SOURCE WATER ASSESSMENT

Town of Emmitsburg
Frederick County, Maryland

Photo of Rainbow Lake

Prepared by
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Water Management Administration
Water Supply Program
February 2001

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SUMMARY

The 1996 Safe Drinking Water Act Amendments require states to develop and implement source water assessment programs to evaluate the safety of all public drinking water systems. A Source Water Assessment (SWA) is a process for evaluating the vulnerability to contamination of the *source* of a public drinking water supply. The assessment does not address the treatment processes, or the storage and distribution aspects of the water system, which are covered under separate provisions of the Safe Drinking Water Act. The Maryland Department of the Environment (MDE) is the lead state agency in this source water assessment effort.

There are three main steps in the assessment process: (1) *delineating* the watershed drainage area that is likely to contribute to the drinking water supply, (2) *identifying* potential contaminants within that area and (3) *assessing* the vulnerability of the system to those contaminants. This document reflects all of the information gathered and analyzed required by those three steps. MDE looked at many factors to determine the vulnerability of this water supply to contamination, including the size and type of water system, available water quality data, the characteristics of the potential contaminants, and the capacity of the natural environment to attenuate any risk.

Emmitsburg's source water supply is comprised of ground water from three wells and surface water from Rainbow Lake. The wells draw water from an unconfined fractured rock aquifer that can be vulnerable to activities on the land surface but because of the protected nature of the recharge area and watershed, it was determined the wells are not susceptible to contamination at the current condition. Similarly, the Rainbow Lake watershed is completely forested and the likelihood of the contaminant reaching the intake remains very low under the current condition. The Town of Emmitsburg's water system utilizes an excellent water supply and should be preserved. In order to maintain the high quality of the water supply, the Town is encouraged to implement the recommendations for an active source water protection plan as included in Section VII of this report.

I. INTRODUCTION

The Town of Emmitsburg is located in the north-central part of Frederick County, approximately one mile south of the Pennsylvania state line (Figure 1). The Town owns and operates the water system that serves an estimated population of 2,070 persons (1,027 service connections). Currently, the raw water is supplied by ground water from three wells (Nos. 1, 2, and 3), and surface water from the Rainbow Lake on Turkey Creek. In addition to the above used sources, there are several unused surface and ground water sources located on the Town's protected property in Hampton Valley, between Derr Hill and College Mountain. Table 1 contains a summary of the Town's surface and ground water supplies.

Table 1
Town's Wells and Surface Supplies[1]

Supply Source	**Capacity (Surface) Reported Yield (Well)**	**Current Discharge Point**
Rainbow Lake	33 million gallons	Water treatment plant inlet
Reservoir 1	300,000 gallons (this reservoir receives backwash water; not used as a source)	Not used
Reservoir 2	300,000 gallons (drained, disconnected and not used)	Not used
Reservoir 3	3 million gallons (disconnected from piping)	Not used
Well No. 1	100 gpm	Finished water storage tank
Well No. 2	160 gpm	Clarifier inlet
Well No. 3	109 gpm	Water treatment plant inlet
Old Well No. 4	N/A	Not used
Well No. 5	N/A	Not used
Well No. 6	20 gpm	Not used
Well J	115	Not used and not connected to distribution system
New Well No. 4	42 gpm[2]	Not used (future use)

[1]Smith Environmental Technologies Corporation, June 1996
[2]From Preliminary Impact Analysis Summary for permit FR 1997G032

(A) SURFACE WATER SUPPLY SOURCE

Approximately thirty-eight percent (38%) of the potable water supplied to the Town of Emmitsburg 's customers is appropriated from a surface water source, Rainbow Lake. Rainbow Lake, an impoundment which is owned and operated by the Town of Emmitsburg, is located along Hampton Valley Road approximately one mile west of the water treatment plant. Rainbow Lake is primarily spring fed but does receive runoff from a 523 acre watershed, 40 percent of which is owned by the Town and forms the headwaters of Turkey Creek. An earthen dam was constructed for the primary purpose of supplying water for the Town of Emmitsburg in 1950. The reservoir also serves the local fishing interest (see Table 2 for relevant statistics of Rainbow Lake).

Rainbow Lake watershed lies in the upper Monocacy River drainage basin, between the College Mountain (southeast) and Derr Hill (northwest). Soils in the watershed predominantly are Highfield Series very stony loam, 0 to 20 percent and 20 to 45 percent slopes.

The Highfield Series are well drained and fairly deep. They developed on materials weathered from metabasalt, also known as greenstone or Catoctin Metabasalt. This greenstone contains a considerable amount of quartzite. As a result, most Highfield soils are gravelly and large areas are very stony. The Highfield soils occur chiefly on spurs of the low Blue Ridge Mountains and on inter-mountain areas at rather high elevations in the northern and northwestern parts of the Frederick County (U.S. Department of Agriculture, Soil Survey of Frederick County, 1960).

Rainbow Lake is fed by two feeder streams (Turkey Creek) and a spring on the south side of Hampton Valley Road on College Mountain. Discharge from the Lake is back to Turkey Creek, a tributary to Tom's Creek of the Monocacy River basin. The Rainbow Lake and the Town of Emmitsburg is located at the juncture of the Piedmont and Blue Ridge physiographic provinces. While the Town is within the Triassic Upland subprovince of the Piedmont physiographic province, Rainbow Lake is within the Catoctin Mountain subprovince of the Blue Ridge physiographic province.

Emmitsburg, like the rest of Frederick County, has a humid, temperate climate with an average annual temperature of 50° F or less and an average precipitation range between 44 and 46 inches (*Frederick County Comprehensive Plan 1997*).

Several relevant statistics for Rainbow Lake are provided in Table 2.

Table 2
Physical Characteristics of Rainbow Lake

Location	Frederick County, MD Lat 39° 41' 44" Long 77° 23' 17"
Surface Area	13.5 acres at spillway crest
Length	0.21 miles
Volume of lake	100 acre-feet at spillway crest*
Drainage area to lake	523 acres
Dam	Type – Rolled earth fill Length – 487 feet Height – 25 feet from streambed to top of dam Top width – 12 feet Elevation: Top of dam – 870 MSL Spillway crest – 866.5 MSL*

Department of the Army, Corps of Engineers, Inspection Report, July 1978

*As a result of a drought in 1965-66, the Town raised the spillway 3.5 feet to an elevation of 866.5 MSL, increasing the water supply pool from approximately 63 acre feet to approximately 100 acre feet. The drought gave the Town an opportunity to remove accumulated sediment and debris. Approximately 200 truck loads were removed.

