SOURCE WATER ASSESSMENT

Piney Creek Reservoir & Savage River Pumping Station

For the City of Frostburg, Maryland

<u>*Prepared by*</u>

Maryland Department of the Environment
Water Management Administration
Water Supply Program
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EXECUTIVE 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 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.

The City of Frostburg and surrounding communities' source water supply is comprised of ground water from combination of wells and springs and surface water from Piney Reservoir. The Wellhead Protection Area (WHPA) was delineated for Frostburg wells using the EPA approved WHPA code and topographic divides. Land use in the Wellhead Protection Area is not expected to change in the near future because of its remoteness and rugged terrain. The City owns a portion of the land around the wells, and the spring recharge area is mostly forested. According to the 1996 MDE wellhead protection report, the turbidity is consistently low and several publications on the quality of the groundwater from the Pocono formation indicate low concentrations of nitrates and dissolved solids, but with some concentration of iron.

The surface water source is from Piney Reservoir that receives runoff from 12 square miles (7,677 acres), located on the west slope of Big Savage Mountain in Garrett County, Maryland and extends into Somerset County, Pennsylvania. The watershed consists of mixed land use with the majority in forested land and almost a third of the land used for agriculture. There is no major population centers in the watershed, only a few low-density residential areas. Potential source of contamination to the Piney Creek Reservoir are agricultural land including crops and pasture, spills and runoff from roads, timber harvest operation in the forested land and existing and future development in the watershed. As part of this assessment, the University of Maryland Center for Environmental Sciences, Appalachian Laboratory completed a two-year study, funded by MDE, to characterize the chemical and biological status of the Piney Creek Reservoir and Watershed. The goal of this study was to develop a comprehensive baseline of water quality in the system and to provide the City with the information necessary to develop a cost-effective water quality management

1.0 BACKGROUND

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.

Maryland has more than 3,800 public drinking water systems. Approximately 50 of Maryland's public drinking water systems obtain their water from surface supplies, either from a reservoir or directly from a river. The remaining systems use ground water sources. Maryland's Source Water Assessment Plan was submitted to the Environmental Protection Agency in February 1999, and received final acceptance by the EPA in November 1999. MDE has until May of 2003 to complete assessments for all of the public drinking water sources in the state. A copy of the plan can be obtained at MDE's website, www.mde.state.md.us, or by calling the Water Supply Program at (410) 537-3714.

2.0 DEVELOPMENT OF THE CITY OF FROSTBURG'S WATER SUPPLY

The City of Frostburg relies on two different sources of water to meet the drinking water needs of the city and several surrounding communities. Piney Reservoir, located approximately five miles northwest of Frostburg, is a 110-acre lake that provides the majority of the city's water needs. In addition to the reservoir, the city collects water from a series of springs and two deep groundwater wells near the Savage Creek Pumping Station, approximately three miles west of Frostburg.

Frostburg is located within Allegany County, Maryland, but both Piney Reservoir and the pumping station are on the west slope of Big Savage Mountain in Garrett County, Maryland. The watershed for Piney Reservoir extends up into Somerset County, Pennsylvania. Below is a figure depicting the general area:

