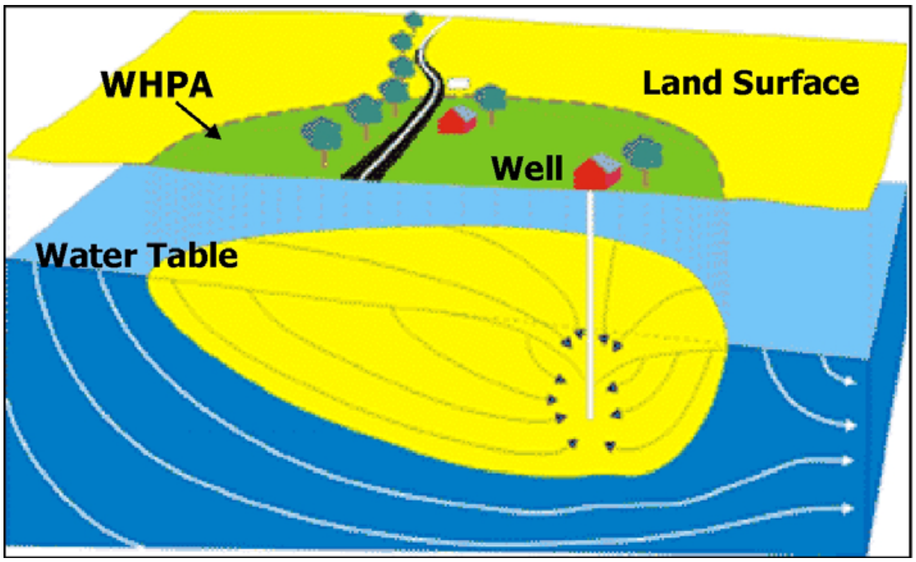
Source Water Assessment

for the Town of Walkersville
Frederick County, MD



Prepared By
Maryland Department of the Environment
Water Management Administration
Water Supply Program
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MDE

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SUMMARY

The Maryland Department of the Environment's Water Supply Program has conducted a Source Water Assessment for the Town of Walkersville. The required components of this report as described in Maryland's Source Water Assessment Program (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 Walkersville's water supply is an unconfined carbonate rock aquifer. Walkersville currently uses three wells. The Source Water Assessment area was delineated for the Town of Walkersville using U.S. EPA approved methods specifically designed for each source.

Potential point sources of contamination were identified in within the assessment area were identified from contaminant inventory databases conducted during a Wellhead Protection project. The Maryland Office of Planning's 1997 land use map for Frederick County was used to identify non-point sources of contamination. Well information and water quality data were also reviewed. Figures showing land use and the location of sinkholes and fracture traces with the Source Water Assessment Area and an aerial photograph of the well locations are enclosed at the end of the report.

The susceptibility analysis is based on the existing water quality data for the Town of Walkersville's water system, the presence of potential sources of contamination in the assessment area, well integrity, and the inherent vulnerability of the aquifer. It was determined that Walkersville's wells are susceptible to contamination by any activity at the land surface within the Source Water Assessment Area. Specifically the source is susceptible to inorganic compounds (particularly elevated nitrate levels), volatile organic chemicals (from improper disposal of solvents of leaks from underground fuel tanks), synthetic organic chemicals (from excessive pesticide applications or spills) and microbiological contamination (from runoff from agricultural and residential lands).

INTRODUCTION

The Town of Walkersville is located approximately 5 miles northeast of the City of Frederick, in Frederick County. Walkersville's water supply system serves a population of 7500 and has 2438 service connections. Walkersville presently obtains its water supply from three wells (Nos. 1, 2, and 3). Three additional wells are located within the Town that formerly served the water supply but have been out of use for many years.

Walkersville has been involved with the State's Wellhead Protection Program for several years and has received grants for two wellhead protection projects. This document summarizes information from the completed wellhead projects and activities and also contains the required components of Maryland's Source Water Assessment Plan; delineation, contaminant source inventory, and susceptibility analysis.

WELL INFORMATION

A review of the well completion reports and sanitary surveys of Walkersville's water system indicate that Well Nos. 2 and 3 meet the State's well construction standards and that Well No. 1 was installed prior to the 1973 regulations went into effect. Table 1 contains a summary of the well construction data.

PLANT	SOURCE NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	AQUIFER
01	WALKERSVILLE 1	FR720037	300	93	GROVE LIMESTONE
01	WALKERSVILLE 2	FR810307	120	37	GROVE LIMESTONE
01	WALKERSVILLE 3	FR815107	250	22	GROVE LIMESTONE

Table 1. Town of Walkersville Well Information.

The Town has a ground water appropriation permit (FR1978G017) issued for a daily average of 1,000,000 gallons on a yearly basis. Based on the most recent available annual pumpage report (1998), the three production wells are producing an average of 755,000 gallons per day (gpd). This would equate to an average well production of 175 gallons per minute (gpm), however 24 and 72 hour pump tests conducted on well Nos. 2 and 3 when they were installed indicated much higher capacities (525 and 830 gpm, respectively).

HYDROGEOLOGY

Walkersville's wells draw water from the Grove Formation (Fig. 1). The Town of Walkersville and the surrounding vicinity is underlain by this carbonate rock aquifer, an interbedded sequence of fossiliferous limestone and laminated to massive dolomite (Nutter, 1973). This formation is a prolific aquifer due to solution-enlarged fractures, joints, and bedding planes that rapidly transport water. Ground water is recharged by precipitation percolating though soil and saprolite, through direct runoff into sinkholes, and by losing streams in this karst-like aquifer. Near Walkersville, the majority of ground water storage is in the upper 30 feet of the bedrock, known as the epikarst (Aley, 1993). Aley also found that the stream channel of Glade Creek contributes approximately 25% of the water pumped from the Town wells.