(B) GROUND WATER SUPPLY SOURCES

Emmitsburg presently obtains its ground water supply from three wells (Nos. 1, 2, and 3). A fourth well (No. 4) has been drilled but is not currently in use. Well 4 will be hooked up to the water system when construction of the new water treatment plant is completed. All four wells are located within the Turkey Creek watershed west of the Town and downstream of the Rainbow Lake reservoir (Fig 2). A review of the well completion reports and sanitary surveys of Emmitsburg's water system indicate that Well Nos. 1, 2 and 3 were installed prior to the 1973 well construction regulations went into effect. A September 2000 inspection by water supply staff revealed sanitary defects in all three wells. Wells 1 and 2 had unscreened vents and Well 3 lacked a well cap. The Town's water plant operator, Mr. Dan Fissel, has since addressed these deficiencies by installing a cap on Well 3 and placing screens in Wells 1 and 2. Mr. Fissel stated he would like to complete further repairs on the Well 3 cap, which has proven difficult to seal due to the construction and age of the well. The condition of the casing in Well 2 was reported as "deteriorated" during pump testing in 1998. Well No. 4 was constructed

in 1998, and a review of its permit reveals that it meets well construction standards. Table 3 contains a summary of the well construction data.

PLANT	SOURCE NAME	WELL PERMIT	TOTAL DEPTH	CASING DEPTH	APPROPRIATION PERMIT (*AMT IN GPD*)
01	WELL 1	FR690288	250	76	FR1975G011 (*168,000*)
01	WELL 2	FR035425	161	23	
01	WELL 3	FR650432	212	43	FR1976G114 *(72,000)*
01	WELL 4	FR941117	600	84	FR1997G032 *(40,000)*

Table 3. Town of Emmitsburg Well Information.

The Town has three ground water appropriation permits issued for a combined 280,000 average gallons per day (gpd) on a yearly basis. The permits are considered supplemental, meaning that the individual appropriation limits may be exceeded, as long as the total of 448,000 gpd total, for both ground water and surface water, is not exceeded over the course of the year. These appropriation amounts were arrived at from an extensive review of the Town's water demand and the availability of ground water based on pumping tests of the four wells conducted between 1997 and 1999. Based on the most recent available annual pumpage reports (1999), Wells 1 and 2 averaged 58,000 gpd, and Well 3 average 64,000 gpd.

Emmitsburg's wells draw water from the Catoctin Metabasalt Formation. The Turkey Creek watershed, in which the wells are located, is underlain by this fractured rock aquifer, a dense green schistose rock which is believed to be a series of metamorphosed lava flows (Meyer and Beall, 1958). The primary porosity and permeability are small due to the dense nature of the metabasalt. Ground water moves principally through joint openings and is recharged by precipitation percolating through soil and saprolite. A fracture trace analysis has not been completed in the vicinity of Emmitsburg's wells, however fractures were inferred to be oriented north-south to northeast-southwest from topographic observations and pumping tests conducted in support of the water appropriation permit renewal.

A summary of updated Water Appropriation and Use Permits for surface and ground water supplies are shown in Table 4 below:

Table 4
Town's Water Appropriation and Use Permits

Permits (No.)	Daily Average on A Yearly Basis (GPD)	Daily Average for Maximum Month (GPD)
FR76014(03) Rainbow Lake and the Reservoir near Well #3	168,000	350,000
FR75G011(05) Wells #1 and #2 in the Catoctin Metabasalt	168,000	252,000
FR76G114(03) Well #3 in the Catoctin Metabasalt	72,000	108,000
FR97G032(02) Well #4 in the Catoctin Metabasalt	40,000	60,000

(C) WATER SUPPLY DEVELOPMENT

The Town of Emmitsburg and Mt. St. Mary's College are served by independent water systems which are connected for emergency purposes. Emmitsburg/Mt. St. Mary is one of 14 regional water service areas in Frederick County serving a population of 2,821. A review of population change in Frederick County and municipalities from 1980 to January 2000 indicates a 28% increase of population for the Town of Emmitsburg. This increase is comparable to a 33% increase for Frederick County during the same period. According to Frederick County Planning and Zoning Department, 40% of the current county population resides within the incorporated municipalities. Future customers of the Emmitsburg water system (total service area) is expected to increase to 4,000 by the year 2010 (Davis Renn & Associated, Inc.).

Water Treatment Plant

The Town of Emmitsburg's existing water treatment plant was constructed in 1964. The plant consists of a 26-foot diameter clarifier with a rated capacity of 471 gallons per minute, two 10-foot diameter gravity filters with a maximum filtration rate of 2.0 gallons per minute per square foot. The two filters have a reported capacity of 450,000 gallons per day. The deteriorated physical condition of the filters and associated piping and controls (rust and surface corrosion) and inadequate water supply source due to a growing demand are the major problems for the Town's water system.

In order to address Emmitsburg water system problems, the Town hired engineering firms to evaluate alternatives for Emmitsburg and Mt. St. Mary's College's future water requirements.

The following three alternatives were studied in detail:

1. Operating the Town and college water supply systems as separate systems using ground water and surface water.
2. Operating the Town and college water systems as separate systems, using ground water only.
3. Operating the Town and college water systems as a combined system, using ground water only.

After review of the feasibility of the above alternatives and long-term aquifer testing of water supply wells 1, 2, and 3, the Town decided to proceed with the design and construction of a new treatment facility that will consist of three (3) manually operated pressurized diatomaceous earth (PDE) with the service flow rate for each filter 169 to 171 GPM. The new plant also will be equipped with three automatic multimedia pressure-type roughing filters with provision of a fourth filter. Notice to proceed with the construction was issued on November 14, 2000 with the total of 255 contract days and final completion date of July 29, 2001.

II. RESULTS OF SITE VISIT(S)

Water Supply Program personnel conducted a site survey of the Town's raw water sources and other raw water facilities in order to accomplish the following tasks:

- To collect information regarding the locations of raw water sources and intakes by using Global Positioning System (GPS) equipment.
- To determine the general condition and structural integrity of intakes and other raw water facilities.
- To discuss source water issues and concerns with the Town's water system operators.
- To conduct a windshield survey of the watershed and to document potential problem areas.

The intake tower (gate house) is located in Rainbow Lake. A bridge walkway that extends from the top of the dam's roadway provides access to the gate house. There are four gate valves installed with different elevations of 5', 9' 14' and 18' below the lake's normal pool level. The valve that is located at nine (9) feet below the water level remains open (always) and the valves at elevations 5, 14, and 18 feet below water level always remain closed during the operation of the water plant. Because of the age and inoperable condition of these valves, the

level of the intakes cannot be changed. The intake tower supplies a 12 inch cast iron pipe extending through the dam to the supply system. A six (6) inch cast iron pipe from Rainbow Lake increases to an eight (8) inch line at Well #3, delivering raw water to the treatment plant for a total distance of approximately 5,500 feet.

A mixed supply of groundwater and surface water enters into the treatment plant for processing, with a reported average daily flow of 0.166 MGD (115 gpm). Due to the absence of a raw water meter, the operators estimate the raw water flow based on existing finish (treated) water meter. The ratio of groundwater and surface water flows depends upon the turbidity of Rainbow Lake and is adjusted daily.