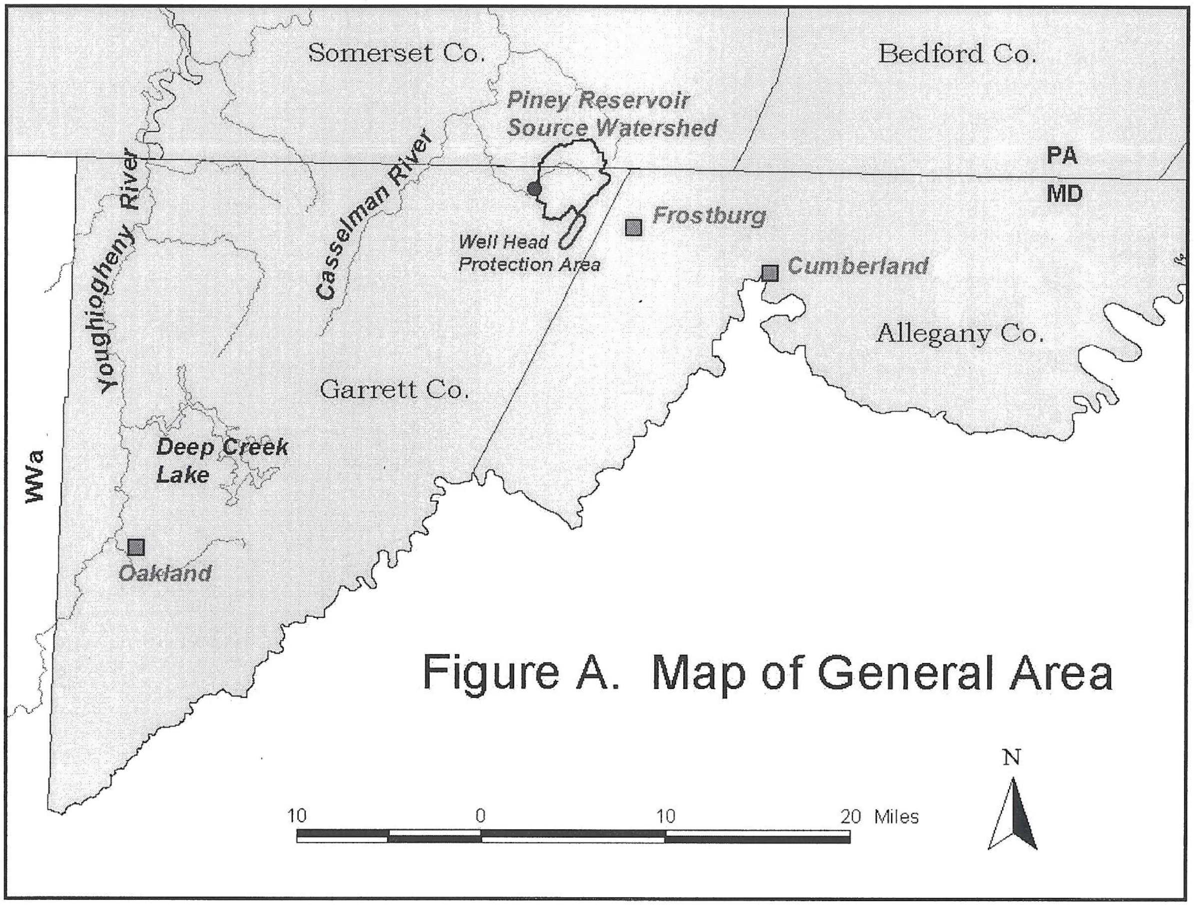

Figure A. Map of General Area

In 1935, the City of Frostburg built a dam across Piney Creek, a tributary to the Casselman River. The original Piney Reservoir Dam created Piney Reservoir, which had a capacity of 80 million gallons. Due to frequent water shortages and restrictions, and projected future demand, a new dam was constructed and completed in June of 1992. The new dam was built approximately 300 feet downstream of the original, creating a larger reservoir covering 110 acres and containing 400 million gallons of water (Piney Creek Dam Completion Report, 1992).

Water from the reservoir is pumped to the top of Big Savage Mountain where it combines with well and spring water from the Savage River Pumping Station. Located near the Little Savage River on the western slope of Big Savage Mountain, the city's groundwater source is composed of approximately 25 spring collection houses and two groundwater wells. Frostburg has used the springs for its water supply for over 100 years (Frostburg Wellhead Protection Plan, 1996). The two wells were drilled to supplement the spring flow in 1981. This area is depicted in Figure A, as the Well Head Protection Area. In the summer, approximately 30% of the raw water entering the water plant is from the pumping station, and 70% from Piney Reservoir.

From the top of Big Savage Mountain water flows by gravity to the Frostburg Water Treatment Plant. The plant is designed for an average daily flow of 1.63 million gallons per day (MGD), and a maximum daily flow of 3.0 MGD. The plant operates 24-hours a day, treating an average of 1.2 MGD, and serves approximately 12,000 people. In addition to the city, the Frostburg system serves smaller communities in the surrounding area, extending north to Zihlman and Borden, and south to Carlos-Shaft, Vale Summit, and Eckhart. Midland-Lonaconing also has an emergency connection to the Frostburg system in the event of a drought. Planning is underway to extend service north to Morantown and south to Klondike (Allegany County Water & Sewer Plan, 2000). The two largest users of water in the Frostburg system are Frostburg State University and a country club within the town limits.