Field (1993) mapped the bedrock geology of the Walkersville area. As part of a wellhead project, the Town had this geology base map (Fig. 1), as well as fracture traces and sinkholes (Fig. 2), digitized into a Geographic Information System (GIS).

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered the source water assessment area for the system. The WHPA represents the area around a well in which any contaminant present could ultimately reach the well. A WHPA was delineated in 1993 for Well Nos. 1, 2 , and 3 (Fig. 2) using fluorescent tracer dyes, and is used in this report since no changes have been made to the water system (Aley, 1993). Based on the dye study, ground water divides coincide with watershed boundaries and ground water supplying the wells is partially recharged from the channel of nearby Glade Creek. Therefore, the Glade Creek watershed upstream of the well field is delineated as the WHPA.

Hydrogeologic mapping identifies the physical and hydrologic features that control ground water flow (EPA, 1991). In Walkersville, hydrogeologic mapping was used to identify geologic formation boundaries and to identify major fractures that are likely to transmit water. Sinkholes were mapped because they can contribute recharge from stormwater runoff that moves rapidly from the surface to the Town wells. Travel times encountered during dye tracing ranged from a few hours to a few days.

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). Earth Resources Technology, Inc (ERT) mapped fracture traces in Walkersville's WHPA (Fig. 2). The Town wells do not appear to fall on any of the fractures mapped, however many sinkholes do tend to follow fracture traces. The importance of fracture trace mapping in Walkersville is to identify locations where sinkholes are likely to form.

Delineation Zones

A single zone has been delineated as the wellhead protection area for Walkersville's wells using the information gathered from the 1993 dye tracing study. The WHPA follows the topographic drainage basin boundaries of Glade Creek upstream of the wellfield. Pumping during dry conditions may cause some drawdown to the south of the well field, therefore the southern boundary of the WHPA is extended approximately 1500 feet downstream. Sinkholes to the south of the wellfield do not appear to be connected to the wells based on dye tracing (Aley, 1993).

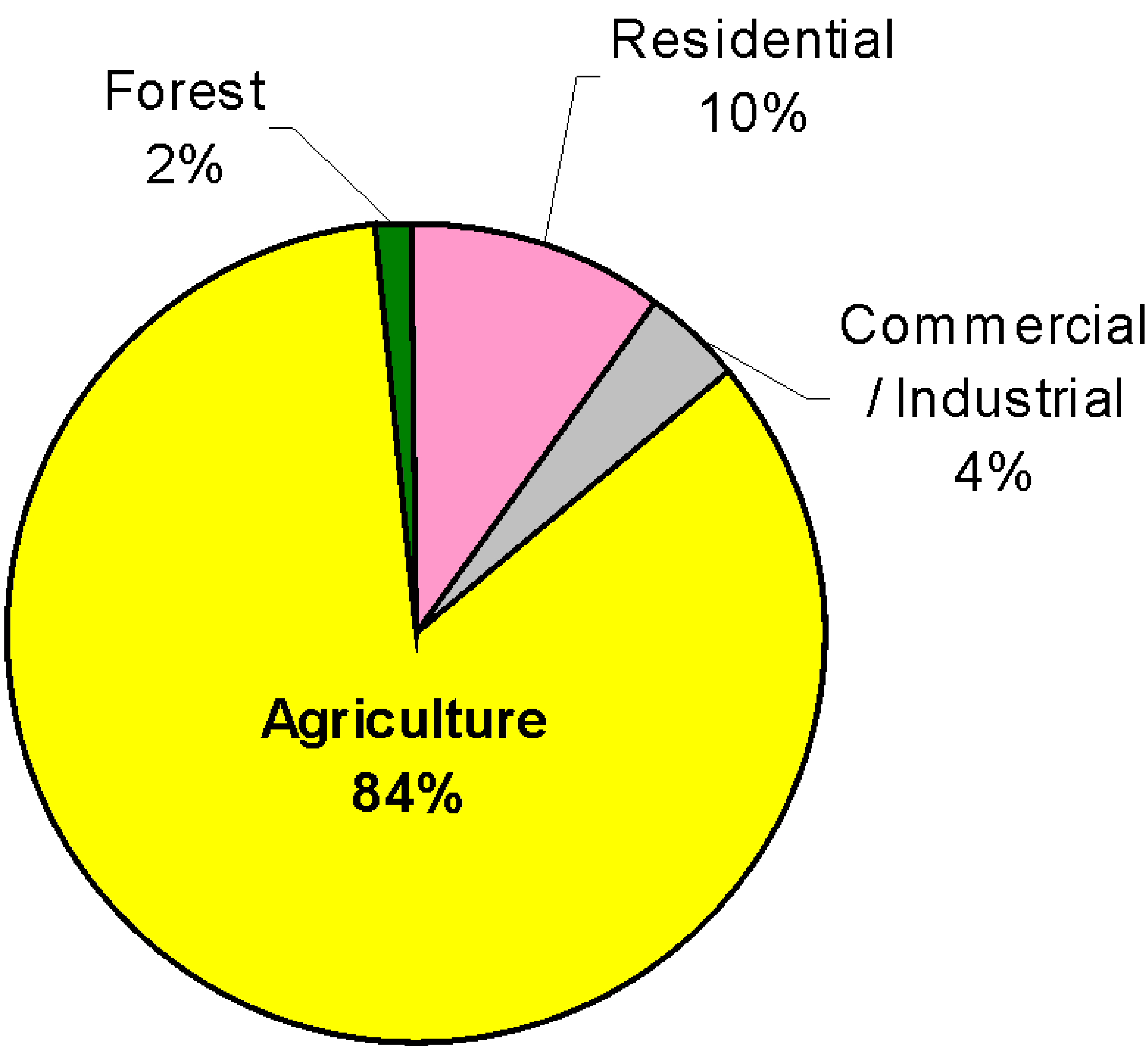
It is difficult to precisely model time of travel (TOT) in a heterogeneous aquifer such as the Grove limestone. Additionally, the karst features in this area make it difficult to delineate continuous "zones" where water will flow to a well in a predictable manner or in an expected TOT. However, dye tracing has shown that contaminants washed into sinkholes or in stream water can arrive in the wells in a matter of days. Therefore the area along Glade Creek and surrounding sinkholes are considered the most vulnerable areas within the WHPA and a "critical" zone should be established. The critical zone may be defined, for example, as a 100-foot buffer zone along Glade Creek and around identified open sinkholes. This zone is not mapped because this is a system that is constantly changing, and because the Town is identifying sinkholes as they are discovered or as they open. Contaminant spills or other threats should be responded to immediately if they occur in the critical zone.