As part of the new treatment facilities, it is proposed to install a new valve pit complete with gate valve and flow measurement equipment on an existing 8 inch raw water line from Rainbow Lake. The Well #3 discharge line (3 inch) will be connected below the new valve pit. An additional new raw water meter will be installed to measure daily flow entering the plant. These improvements will enable the Town's water operators to keep more exact records of ground and surface water supplies.

During the field survey of the raw water line from Rainbow Lake to the treatment plant, it was observed that the entire length of the water line is located in the Town's property with the exception of two road crossings. The area is mostly forested and covered with thick brush and vegetation. This condition presents problems to water operators during repair and maintenance of the water line. It is advisable to clear the routing of the raw water transmission line and dedicate a maintenance easement that provides easy access during routine and/or emergency repairs. At the time of our site visit, no apparent leak was detected in the raw water line, but there were a few segments of pipeline exposed without proper cover and embedment.

Operators' major source water concerns for Rainbow Lake were algae bloom during summer months and migration of geese around the reservoir. Copper sulfate is added to the raw water during algae bloom seasons. There is no active water quality monitoring program for collecting samples directly from Rainbow Lake. The Town reports only three water quality parameters (pH, alkalinity and turbidity) for mixed supply of ground and surface water as required by the Monthly Operating Report, and has begun collecting for a raw water bacteriological analysis.

III. WATERSHED CHARACTERIZATION

Source Water Assessment Area Delineation Method (Surface Water)
An important aspect of the source water assessment process is to delineate the watershed area that contributes to the source of drinking water. A source water protection area is defined as the whole watershed area upstream from a water plant's intake (MDE, 1999). Delineation of the source water area was performed by using ESRI's Arc View Geographic Information Software (GIS), utilizing existing GIS data, and by collecting location data using a Global Positioning System (GPS). GPS point locations were taken at each water source intake during site visits and differentially corrected (for an accuracy of +/-2 meters) at MDE. Once intake locations were established, watersheds were delineated based on existing Maryland Department of Natural Resources digital watershed data and Maryland State Highway Administration digital stream coverage. Digital USGS 7.5 topographical maps were also used to perform "heads up" digitizing, or editing, of watershed boundaries.

The source water protection area for Rainbow Lake watershed encompasses 522 acres of mostly forested land above the reservoir. The two feeder streams to Turkey Run and a spring above this reservoir are buffeted by the forested land under private and the Town's ownership. The watershed map (Figure 3) shows the land use in the watershed draining into Rainbow Lake is entirely forested/deciduous. Because of the relatively small size of the watershed, the delineated area shows the whole watershed without a breakdown of sub-watersheds.

Source Water Assessment Area Delineation Method (Ground Water)
The source water assessment area (SWAA) for public water systems using wells in fractured-rock aquifers is the watershed drainage area that contributes to the well. The area should be modified to account for geological boundaries, ground water divides, and by annual average recharge needed to supply the well (MDE 1999). The Turkey Creek watershed upstream of the wells has been delineated as the source water assessment area (Fig. 2). The availability of ground water for the wells was calculated based on this drainage basin when appropriation amounts were issued and therefore it is the appropriate area to use. The flow model developed during pumping tests conducted on wells 1 and 2 show that pumping during dry conditions may cause 0-15 feet of drawdown in the nearest domestic supply wells, therefore the eastern boundary of the SWAA is extended approximately 1000 feet downstream of the wells. It must be noted that wellhead protection areas (WHPAs) are considered as SWAAs for systems using ground water as their source of supply.

Maryland's SWAP also states that where feasible, a fracture trace analysis can be used to delineate the most vulnerable areas around the well. Fracture traces are surface expressions of vertical, closely spaced joints and fractures in the bedrock below. Highly developed fracture systems in bedrock aquifers readily transmit

water; thus fracture trace analysis is commonly used to locate high yield wells in fractured bedrock aquifers. A well intercepting a fracture, or fracture zone, will demonstrate a drawdown pattern that is greatest along the trace of the fracture(s). Although Emmitsburg's wells are located along fractures, separate source water assessment zones have not been delineated due to the complexity of the aquifer. Previous studies have shown that the orientation of fractures controlling ground water flow to the wells is not obvious. Furthermore, well exploration has shown that the saprolite in the Catoctin formation is very thick in places, and therefore may have a large influence on ground water storage and time of travel to the wells.

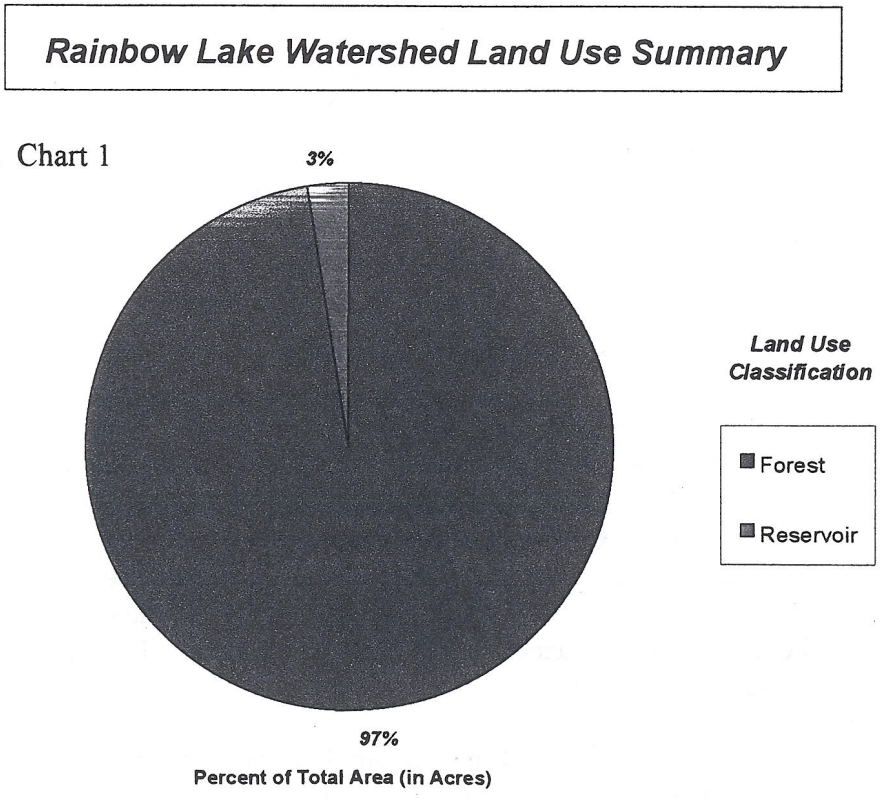
Land Use Characteristics

Based on the Maryland Department of Planning's 1997 land use data, the land use distribution in the Rainbow Lake watershed is summarized in Table 5 and Chart 1 below:

Table 5

Land Use	Total Area in Acres	Percent of Total Watershed
Forest	508.8	97%
Open Water/Lake	13.4	3%

Chart 1



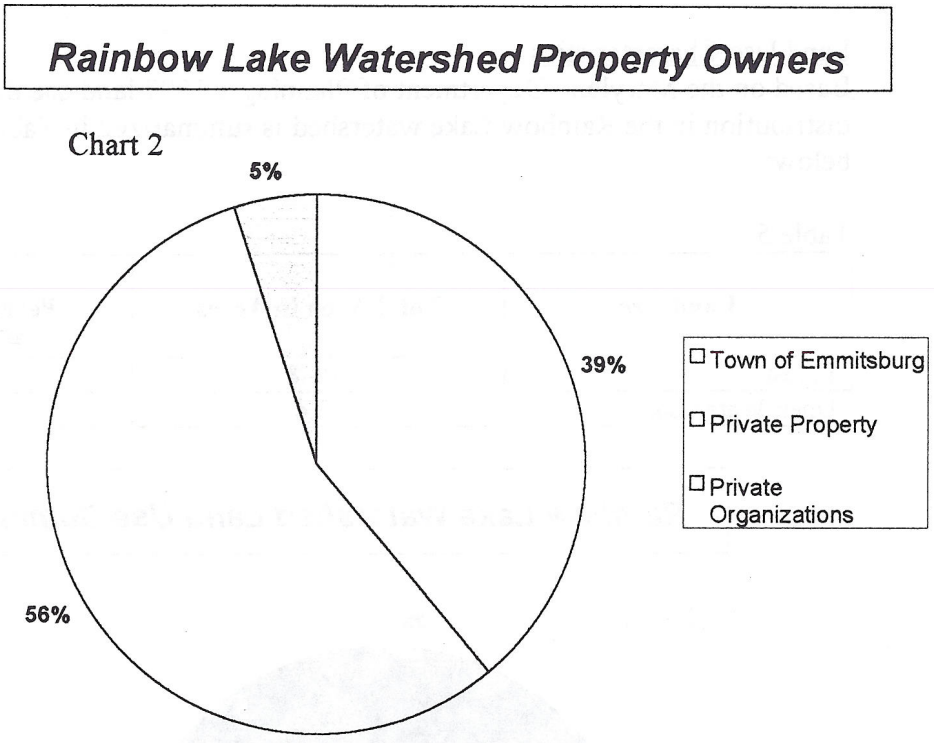
*1997

The property ownership is shown in Table 6 and Chart 2 below:

Table 6

Property	Type	Approximate Total Area in Acres	Percent of Total Watershed
Town of Emmitsburg	Municipal	203	39%
Private Property	Private	294	56%
Private Organizations	Private	26	5%

Chart 2



Localized Characteristics

The Town of Emmitsburg owns a total of 660 acres of land that extends from above Rainbow Lake to the water treatment plant that is located approximately one mile below Rainbow Lake. Hampton Valley Road crosses the watershed south of the reservoir with a forested buffer between the road and Rainbow Lake. There is a private gravel road that crosses the raw water transmission line below the lake, providing access to the adjacent property. This land is considered for future development.

Fishing as only a recreational activity is allowed by the Town in Rainbow Lake; boating and swimming are not allowed.

IV. SIGNIFICANT SOURCES OF CONTAMINATION

Non-Point Concerns

Almost all of the Rainbow Lake watershed is forested and protected from urban non-point pollution runoff. Analysis of land use maps and satellite photography shows that both upper feeder streams draining into the Rainbow Lake are buffered by forest. There is no residential land use in the watershed. There are a few residential houses that exist below the dam adjacent to the Town's owned watershed areas.

Based on the Maryland Office of Planning's 1997 digital land use map of Frederick County, the land use within Emmitsburg's SWAA is completely forested. The digital sewer service map shows that the entire SWAA is in an area that is not planned for service.

Point Discharge Concerns

No point sources of contamination were identified in the Emmitsburg Source Water Assessment Area (SWAA).

Transportation Related Concerns

Hampton Valley Road is the only paved transportation corridor in the watershed, a fairly traveled road leading to Summit Lake Camp and Shamrock Acres.

V. REVIEW OF WATER QUALITY DATA

Water quality data was reviewed from the Water Supply Program's database for safe drinking water act contaminants. Data from the water source (combined ground and surface) and treated water from the water plant was compared with Maximum Contaminant Levels (MCLs). If any monitoring data is greater than 50% of an MCL, a detailed susceptibility analysis will be performed for that contaminant and its probable source. Due to the absence of an active water quality monitoring program for Rainbow Lake and lack of adequate raw water data, this review will rely mostly on plant data. Plant data reflects the quality of mixed supply of ground and surface water.

All contaminants detects from the plant data are listed below. Most data is from finished (treated) water unless otherwise noted.

Existing Plant Data

The Town of Emmitsburg is required to perform water quality tests on the drinking water produced from the water treatment plant in order to ensure compliance with the EPA's Safe Drinking Water Act (SDWA) requirements. They are also required to submit operating reports to MDE which includes daily testing of some raw water quality parameters such as turbidity (cloudiness of the water), alkalinity and pH. Review of the Town's monthly operating reports from

April 1999 to March 2000 indicates that the turbidity of the raw water (mixed supply of ground and surface water) fluctuates from 1 NTU to 8 NTU. The pH of the raw water is relatively stable and well within the 6.5 – 8.5 range as recommended by secondary standard for drinking water.

Inorganic Compounds (IOCs)

The Emmitsburg plant regularly tests for the presence of nitrate in finished drinking water. Below is a summary of nitrate testing results.

Nitrate Table

Contaminant Name	MCL (ppm)	Sample Date	Result (ppm)
Nitrate	10	12/17/1993	0.86
Nitrate	10	02/03/1994	0.3
Nitrate	10	09/13/1995	1.18
Nitrate	10	08/27/1996	0.68
Nitrate	10	12/03/1996	0.6
Nitrate	10	07/28/1997	0.6
Nitrate	10	12/01/1999	0.4
Nitrate	10	07/25/2000	0.5

Results of monitoring for regulated inorganic contaminants is listed below.

Other Inorganic Contaminants

Contaminant Name	MCL (ppm)	Sample Date	Result (ppm)
Barium	2	08/27/1996	0.007
Barium	2	07/21/1998	0.033
Barium	2	07/25/2000	0.009
Fluoride	4	08/27/1996	0.752
Fluoride	4	07/25/2000	0.46
Nickel	0.1	07/21/1998	0.0007
Nitrite	1	12/03/1996	0.005
Nitrite	1	07/28/1997	0.002

Synthetic Organic Compounds (SOCs)

MDE conducts annual SOC testing at Emmitsburg. Below is a summary of SOCs detected at the water plant. Di(2-Ethylhexyl) Adipate and Di(2-Ethylhexyl) Phthalate were also found in laboratory blank samples and therefore not believed to represent the actual water quality of the system.