From the top of Big Savage Mountain the mixed water flows by gravity into a 1-million gallon pre-sedimentation basin at the Frostburg Plant, then through the treatment plant and the finished water reservoirs to the distribution system. The city's water treatment plant was built in 1997, replacing an older facility that did not have the required water filtration process. The plant employs a conventional water treatment process, which includes coagulation, flash-mixing, flocculation, sedimentation, filtration, fluoridation, and disinfection (MDE – Frostburg CPE, 1999). Maryland Environmental Services is currently operating the water treatment plant.

3.0 DESCRIPTION OF THE WATER SOURCES

The City of Frostburg's water sources are both located just west of the Allegany - Garrett County border, in the northeastern portion of Garrett County, MD. Garrett County has a greater mean annual precipitation and a lower mean annual temperature than any other county in Maryland. The University of Maryland Climatological Office reports weather observations in Cumberland (data from 1961-1990). Average annual temperature at Cumberland is 53.7 ° F, with temperatures generally below freezing from December through February. In Garrett County, heavy thunderstorms are common in the summer months, and snowfall can range from 45 inches per year in the east to 70 inches in the north-central part of the county during the winter.

Both water sources are located in the Appalachian Plateau Physiographic Province. Broad ridges and valleys characterize this province topographically. The ridges are composed of anticlines that trend northeast throughout the province. Secondary joints and fractures in the bedrock account for most of the porosity and hydraulic conductivity and subsequent groundwater supplies in the region. The water table in the Appalachian Plateau occurs in both the bedrock and the regolith (weathered bedrock–soil), depending on the elevation. Springs are common at the base of ridges (Bolton, 1996).

3.1 Groundwater Sources

The Frostburg system obtains well water from the unconfined Pocono formation, an 800 foot thick outcrop of predominantly sandstone bedrock, which crops out at the ridge of Big Savage Mountain on the east and Four-Mile Ridge on the west, and dips below the Little Savage River (see Figure 6). According to Meiser and Earl (1978), recharge for the wells funnels down the slopes of the aforementioned ridges into the narrow and elongated Little Savage River valley where the wells are located. The wells, drill permit numbers GA-73-2374 (No.2) and GA-73-2353 (No.3), are 279 feet and 400 feet deep, respectively. No.2 well is the main well, while No.3 is a backup.

In the Frostburg area, springs are associated with the Pocono formation, and the Greenbrier formation (which is made up of limey shale), especially at the contact points between these two formations. Past studies have identified thirty to forty springs on the western slope of Big Savage Mountain (Frostburg Well Head Protection Plan, 1996). The City of Frostburg utilizes 25 of these springs as its major source of groundwater. Water from each spring is collected in a springhouse and flows down into a sump house, before combining with water from the wells in a wet well, at the Savage River Pumping Station (and pumped up the mountain). The springs are the main source of Frostburg's groundwater supply; flow data demonstrates that approximately 86% of the groundwater contribution is from the springs.

A wellhead protection area was delineated for Frostburg's wells and spring recharge areas. The method of delineating these areas is discussed in the next section. Three areas, or zones, were delineated: a 10-yr time of travel (TOT) zone, an ultimate recharge area, and a spring recharge area. All of these areas are in a relatively undeveloped, forested area near the confluence of the main stem of the Little Savage and a smaller tributary. The area encompasses a portion of the Little Savage River valley between Big Savage Mountain and Four-Mile Ridge. The ultimate recharge zone, which includes both the 10-year TOT zone and the spring recharge area, is elongated in a northeast-southwest direction, and is approximately 2 miles long and a ½ mile across at its widest point. The total area of this zone is approximately 768 acres.

The 10-year TOT zone is defined as the border area at which any contaminant source (which moves as fast as the groundwater) would reach the well in 10 years time. This zone, referred to as Zone 1 in the Wellhead Protection Plan for Frostburg (1996), is roughly the same shape as the ultimate recharge area but is understandably smaller, covering approximately 124 acres. All of the springs serving the water system are found in this Zone 1. The primary recharge area for the springs is up gradient of this zone. The spring recharge area is shaped like a bowl, with the bottom at the spring discharge points and the top along the ridge of Big Savage Mountain, centered near St. Johns Rock (see Figure 2). The spring recharge area is approximately 78 acres (Frostburg Well Head Protection Plan, 1996).