POTENTIAL SOURCES OF CONTAMINATION

Several potential point sources of contamination have been identified in the Environmental Assessment Report completed by ERT (2000). A descriptive table of these point sources is included in the appendix. This is a comprehensive list, however facilities have not been field verified and locations are not mapped. Potential contaminants were identified from several databases (Appendix, Table 1) from the State of Maryland including Underground Storage Tanks (UST), Leaking Underground Storage Tanks (LUST), Above Ground Storage Tanks (AST), State Hazardous Waste Sites (SHWS), and from Federal databases including Resource Conservation and Recovery System (RCRIS), Hazardous Materials Information Reporting System (HMIRS), Emergency Response Notification System (ERNS), Facilities Index System (FINDS), Toxic Release Inventory System (TRIS), and Toxic Substances Control Act (TSCA). Twenty-five sites from this database search were identified within the WHPA. Table 2 of the appendix lists these facilities and the associated potential contaminants for the facility type. These are based on generalized categories associated with use 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. Table 3 of the appendix lists the potential contaminants associated with the permitted land uses in the area. These may include current and potential activities in the area.

Based on the Maryland Office of Planning's 1997 Land Use map, the land use within Walkersville's WHPA is primarily agricultural (84%) with smaller proportions of

Land Use Summary for Walkersville WHPA



residential and commercial/industrial areas (Fig. 3). Most of the residential and commercial/industrial land use is in the southern part of the WHPA, where the wells are located, and within the Town corporate limits. Table 2 outlines the distribution of land use within the WHPA.

Land Use	Total Area (Acres)	Percentage of Total WHPA
Low Density Residential	111	2.6
Medium Density Residential	270	6.4
High Density Residential	50	1.2
Commercial	171	4.0
Cropland	3386	80.0
Pasture	160	3.8
Feeding Operations	20	0.5
Forest	64	1.5
Total	4232	100

Table 2. Land Use Summary of Walkersville WHPA.

A review of the Maryland Office of Planning's Frederick County Sewer map shows that 14% of the land area in the WHPA is in the sewer service area and 82% of the WHPA is not planned for sewer service (Fig. 4). The medium and high density residential, commercial, and industrial areas in the WHPA tend to follow the boundaries of the existing sewer service area. Almost all of the area that is not planned for service is currently shown as agricultural land on the land use map, with the exception of small pockets of low density residential and forested areas that collectively cover an area of 174 acres.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database for Safe Drinking Water Act contaminants. All data reported is from the finished (treated) water unless otherwise noted. The treatment currently in use in Walkersville includes disinfection, ion exchange for nitrate removal and softening, coagulation, rapid sand and membrane filtration for microorganism removal, and fluoridation for health benefits.

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 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 1993 for Walkersville's water indicates that nitrate and turbidity levels exceed the 50% threshold. Treatment for nitrate removal was installed in 1995, and since then the level in finished water has consistently stayed around or below 5 ppm. A filtration system enables the town to provide treated water that meets the turbidity standards.

Of the inorganic compounds tested, nitrate was the only contaminant detected above the 50% MCL threshold level (Table 3). If a 300 pCi/L radon MCL is established, Radon-222 was the only radiological contaminant present at a level of concern (Table 3). Nine sets of volatile organic compounds have shown no detections above the reporting threshold since March 1989. No synthetic organic compounds were detected above 50% of the MCL in seven sets of samples since August 1993. Indicators of microbiological pathogens have been detected in raw water samples from all 3 wells.

Inorganic Compounds (IOCS)

The MCL for Nitrate is 10 ppm. Nitrate has been consistently present in raw water from all 3 wells. The levels appear to be declining over the past 7 years, however nitrate is still greater than 7 ppm (Chart 1). Finished water samples have complied with drinking water standards since the installation of treatment to remove this contaminant.

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. MDE is currently waiting for the EPA to promulgate a final rule to determine what standard it will adopt. The levels of Radon-222 in Walkersville's production wells are between 290 and 410 pCi/L (Table 3). Carbonate aquifers, such as the Grove limestone, typically have lower radon levels than other Piedmont aquifers.