SOC Detect Table

Contaminant Name	MCL (ppm)	Sample Date	Result (ppm)
Dalapon	200	05/31/1995	0.225
Dalapon	200	08/08/2000	1.74
Picloram	500	08/08/2000	0.32
Di(2-Ethylhexyl) Adipate	400	05/31/1995	2.34
Di(2-Ethylhexyl) Adipate	400	06/19/2000	0.6
Di(2-Ethylhexyl) Phthalate	6	05/31/1995	1.33
Di(2-Ethylhexyl) Phthalate	6	06/19/2000	0.7

Volatile Organic Compounds (VOCs)

The Emmitsburg water supply has not detected any VOCs above 50% of the MCL, Annual VOCs samples were reviewed for the years 1990 – 2000.

Radionuclides

There is currently no MCL for Radon-222, however EPA has proposed a MCL of 300 pCi/L or an alternate of 4000 pCi/L. Although Radon-222 has been detected in Emmitsburg water supply, it has not exceeded the 50% MCL threshold level. The highest level of radon in Emmitsburg's finished water is 145 pCi/L. Since this is a combined result for all sources, it is not clear what the level of radon is in the wells. However, it is likely that the wells have a higher level than the surface supply because it is a common contaminant found in ground water in the Blue Ridge due to naturally occurring elements in the bedrock that decay to form radon.

Microbiological Contaminants

The Town sampled raw (untreated) water from all 3 wells to test for "Ground Water Under the Direct Influence of Surface Water" (GWUDI) in 1995 and 1996. The wells were free of fecal coliform and turbidity levels were consistently less than 1 NTU (Table 7). The wells were determined not influenced by surface water. Wells 2 and 3 both had total coliform bacteria present in several samples. Total coliforms are a group of bacteria that are ubiquitous in the environment. The coliform group is used as an indicator of contamination, but is not as specific as the fecal coliform group, which is used to indicate the presence of human or mammal waste.

MDE with cooperation of the Town of Emmitsburg water plant operators is currently conducting a raw water bacteriological monitoring study for a period of two years, which started in October 2000. The raw water samples are collected bi-weekly and delivered to the Maryland Department of Health and Mental Hygiene central lab for testing of E. Coli and fecal coliform. Upon completion of the study, the data will be reviewed to further understand the microbiological quality of the raw water.

Table 7

Sample Location	Sample Type	Sample Date	Total Coliform (MPN/100 ml)*	Fecal Coliform (MPN/100 ml)	Temp. (°C)	pH	Turbidity (NTU)
Well 1	Dry Weather	12/20/95	<1.1	<1.1	13	6.7	0.17
Well 2	Dry Weather	10/14/96	4.6	<1.1	14	7.3	0.052
Well 2	Dry Weather	10/16/96	1.1	<1.1	n/a	6.9	n/a
Well 2	Wet Weather	1/22/96	2.6	<1.1	11	6.6	0.25
Well 2	Wet Weather	1/23/96	4.6	<1.1	10.8	6.8	0.18
Well 2	Wet Weather	1/24/96	2.6	<1.1	12	6.8	0.22
Well 2	Wet Weather	1/25/96	<1.1	<1.1	11	6.7	0.25
Well 2	Wet Weather	3/12/96	<1.1	<1.1	10.9	6.5	0.04
Well 2	Wet Weather	3/13/96	<1.1	<1.1	13.2	6.9	0.045
Well 2	Wet Weather	3/14/96	<1.1	<1.1	11.6	6.8	0.05
Well 2	Wet Weather	12/16/96	<1.1	<1.1	10.8	6.7	0.08
Well 2	Wet Weather	12/17/96	2.6	<1.1	11.1	6.7	0.08
Well 2	Wet Weather	12/18/96	2.6	<1.1	11.6	7.0	0.1
Well 2	Wet Weather	12/19/96	<1.1	<1.1	11.6	7.2	0.095
Well 3	Dry Weather	10/14/96	4.6	<1.1	14.5	7.1	0.038
Well 3	Dry Weather	10/16/96	1.1	<1.1	n/a	6.9	n/a
Well 3	Wet Weather	1/22/96	2.6	<1.1	13	7.0	0.2
Well 3	Wet Weather	1/23/96	4.6	<1.1	12.7	6.7	0.2
Well 3	Wet Weather	1/24/96	8.0	<1.1	14	6.99	0.19
Well 3	Wet Weather	1/25/96	8.0	<1.1	13	6.9	0.78
Well 3	Wet Weather	3/12/96	<1.1	<1.1	13.7	6.3	0.1
Well 3	Wet Weather	3/13/96	<1.1	<1.1	13.6	6.6	0.055
Well 3	Wet Weather	3/14/96	<1.1	<1.1	14.3	6.6	0.048
Well 3	Wet Weather	3/15/96	<1.1	<1.1	14.6	7.1	0.065
Well 3	Wet Weather	12/2/96	<1.1	<1.1	11.2	6.8	0.09
Well 3	Wet Weather	12/3/96	2.6	<1.1	11.8	6.9	0.095
Well 3	Wet Weather	12/4/96	<1.1	<1.1	12.2	6.9	0.08
Well 3	Wet Weather	12/5/96	<1.1	<1.1	11.4	7.0	0.09

Table 7. Raw water GWUDI Testing Data for Emmitsburg Wells.
*MPN = Most Probable Number

VI. SUSCEPTIBILITY ANALYSIS

(A) GROUND WATER SUPPLY

Emmitsburg's wells draw water from an unconfined fractured rock aquifer, and therefore can be vulnerable to any activity on the land surface that occurs within the SWAA. In order to determine *susceptibility* to each group of contaminants the following criteria were considered: 1) the presence of potential contaminant sources within the SWAA, 2) water quality data and 3) the well and aquifer conditions. Based on the protected nature of the forested watershed in which the wells are located, the lack of potential contaminants in the SWAA, and the water quality data, the wells are considered not susceptible to the inorganic, volatile organic, and synthetic organic compound groups. Based on the review of raw water GWUDI data, the wells are not susceptible to protozoa. However, the GWUDI data together with the structural condition of the wells indicate that the wells may be susceptible to viruses. Additionally, the old unused wells represent a risk to the aquifer.

Microbiological Contaminants

The consistent presence of total coliform bacteria in Wells 2 and 3 indicate that they are susceptible to viral contamination. Total coliform bacteria are a broad class of organisms found in the digestive tracts of human and animals, but may also occur in the natural environment. The presence of these organisms in well water indicate that ground water moves through the soil and saprolite fast enough to allow for organisms with relatively long survival rates, such as viruses, to reach the wells. The age of the wells and the condition of the casing may also create routes for coliform bacteria to enter the wells. The fecal coliform bacteria group is used as an indicator for pathogens because they are associated with fresh feces from mammals or humans. The absence of fecal coliform in the wells and their low turbidity indicate that they are **not** susceptible to pathogenic protozoa, such as *Giardia* and *Cryptosporidium*.