3.2 Piney Reservoir

Piney Creek Reservoir is located approximately five miles northwest from the City of Frostburg, in Garrett County, MD off of Piney Run Road. The reservoir was created by the construction of a dam in 1935, and was enlarged by the completion of a new dam in 1992. The original reservoir covered approximately 37 acres and had a volume of 80 million gallons. The new dam inundated the older structure, and since 1992, the reservoir covers approximately 110 acres and holds 400 million gallons, at the normal pool elevation of 2367 at mean sea level (MSL). The dam is a clay core earthen embankment, 1,275 feet long, and 47 feet high from the original bed of Piney Creek. The new dam increased the safe yield of the reservoir from 0.8 MGD to 2.3 MGD (Piney Creek Dam Completion Report, 1992).

Piney Creek is the main stream that enters at the head of the reservoir. Piney Creek flows in a westerly direction from its headwaters region on the western slope of Little Savage Mountain near the town of Finzel, and enter Pennsylvania before heading south back into Maryland towards the reservoir (see Figure 1). From the dam release, Piney Creek flows into the Casselman River a tributary of the Youghiogheny River. Piney Creek has many smaller order tributaries that contribute to its stream flow, but the main stem is approximately 3.8 miles long from the furthest headwater region to the head of the reservoir. The stream is classified by State of Maryland regulations as a Class I – P use stream, which means that is has the requirements of a Class I stream (swimmable & fishable), with the added "P" designation indicating its source as a water supply. Several other smaller streams directly discharge into the reservoir, including Blandy Run and an unnamed tributary. Also, Getz Run combines with the main stem of Piney Creek less than a hundred yards above the reservoir.

The source water protections area, or watershed, for Piney Reservoir encompasses approximately 12 square miles (7677 acres) of mostly upland forest. The approximate boundaries of the watershed extend from the reservoir south to MD Route 40, east to Route 48-Finzel Rd. interchange, northeast along the ridge of Little Savage Mountain, northwest to the town of Pocahontas, and arcing southwest along smaller ridges to the reservoir (see Figure 1)(Envirens, 1991). The northern portion of the watershed lies within Somerset County, Pennsylvania. Approximately one-third (33%) of the total watershed area is within Pennsylvania. The watershed is mostly forested, but includes areas of agriculture, and two small population centers, Finzel, located in MD, and Pocahontas, in PA.

4.0 SOURCE WATER PROTECTION SITE VISIT

Personnel from the Maryland Department of the Environment's Water Supply Program visited the City of Frostburg's water system on April 6th, 1999 as part of a Comprehensive Plant Evaluation (CPE), to discuss the assessment of the Piney Reservoir and groundwater sources, and to describe the source water protection program. Main objectives of this 1st site visit included: obtaining an accurate GPS location of the water supply intakes, inspecting the integrity of the intakes, and documenting operator's source water concerns. A windshield survey of the watershed was also undertaken, and further trips have been made to both the reservoir and the watershed as part of the Piney Reservoir – Watershed Water Quality Assessment project.

4.1 Intake Integrity

4.1.1 Savage River Pump Station

Water from the springs on the side of Big Savage Mountain are collected in what the city refers to as the "sump", which is actually two small open collection basins, or reservoirs, located above the pumping station. From the "sump" the spring water flows down into the pumping station wet well. The two wells are located in close proximity to the pump house. Well water enters the wet well, where it mixes with the spring water. Two pumps (one @ 410 gallons per minute (GPM) and one at 620 GPM) operate simultaneously to pump water atop Savage Mountain (MDE-Frostburg CPE, 1999). From the top, water flows by gravity down to the pre-sedimentation reservoir above the plant, which the city refers to as the "supply dam." Water plant operators and the MDE system engineer did not express any concern with the wells, springs, or transmission lines. The spring sumps and collection network appeared old, but were in good working condition. A roof over the spring sumps could provide an additional safeguard against purposeful contamination into the system, and would keep out animals that could contaminate the water source (Wellhead Protection Report, 1996).