Microbiological Contaminants

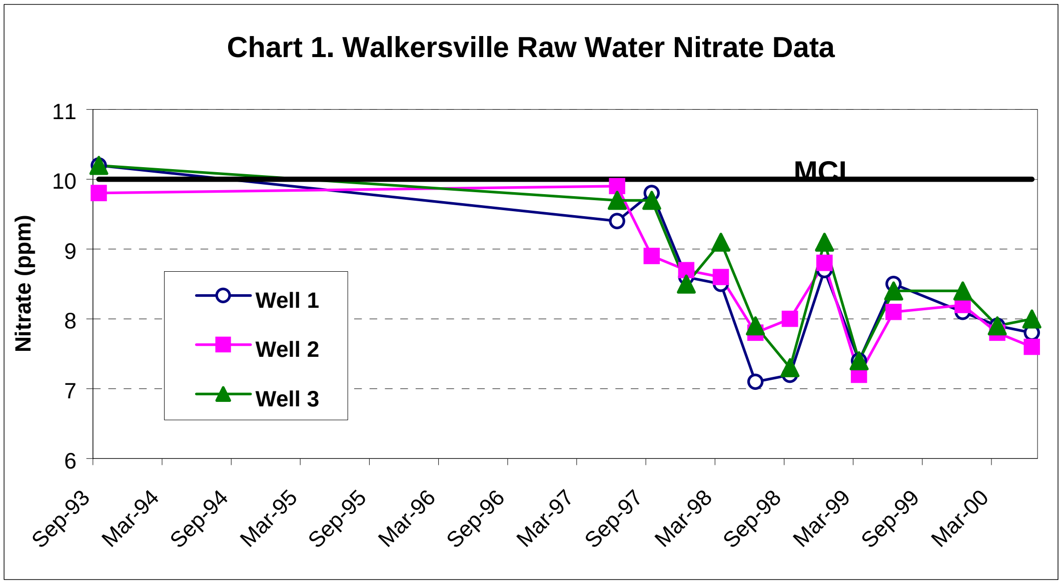
The Town was notified in 1993 that the wells are classified as "Ground Water Under the Direct Influence of Surface Water" (GWUDI) source as defined in COMAR and the Surface Water Treatment Rule. The determination was based on dye tracing results, flow measurements, and bacteriological and endotoxin data in the wellhead protection report (Aley, 1993).

Turbidity

The turbidity standard for GWUDI sources is not to exceed 0.5 NTU 95% of the time or not to exceed the 5.0 NTU at any time. The Town monitors raw water turbidity daily and a review of the data shows that the levels range from0.1 to approximately 3.0 NTU with an average of 0.2 NTU in the past year.

Sample Location	Contaminant	MCL	Sample Date	Result
TOWN OFFICE	NITRATE	10 (ppm)	12-Jul-93	9.4 (ppm)
n/a	NITRATE	10	22-Nov-93	9
n/a	NITRATE	10	01-Dec-93	9.8
DISTRIBUTION	NITRATE	10	11-Jan-94	5.9
DISTRIBUTION	NITRATE	10	07-Mar-94	7.7
DISTRIBUTION	NITRATE	10	04-Apr-94	7.7
n/a	NITRATE	10	05-Dec-94	6.1
n/a	NITRATE	10	05-Jul-95	4.5
DISTRIBUTION	NITRATE	10	04-Oct-95	7.6
DISTRIBUTION	NITRATE	10	04-Dec-95	2.6
DISTRIBUTION	NITRATE	10	19-Mar-96	3.2
n/a	NITRATE	10	27-Jun-96	0.3
CLEAR WELL	NITRATE	10	16-Sep-96	5.7
n/a	NITRATE	10	04-Dec-96	3.4
n/a	NITRATE	10	21-Mar-97	3.9
CLEAR WELL	NITRATE	10	10-Jun-97	7.5
POE	NITRATE	10	10-Sep-97	5.3
POE	NITRATE	10	02-Dec-97	1.1
POE	NITRATE	10	03-Mar-98	3.5
POE	NITRATE	10	08-Jun-98	4.7
n/a	NITRATE	10	13-Oct-98	5.3
POE	NITRATE	10	01-Dec-98	4.3
CLEAR WELL	NITRATE	10	02-Mar-99	3.3
CLEAR WELL	NITRATE	10	07-Jun-99	4
CLEAR WELL	NITRATE	10	06-Dec-99	4.1
CLEAR WELL	NITRATE	10	01-Mar-00	4.6
n/a	NITRATE	10	16-May-00	4.9
CLEAR WELL	NITRATE	10	01-Jun-00	4.4
n/a	RADON-222	Not established	16-May-94	410 (pCi/L)
n/a	RADON-222	Not established	20-Dec-99	290 (pCi/L)

Table 3. IOC and Radiological Results from Walkersville Treatment Plant since July 1993.



SUSCEPTIBILITY ANALYSIS

An incident of ground water contamination, which occurred in the Walkersville WHPA in June of 1999, exemplifies the vulnerability of the water system to activities on the land surface. A pipe carrying raw sewage was ruptured on a construction site within the Town limits and spilled an estimated 900,000 gallons of sewage, most of which entered into the ground water. Fecal coliform samples collected daily after discovery of the spill indicated that the sewage plume had reached the wells within one week and a boil water advisory for the Town was issued. A temporary water line from the City of Frederick supplied the Town of Walkersville with water for almost five months until renovations to the water treatment plant were completed.

Walkersville's wells draw water from unconfined fractured rock aquifers, and are therefore vulnerable to any activity on the land surface that occurs within the WHPA. In order to determine susceptibility to each group of contaminants the following criteria were considered: 1) the presence of potential contaminant sources within the WHPA, 2) water quality data and 3) the aquifer conditions. Due to the nature of the karst aquifer and the rapid movement of water through the aquifer coupled with the presence of potential contaminant sources within the WHPA, the water supply is considered susceptible to all contaminants, despite the fact that not all contaminants have been detected (e.g. SOCs, VOCs).

Inorganic Compounds

Nitrate is present in all of Walkersville's wells near the MCL. Sources of nitrate can generally be traced back to land use. Fertilization of agricultural fields and residential lawns, and septic systems are two non-point sources that are generally associated with nitrate loading in ground water. Low concentrations of nitrate are also found in precipitation throughout Maryland, which is the primary recharge of unconfined aquifers, due to reactions with atmospheric nitrogen (Bolton, 1996). Agricultural land makes up 84% (Fig 3) of the WHPA based on 1997 land use and is considered the most significant source of nitrate to ground water. Trends in nitrate concentration in Walkersville's wells show that they peaked in 1993, and have been on a declining trend through 2000 (Chart 1). This may be attributable to the nutrient management efforts of the Monocacy River Water Quality Demonstration Project (1996), which includes the Glade Creek watershed.