Inorganic Compounds

The wells are **not** susceptible to inorganic compounds. The only IOCs that have been detected were well below 50% of the MCL. There are no potential contaminant sources identified in the SWAA for this group of compounds.

Radionuclides

There is currently no MCL for Radon-222, however EPA has proposed an MCL of 300 pCi/L or an alternate of 4000 pCi/L if the State has a program to address the more significant risk from radon in indoor air. The EPA received many comments in response to their proposed rule, and promulgation may be delayed. Radon-222 has been detected in

Emmitsburg's water supply, but below 50% of the lower proposed level of 300 pCi/L. The source of radon in ground water can be traced back to the natural occurrence of uranium in rocks. Radon is prevalent in ground water of crystalline rock aquifers, such as the Catoctin Metabasalt, due to radioactive decay of uranium bearing minerals in the bedrock (Bolton, 1996). The EPA also has information on proposed regulations for radon in indoor air and drinking water on their web site (http://www.epa.gov/OGWDW/radon.html). Currently, it appears that Emmitsburg's water supply is **not** susceptible to radon or other radionuclides.

Volatile Organic Compounds

The wells are **not** susceptible to volatile organic compounds. VOCs have not been detected in the wells and no potential contaminant sources were identified within the SWAA.

Synthetic Organic Compounds

The wells are **not** susceptible to synthetic organic compounds. The SOCs detected in the finished water were either at very low levels compared to MCLs or have been associated with laboratory contamination and therefore are not representative of the actual water supply. No potential contaminant sources were identified within the SWAA.

(B) SURFACE WATER SUPPLY

The Rainbow Lake watershed is almost 100% forested and the streams above the lake are entirely protected by forest. This condition greatly reduces the presence and impact of contaminants before reaching the reservoir. However, like any other surface water source, Rainbow Lake is subject to higher turbidity during heavy storms or snowmelt. Because of its relatively small size of watershed and steep slopes, the storm water travels quickly, transporting sediment to the reservoir. Also, the ability of the reservoir to mitigate a high turbidity is limited by its relatively small capacity, especially during low water supply (drought). Excessive turbidity can interfere with the water treatment process and can carry harmful microorganisms into drinking water supplies. An example of raw water turbidity changes during year 1999-2000 is shown below. This chart indicates a relatively consistent water quality with measured raw water levels all below 10 NTUs, even during heavy rainfall.

EMMITSBURG WATER TREATMENT PLANT

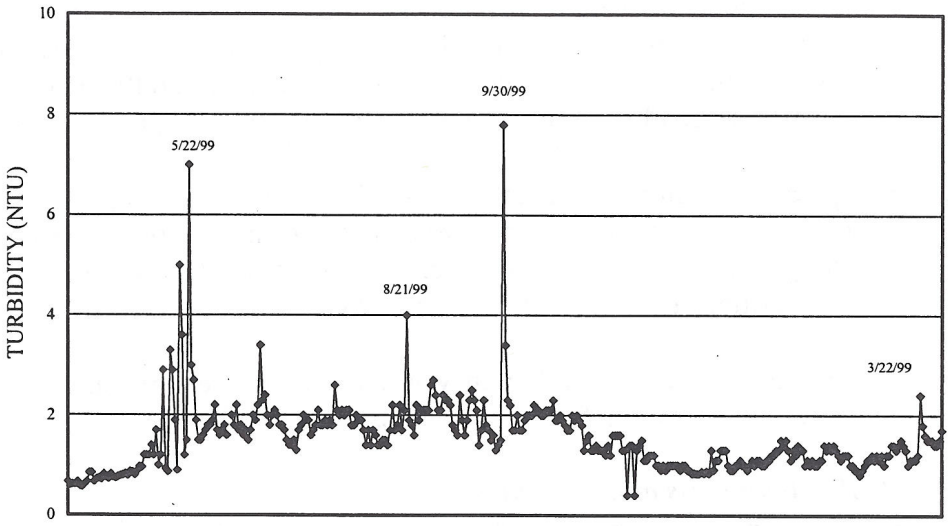


FIGURE 3 - RAW WATER TURBIDITY (APR 99 - MAR 00)

The surface water supply of Emmitsburg may be threatened by potential spills of hazardous materials into the Rainbow Lake upstream of intake along the Hampton Valley Road that may occur due to vehicular accidents. This road is not often used so the likehood of such an accident is not very high.

The deteriorated condition of intake valves increases the susceptibility of the reservoir to low dissolved oxygen (DO) level during summertimes when the stratification occurs. The inability to change the level of intake in the reservoir during those times can increase the cost of the treatment process by requiring additional chemicals to address taste and odor problems.

VII. RECOMMENDATION FOR SOURCE WATER PROTECTION PLAN

With the information contained in this report the Town of Emmitsburg is in a position to protect its water supply by staying aware of the area delineated for source water protection and evaluating future development and land planning. Specific management recommendations for consideration are listed below:

Form a Local Planning Team

- Emmitsburg should continue to work with Frederick County to implement a source water protection plan. The Town might want to recruit volunteers from the community.

- A management strategy adopted by Emmitsburg should be consistent with the level of resources available for implementation. By consulting with other jurisdictions involved in this process, the Town can benefit from lessons learned by others. There are at least two other nearby municipalities actively involved in wellhead protection (Walkersville and Middletown). MDE remains available to assist in anyway we can help the process.

- MDE has grant money available for Wellhead Protection projects. The Town may want to consider having a fracture trace analysis or other hydrogeologic study to define Zone 1 for the wells. This would allow the Town to know the most critical areas for wellhead protection.

- Emmitsburg should work with Maryland Department of Natural Resources (DNR) to develop a forest management plan for SWAA.

Public Awareness and Outreach

- The Consumer Confidence Report should list that this report is available to the general public through their county library, by contacting the town office or MDE.

- Road signs at the SWAA boundaries is an effective way of keeping the relationship of land use and water quality in the public eye, and help in the event of spill notification and response.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE including raw water reservoir when feasible. MDE remains available to assist the Town to establish a water quality monitoring plan for Rainbow Lake Reservoir.

- Continue monitoring for fecal coliform and E. Coli for raw water after the two-year MDE sponsored monitoring program is over.

Planning/ New Development

- Review the State's model wellhead protection zoning ordinances for potential adoption. MDE recommends that water supply owners encourage the County to adopt a wellhead protection ordinance.

Land Acquisition/Easements

- Loans for purchase of land or easements to protect water supplies is available to Emmitsburg from MDE. Loans are offered at zero percent interest and zero points. Eligible lands must be in the source water assessment area.