4.1.2 Piney Reservoir

The intake on Piney Reservoir was constructed in 1991-1992 at the same time as the new Piney Dam. The intake is a circular tower structure located approximately 25 yards out into the reservoir adjacent to the dam (see picture in Appendix). The circumference of the intake tower is 55 feet. There is a concrete bridge leading from the top of the dam to the intake structure. The tower structure is a multi-level intake, with two separate wet wells with three intakes each, which are separated by 10 feet in elevation (depth). This allows the operators to take water in from three different reservoir depths. Each intake level is 3ft. x 3ft. opening and has a sluice gate and screen (4-inch mesh). The screens can be pulled up and cleaned if necessary. The upper level intake is at 2357.5 feet MSL, middle intake elevation 2347.5, and the lowest level at 2337.5. The city usually pulls water from the upper intake (personal communication, plant operator).

Three pumps (two pumps at 1,250 GPM and one at 750 GPM) force water from the intake wet well up to the top of Big Savage Mountain. The pipe is 12-inches in diameter and travels approximately 8500 feet to the top of the mountain. From there, water from the Savage River Pump Station is mixed in, and the 12-inch line splits into an 8-inch and 10-inch line, which carry water by gravity down to the pre-sedimentation reservoir above the plant (MDE-Frostburg CPE, 1999). There were no observable problems with the intake on the reservoir, and water plant officials, including the dam keeper, did not express any concerns over the intake structure or transmission lines. Also, the dam keeper checks the intake facilities on a daily basis to check for potential problems.

4.2 Operator Concerns and Site Visit Observations

In addition to looking at the dam/intake structure and pumping station, a watershed trip by car, and a discussion with plant operators and city officials was undertaken to determine potential sources of contamination to the water sources. Below is a list of concerns that may affect water quality in the reservoir and groundwater. The list reflects operator concerns from the original meeting, and concerns listed in a survey from sent by MDE and returned by the water treatment plant operator. It also includes MDE site visit observations/concerns:

1. Operator referred to source water concerns listed in *Piney Creek Reservoir Watershed Management Plan,* completed as part of the city's dam building permit and produced by Environs, Inc. in 1991.
    a. Issues include: farming, forestry, and development on sensitive soil areas, septic tank discharge, nutrients from land use practices, feedlots and concentrated agriculture, road salt, and hazardous spills.
2. A past manure spill from an upstream farm degraded the water quality in Getz Run.
3. The city actively timbers watershed property that it owns, mostly using clear-cutting techniques.
4. There are a few houses on septic systems located within the spring recharge area.
5. There is a nursery located near Piney Creek in Pennsylvania.

5.0 WATERSHED CHARACTERIZATION

5.1 Source Water Assessment Area Delineation Method

5.1.1 Surface Water – Piney Reservoir

An important aspect of the source water assessment process is to delineate the watershed 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 – SWAP, 1999). Delineation of the source water area was performed by using ESRI's ArcView Geographic Information System (GIS) software, utilizing existing GIS data, and by collecting location data using a Global Positioning System (GPS). A GPS point location was taken at Frostburg's intake on the reservoir during the initial site visit and differentially corrected (for an accuracy of +/- 2 meters) at MDE. Once the intake location was established, the watershed was delineated based on existing MD Department of Natural Resources digital watershed data and MD State Highway Administration digital stream coverage. Digital USGS 7.5 topographical quad maps were also used to perform "heads up" digitizing, or editing, of watershed boundaries when needed.

5.1.2 Ground Water

The Well Head Protection Areas were delineated for Frostburg's wells using the EPA approved WHPA code and topographic divides. Model runs, which delineate the 10-year TOT (Zone 1) and ultimate recharge areas (Zone 2), were based on the permitted withdrawal amounts of the wells, and were done in two directions, southwest and northeast, to account for the movement of groundwater from both directions. The WHPAs for the two separate wells were merged into one large protection area. The spring recharge area is located in both Zone 1 and Zone 2, and should be considered a special zone within the Well Head Protection Area.

5.2 Piney Reservoir

5.2.1 General Characteristics

The watershed above the reservoir is roughly circular in shape with a slight southwest-northeast tilt, the common direction of mountain ridges in this part of the Appalachian Plateau. The watershed is located just west of the eastern continental divide; Little Savage Mountain, the eastern boundary of the watershed, is part of the divide. Piney Reservoir watershed encompasses 12 square miles (7677 acres) of mostly forested uplands. There are no population centers in the watershed, only a few low-density residential areas like the Finzel area in Maryland and Pocahontas in Pennsylvania. According to land use maps, a majority of the stream miles are buffered by forest, but there are areas of agriculture, especially in the northwest portion of the watershed and in the Gravel Hill area, between Blandy and Getz Run (see Figure 3). Two-thirds of the watershed is within Garrett County, MD.