The small fluctuations in nitrate concentration may be attributable to many factors including residential development, changes in agricultural practices, and seasonal variations in nitrate concentration in ground water recharge. Samples are collected quarterly and appear to be higher in spring than in the fall and winter (Chart 1). Currently, it appears that nitrate concentration is on the decline in Walkersville's water supply. Due to the consistent presence of nitrate and agricultural sources present in the WHPA, the water supply is considered susceptible to this contaminant.

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 at levels commonly associated with the carbonate aquifers of the Piedmont in Walkersville's water supply (Table 3). 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 throughout the Piedmont region of Maryland 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 Walkersville's water supply is not susceptible to radon if the 4000 pCi/L MCL is adopted based on the levels present.

Volatile Organic Compounds

Although VOCs have not been detected at 50% of the MCL in the water supply, the wells are susceptible to VOCs due to several potential contaminant sources identified within the WHPA and the vulnerable nature of the aquifer.

Synthetic Organic Compounds

The wells are susceptible to SOCs due to the presence of potential contaminant sources including facilities and agricultural fields, coupled with the vulnerable nature of the aquifer.

Microbiological Contaminants

The presence of fecal coliform bacteria and the consistent presence of endotoxins in the wells indicate its susceptibility to pathogenic microorganisms. Additionally dye tracing work has shown that a significant proportion of the water pumped from the wells originates from Glade Creek. Pathogenic protozoa, viruses, and bacteria normally associated with surface water can contaminate the wells through this direct connection and from stormwater runoff in sinkholes. Sources of these pathogens are generally improperly treated wastewater, waste material from mammals, and urban runoff in developed areas. Pastureland likely represents a large contribution of fecal contamination to the WHPA. A small percentage of the WHPA has individual septic systems, which may provide a source of fecal contamination if they fail. In town, closer to the wells, runoff from developed areas is a potential source of contaminants to the creek and the wells. As GWUDI sources, the water supply is susceptible to bacteria, viruses, protozoa, and increased turbidity.

MANAGEMENT OF THE WHPA

The Town of Walkersville is currently drafting an Ordinance for Wellhead Protection. With the information contained in this report and the wellhead projects conducted by the Town, Walkersville is in a position to protect its water supply by staying aware of the area delineated for wellhead protection, keeping track of potential contaminant sources, and evaluating future development and land planning. Specific management recommendations for consideration are listed below:

Form a Local Planning Team

- Walkersville should form a local planning team to begin to implement the Town's wellhead protection plan. The team should represent all the interests in the community, such as the water supplier, home association officers, the County Health Department, local planning agencies, local business, developers, farmers and residents within and near the WHPA. The team should work to reach a consensus on how to protect the water supply.

Public Awareness and Outreach

- Conducting education outreach to the facilities listed in Appendix A, Table 2. Important topics include: (a) in ground storage of materials in tanks and piping, (b) waste streams that may go into dry wells, septic tanks or other ground water discharge points, (c) reporting of spills, (d) material and chemical storage, and (e) monitoring well installation.

- 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 WHPA 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.

Planning/ New Development

- Compare the wellhead protection boundaries with town limits to determine how to coordinate with the Frederick County Planning department. MDE recommends water supply owners to encourage the County to adopt a wellhead protection ordinance.

- Continue to monitor the areas most prone to forming sinkholes. Manage stormwater runoff and review new development including storage of chemicals and waste to keep away from sinkholes.

Land Acquisition/Easements

- The availability of loans for purchase of and or easements for the purpose of protecting water supplies is available from MDE. Loans are offered at zero percent interest and zero points.

Contingency Plan

- Walkersville 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 in concert with the Fire Department and other emergency response personnel.

Contaminant Source Inventory Updates/ Inspections

- Consider regular inspections of certain high risk facilities.

Changes in Use

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

REFERENCES

Aley, Thomas, 1993 Wellhead Protection Tracer Study, Walkersville, Maryland. Ozark Underground Laboratory Report of Investigations, 92 pp.

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 pp.

Earth Resources Technology, Inc., 2000, Environmental Assessment Report prepared for the Town of Walkersville.

MDE, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 p.

Meyer G. and R.M. Beall, 1958, The Water Resources of Carroll and Frederick Counties: Department of Geology, Mines and Water Resources Bulletin 22, 355 pp.

Nutter, L.J., 1973, Hydrogeology of the Carbonate Rocks, Frederick and Hagerstown Valleys, Maryland: Maryland Geological Survey Report of Investigations No. 19, 70 pp.