Contingency Plan

- Emmitsburg should have a Contingency Plan for its water system. COMAR 26.04.01.22 requires all community water systems to prepare and submit for

approval a plan for providing a safe and adequate drinking water supply under emergency conditions.

- Develop a spill response plan should an accident occur on Hampton Valley Road in concert with the Fire Department and other emergency response personnel.

Changes in Use

- Emmitsburg is required to notify MDE when new wells are to be put into service. Drilling a new well outside the current SWAA would modify the area, therefore Emmitsburg should contact the Water Supply Program if a new well is being proposed.

Contaminant Source Inventory Updates

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

- The Town should survey the source water assessment area periodically and note any new potential sources of contamination. The Town of Emmitsburg should continue to conduct its own detailed field survey of the watrshed to ensure that there are no new potential sources of contamination in the future.

- The Town will update MDE on potential land use changes that may increase the susceptibility of water supplies.

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Smith Technology Corporation, 1997, *Long-term aquifer testing of water supply wells 1, 2, and 3 in support of application numbers FR76G114 and FR75G011 prepared for the Town of Emmitsburg*, 31 pp.

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U.S. Department of Agriculture, Soil Conservation Service, 1960, *Soil Survey Frederick Co.*

Hyder Consulting, Inc., 2000, *Town of Emmitsburg Project Manual for New Water Treatment Plant.*

OTHER SOURCES OF DATA

Water Appropriation and Use Permit No. FR1975G011, FR1976G114, FR1997G032
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle® Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles for Emmitsburg NW and Blue Ridge Summit NE and SE
USGS Topographic 7.5 Minute Quadrangles Emmitsburg and Blue Ridge Summit
Maryland Office of Planning 1997 Frederick County Digital Land Use Map
Maryland Office of Planning 1996 Frederick County Digital Sewer Map