Below is a summary of land use in the Piney Reservoir watershed. This data is from the Multi-Resolution Land Characterization Consortium (MRLC), a partnership of federal government agencies that produce or use land cover data. The data is based on 30-meter Landsat thematic mapper (satellite) data, and is commonly referred to as the National Land Cover Data set. The MRLC data was designed for use in hydrologic and water quality models. The data below is from the 1997 MRLC data set for EPA Region III:

Table 1. MRLC Land Use

Land Use	Acres	Percent of Watershed
Open Water	91.2	1.2
Low Density Residential	34.9	0.5
Commercial/Industrial	1.8	<0.1
Pasture/Hay	343.3	4.5
Cropland	2211.0	28.8
Forest	4972.7	64.8
Wetlands	5.8	0.1
Mined or Abandoned	0.6	<0.1
Transitional	5.8	0.1

The MRLC land use data covers both the MD and PA portions of the watershed. The Maryland Department of Planning (MDP) also regularly (tri-annually) creates land use data sets, but only in state. Below is data from the MDP 2000 data set of Garrett County:

Table 2. MDP 2000 Land Use, Maryland Portion of Watershed

Land Use	Acres	Percent of MD Watershed
Residential*	335.1	6.5
Commercial/Open Urban	12.0	0.2
Cropland	1278.8	24.8
Pasture	285.8	5.5
Forest	3143.4	60.9
Open Water	105.5	2.0
TOTAL:	5160.6	100.0

*Mostly Low Density, but some Medium Density Residential

5.2.2 Localized Characteristics

The land surrounding the reservoir is heavily forested and owned by the city of Frostburg. The city owns approximately 2000 acres around the reservoir and in the watershed. Most of slopes around the reservoir are greater than 10%, especially on the undeveloped western shore. Upstream of the reservoir near the junction of Piney Creek and Getz Run there are significant beaver meadows, and wetlands fringe portions of the north and east shores. These wetlands were enhanced or created in accordance with the permit to construct the new dam. Piney Dam Road runs across the head of the reservoir, separating the deeper reservoir from an area of shallows and emergent vegetation at the mouth of Piney Run and the unnamed tributary. Similarly, the unimproved access road to the dam and recreational parking areas crosses the reservoir near the mouth of Blandy Run, where it splits the deeper reservoir from the wetland/shallows. Water travels through culverts underneath both of these roads. The unimproved road leads past the dam keeper's house to the edge of the dam itself; along the way there are pullouts for parking. The road is approximately one mile from the dam keeper's house to the intersection with Piney Dam Road. The reservoir is off limits to swimming and boating, but it is a popular fishing destination in the Frostburg area. There is one farm adjacent to the reservoir on Piney Dam Road, and the strip-cropped field comes down to the northwest shoreline of the reservoir (see Figure 5).

5.3 Sub-watersheds

Maryland's Source Water Assessment Plan states that larger source water areas will be segmented into smaller sub-watersheds to assist in the assessment and identify watersheds of concern. Sub-watersheds will be identified and characterized in this assessment, even though the total watershed area is relatively small, because previous studies (the 1991 Management Plan, and the just completed Reservoir – Watershed Study) included segmenting the watershed. The Piney Reservoir watershed is segmented into five sub-watersheds for the purpose of this report (see Figure 1). These watersheds were delineated based on existing MD Department of Natural Resources data and created and modified based on digital topographical maps. Below is a summary of land use (1997 MRLC data) for each sub-watershed in the basin:

Table 3. Sub-watershed Land Use

Sub-Watershed	Total Acres	Forest	Agriculture	Other
Piney Creek	4117	64%	35%	1%
Getz Run	1316	67%	32%	1%
Blandy Run	1293	73%	26%	1%
Reservoir Drainage	567	69%	16%	15%
Unnamed Trib	383	33%	66%	1%

5.3.1 Piney Creek

The largest sub-watershed, and main tributary to the reservoir, it includes many smaller order streams that enter it above the reservoir, except Getz Run. Past studies have broken this sub-watershed down even further. Information from past studies (and smaller watersheds) will be combined into a larger Piney Creek sub-watershed. The creek watershed is mostly forested, and a significant length of riparian area is buffered by forest, however there are substantial areas of cropland and pasture, especially in the northwest portion of the sub-watershed. The only substantial residential areas in the reservoir basin, Pocahontas and Finzel, are located within Piney Creek.