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

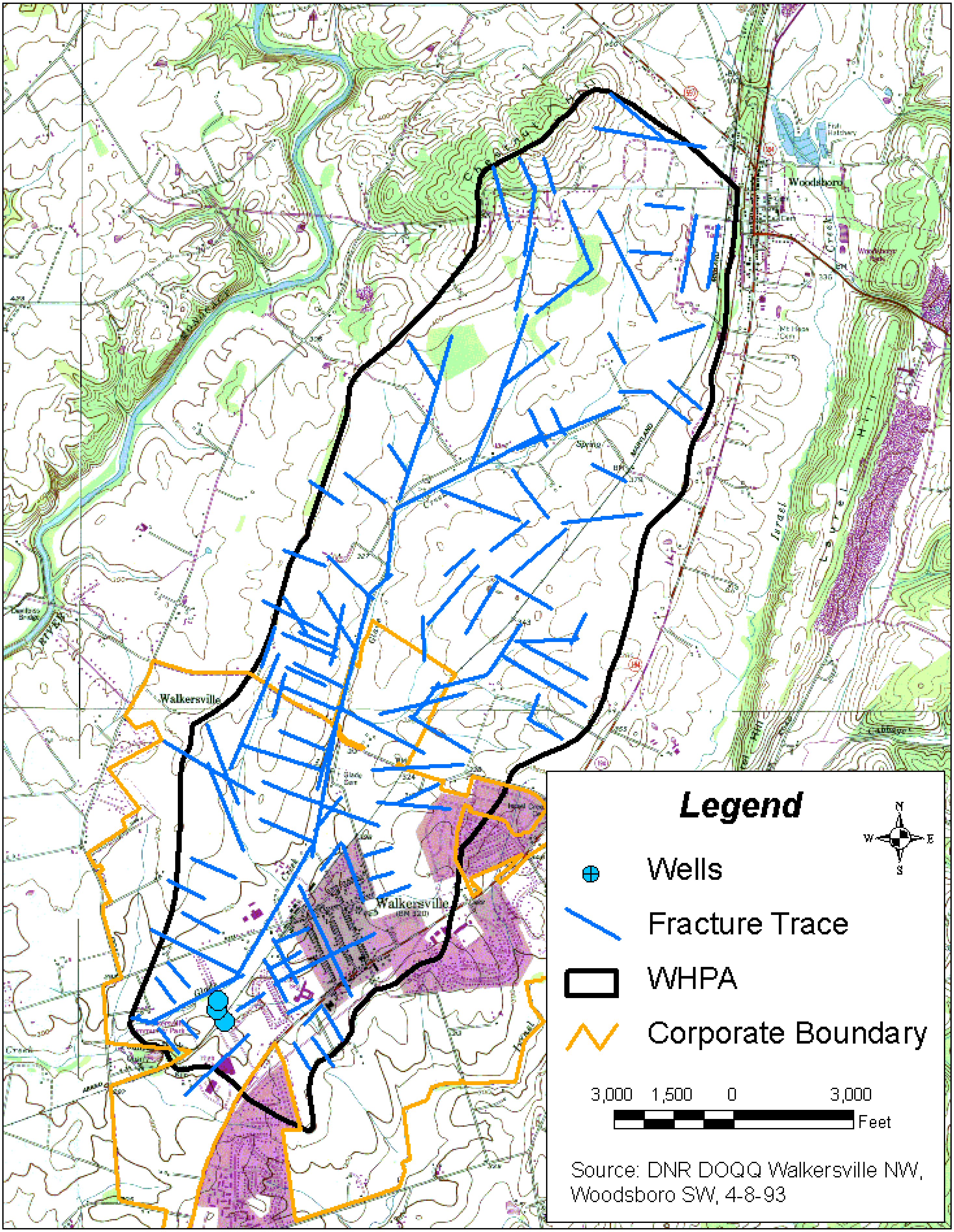
OTHER SOURCES OF DATA

Water Appropriation and Use Permit No. FR1978G017
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 Woodsboro SW and Walkersville NW
USGS Topographic 7.5 Minute Quadrangles Walkersville and Woodsboro
Maryland Office of Planning 1997 Frederick County Digital Land Use Map
Maryland Office of Planning 1996 Frederick County Digital Sewer Map

APPENDIX

FIGURES

Figure 2. Walkersville Wellhead Protection Area.



