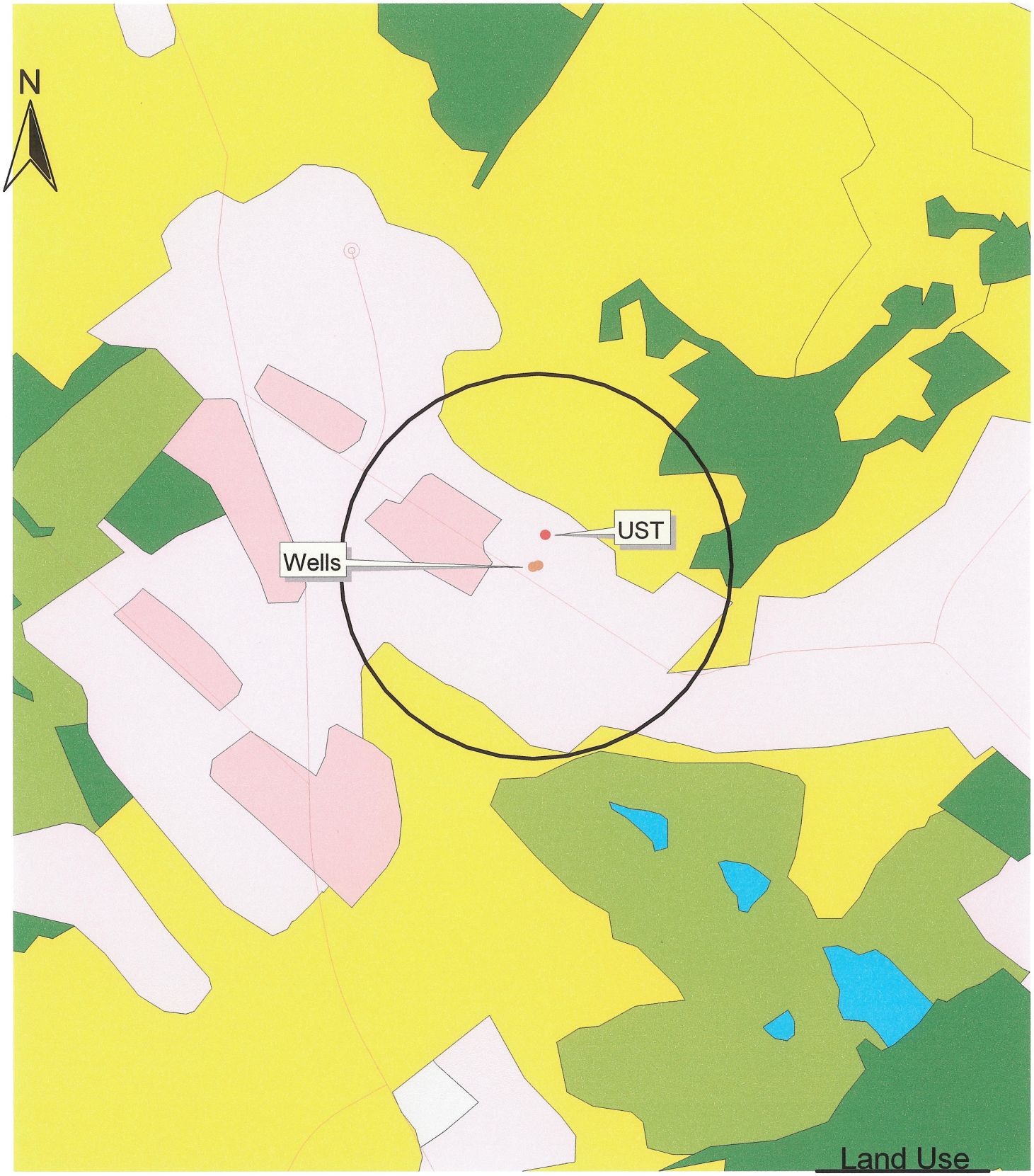

Figure 3: Land Use Type Within WHPA