FIGURES

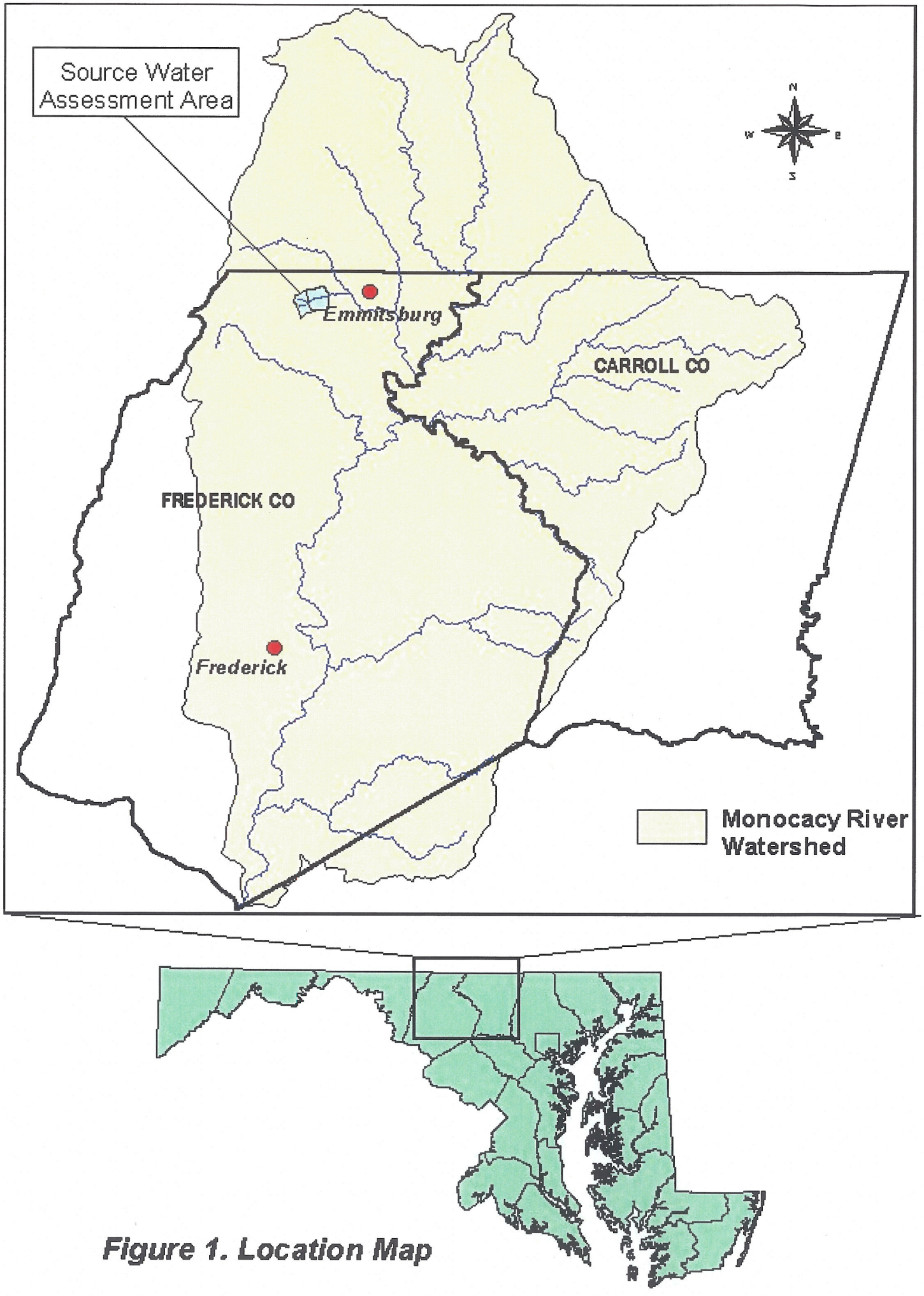

Figure 1. Location Map

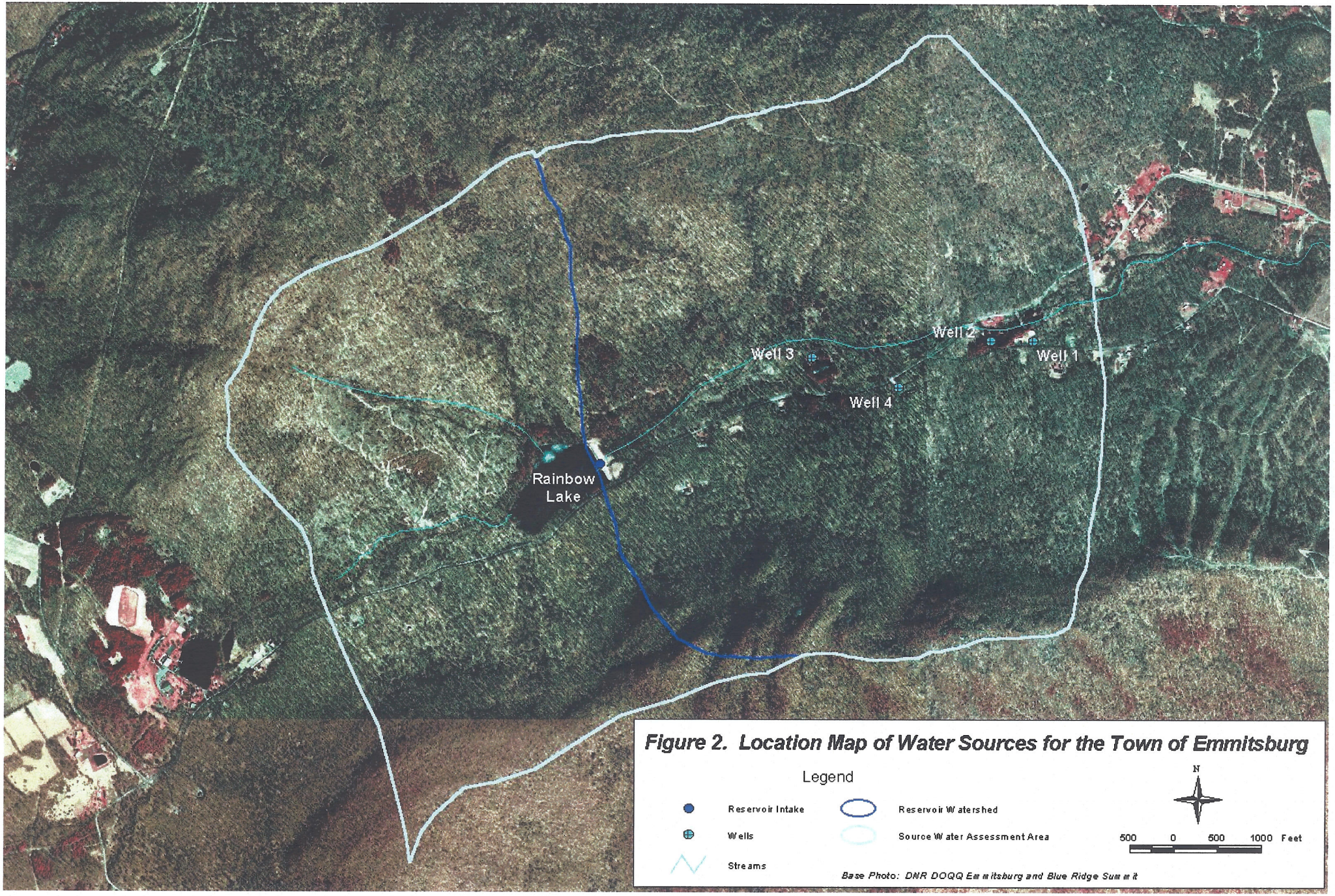

Figure 2. Location Map of Water Sources for the Town of Emmitsburg

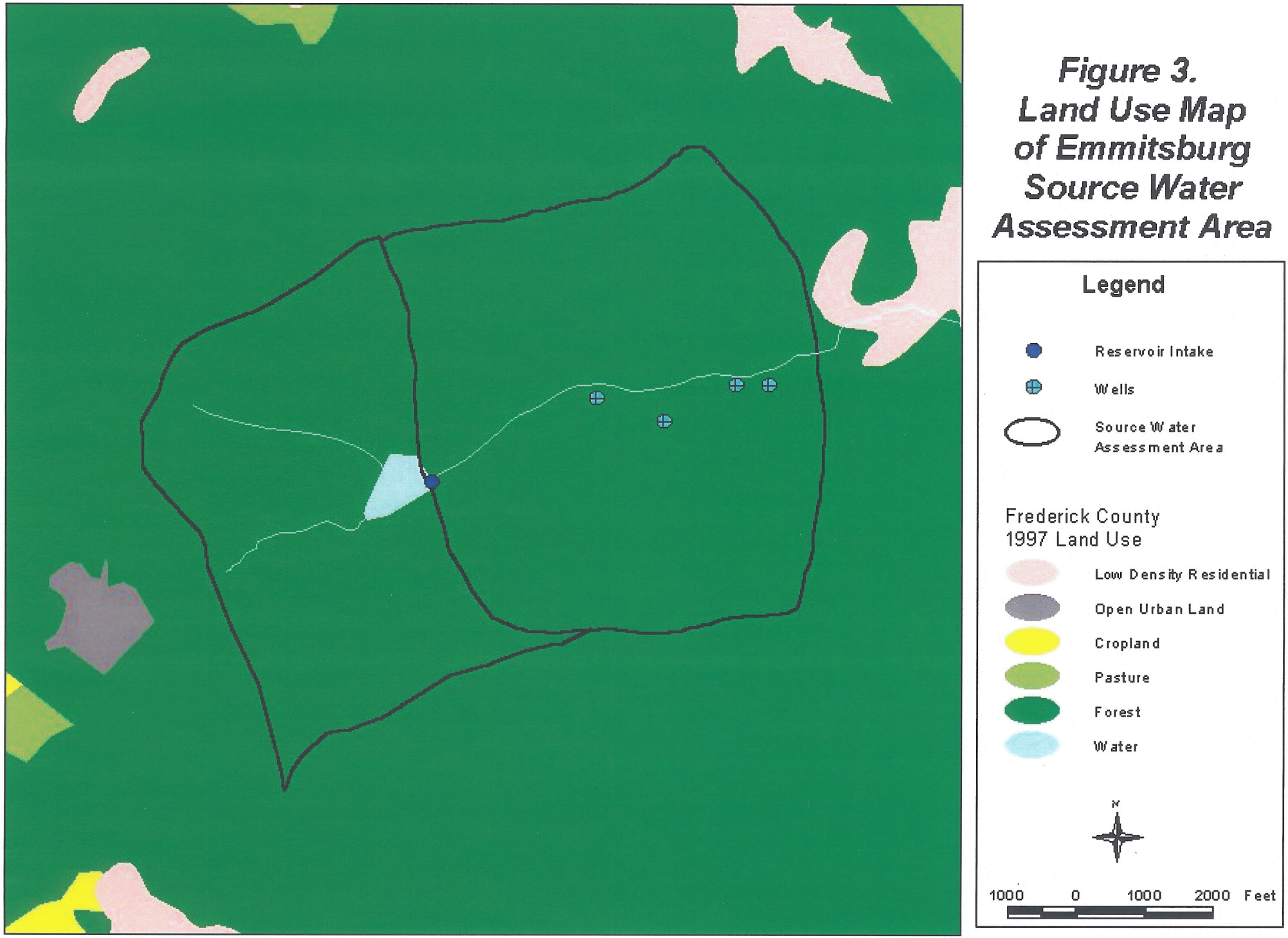

Figure 3. Land Use Map of Emmitsburg Source Water Assessment Area