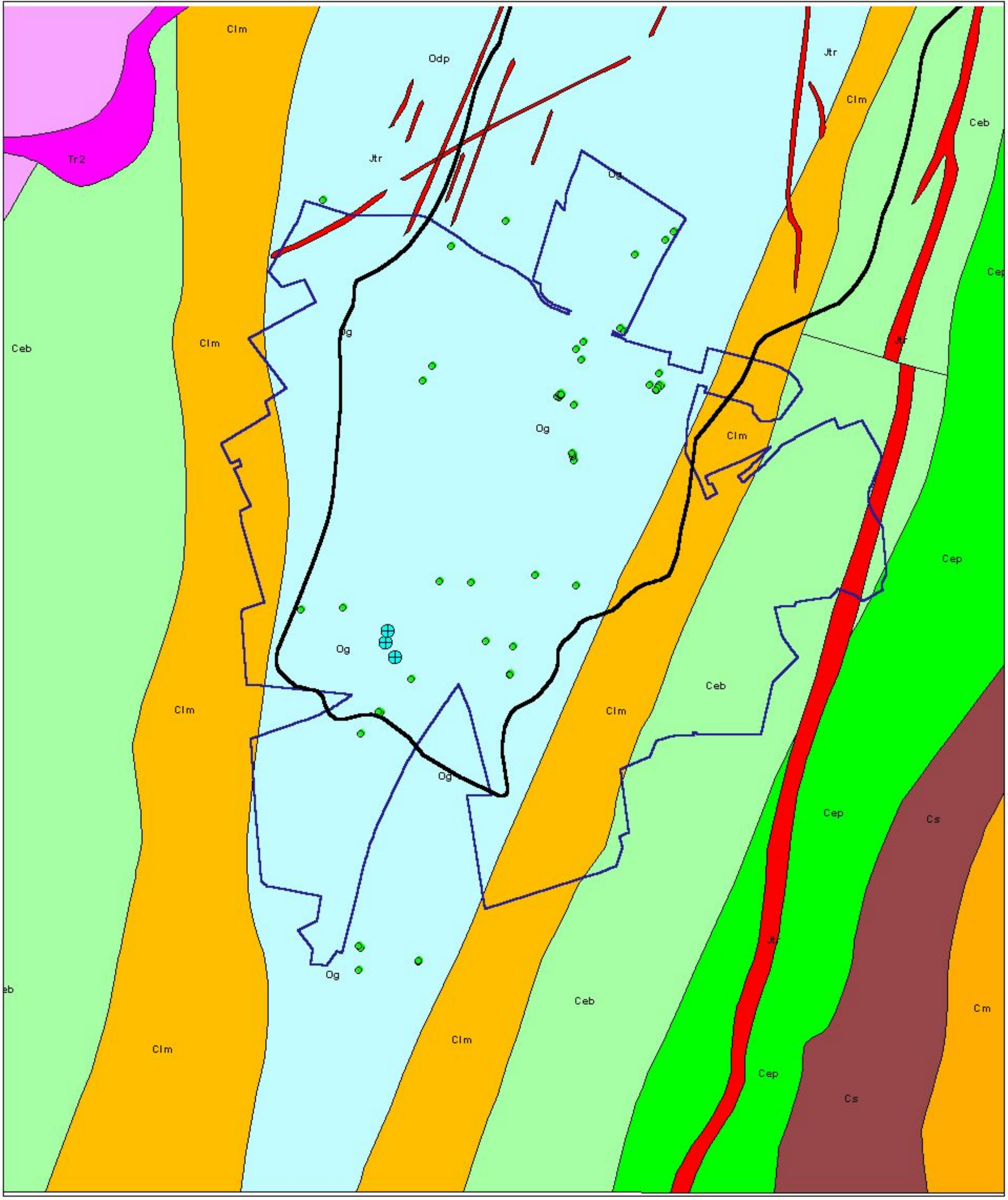


Figure 1. Walkersville Geology

Legend

Wells

Sinkholes

WHPA

Corporate Boundary

N

1000 0 1000 2000 Feet

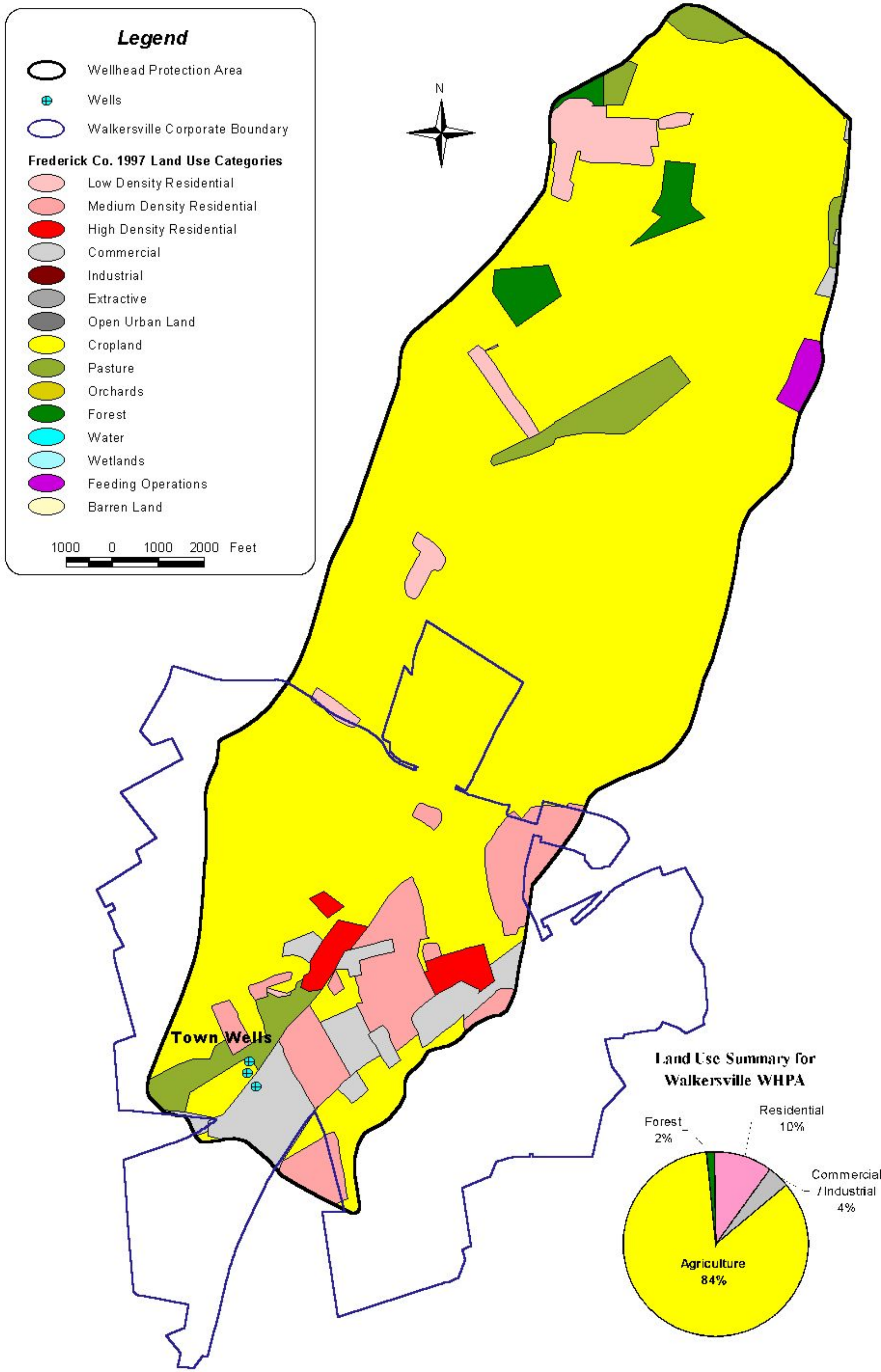
Geology Legend

Jtr	Dark green to black, medium to coarse grained augite diabase
Tr1 Tr2	Maroon to dark reddish-brown, argillaceous to silly sandstone and micaceous siltstone with subordinate interbeded shale and mudstone
Og	Interbeded, cross-beded peloidal to arenaceous limestones, stromatolitic, fossiliferous limestones and laminated to massive dolomites
Clm	Fine grained, thin beded and laminated limestones and dolomites; highly burrowed, containing abundant fossil debris, stromatolitic at very top
Ceb	Uniformly fine grained, laminated and thinn bedded, dark gray limestones and dolomites, sparse burrows and fauna.
Cep	Interbeded light gray peloidal and dark gray thin bedded limestones and dolomites
Cs	Dark gray to black, thin-beded, strongly cleaved phylitic shale or slate, grading upward into thin-beded calcareous shale with limestonee nodules
Cm	Gray to tan siltstone and silty shale with zones of dark gray to black, fine-to medium-grained, argillaceous sandstone or quartzite
Ci	Intermixed layers of dull to lustrous, purple to reddish-gray, hematitic, muscovite phyllite and tan to green chlorite-muscovite phyllite

Geology mapped by M.S. Field, 1993, digitized by Earth Resources Technology, 1999.

Figure 2. Walkersville Wellhead Protection Area.

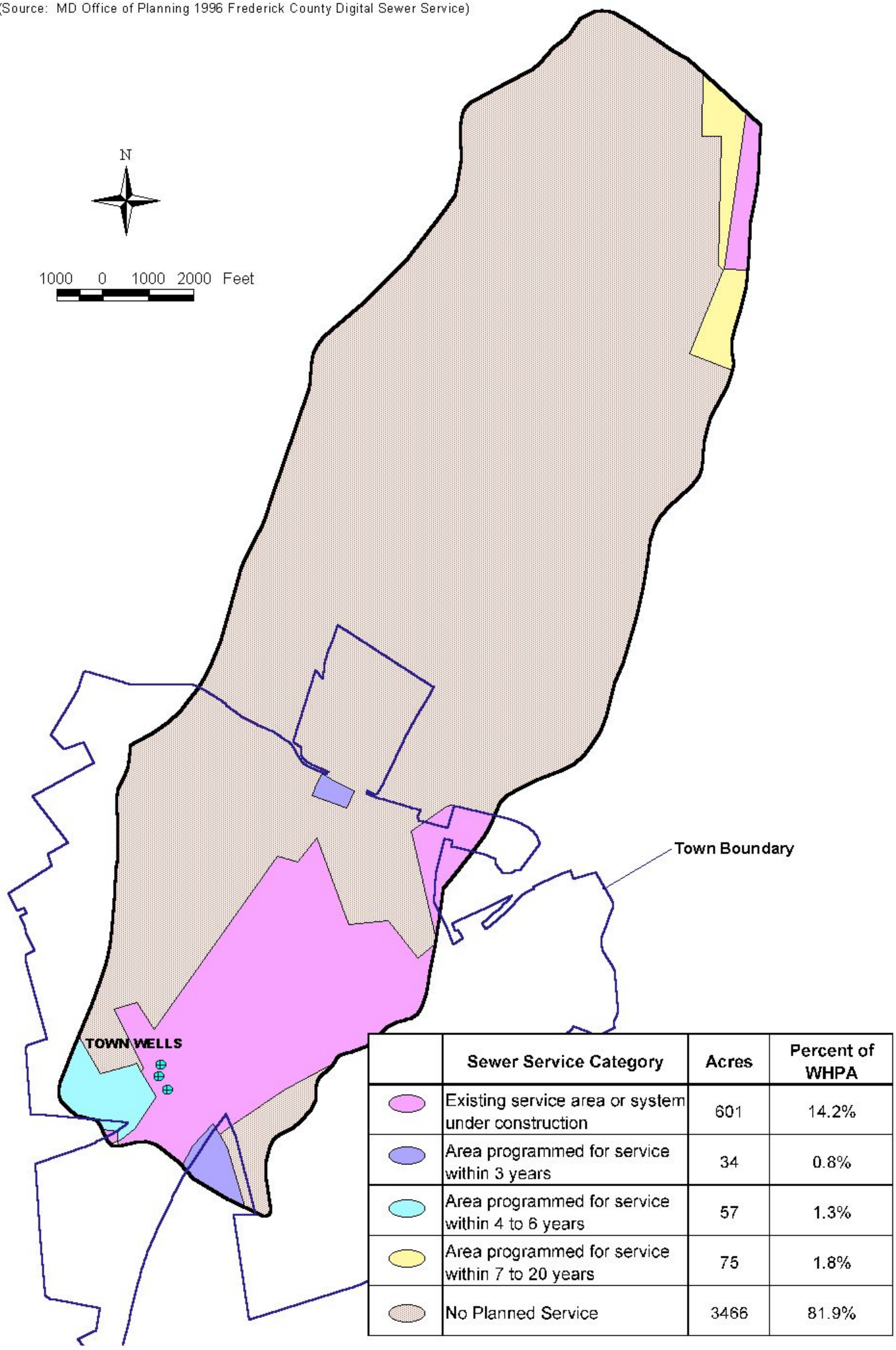
Figure 3. Land Use Map of Walkersville Wellhead Protection Area



Source: MD Office of Planning 1997 Digital Land Use Map for Frederick County.

Figure 4. Sewer Service Area Map of Walkersville Wellhead Protection Area

(Source: MD Office of Planning 1996 Frederick County Digital Sewer Service)



	Sewer Service Category	Acres	Percent of WHPA
	Existing service area or system under construction	601	14.2%
	Area programmed for service within 3 years	34	0.8%
	Area programmed for service within 4 to 6 years	57	1.3%
	Area programmed for service within 7 to 20 years	75	1.8%
	No Planned Service	3466	81.9%