5.3.2 Getz Run

Getz Run has its headwaters form along the base of Little Savage Mountain and is bordered to the south by a ridge referred to as Gravel Hill. Piney Dam Road runs along Gravel Hill, and this sub-watershed valley is easily seen from this road. The sub-watershed is located entirely within Garrett County. Most of the agricultural land is centered near Gravel Hill, and the downstream portion of Getz Run is forested. There is a large dairy operation that had an accidental manure spill within this sub-watershed in the late 1980's.

5.3.3 Blandy Run

Blandy Run is one of three streams that discharge directly into the reservoir (the other two being Piney Creek, and the unnamed tributary). It actually empties into a substantial wetland area on the east side of the access road. The Blandy Run sub-watershed is mostly forested and a portion of it is owned and logged by the City of Frostburg. Blandy Run drains runoff from Interstate 68 and Route 40 it the upper reaches of the sub-watershed. Consequently, road salt contamination has been mentioned as a potential problem in this area (Envirens, Inc., 1999 & Appalachian Laboratory, 2002). Blandy Run sub-watershed is entirely within Garrett County, MD.

5.3.4 Reservoir Drainage

This sub-watershed contains the reservoir and the land that directly surrounds it. Most of the reservoir's shoreline is forested, especially on the western side. Fishing from the eastern shore, where there are parking areas off the access road, is popular. The access road splits the reservoir from the Blandy Run mouth/wetland area, but the potential of a hazardous spill along this bridge is not likely. The northwestern area of this sub-watershed does contain agricultural land. The 1991 Envirens, Inc. report noted that agricultural practices were occurring on soils with high erosion hazard potential, and that there was runoff directly into a stream from a feedlot or livestock holding area. However, this stream may be ephemeral.

5.3.5 Unnamed Tributary

The unnamed tributary is the smallest sub-watershed in the Piney Reservoir basin, and enters the reservoir directly on the northwest side. The headwaters are in Somerset County, PA, and the stream appears to develop downstream from a series of ponds. Over half of the lower stream is forested, but the upper watershed is heavily used for agriculture. The 1991 Envirens, Inc. report cited several potential sources of pollution from this sub-watershed including feedlots and/or holding areas with drainage directly into the stream, cropland on land classified as severe and very severe erosion hazards, and pastureland adjoining waterways with livestock access. Water quality data from an Appalachian Laboratory study (2002) in the Piney Reservoir- Watershed supports these concerns and will be addressed later in the assessment.

5.4 Wellhead Protection Area (WHPA)

The recharge area for the wellhead protection area and spring recharge is in an undeveloped site along the western flank of Big Savage Mountain. The spring recharge area is almost completely forested, and most of the land comprising Zone 1 and Zone 2 is forested. Below is a land use summary of the ultimate recharge area (Zone 2) based on 2000 land use data from the MDP:

Table 4. WHPA Land Use

Land Use	Acres	Percent of Watershed
Residential	25.9	4%
Commercial	13.2	2%
Agriculture	59.1	9%
Forest	546.2	85%
TOTAL:	644.5	

5.4.1 Zone 1 – 10-year Time of Travel

The 10-year TOT area includes at the recharge area for both wells No2. and No.3, and consists of 124 acres forested land. According to the 2000 MDP land use data there are two pastures located within Zone 1. Analysis of aerial photographs (digital orthophoto quads) taken in April 1995, appear to show a hay pasture and an unknown animal pasture/farm north of the pumping station. There are several houses in the Zone 1 WHPA.

5.4.2 Zone 2 – Ultimate Recharge Area

Zone 2 includes both Zone 1 and the spring recharge area. In addition to the pastureland and houses mentioned above, Zone 2 also receives runoff from Interstate 68 and MD Route 40 in the northeastern portion of the WHPA. There is an appreciable amount of commercial and residential land in this travel corridor. The southwestern portion of the WHPA is dominated by forested land. In fact, the Savage River State Forest comprises 151 acres (or 24%) within the entire WHPA, mostly in the southwest section.

5.4.3 Spring Recharge Area

The recharge area covers 77 acres of mostly forested land. The area is bowl shaped and starts along the ridge of Big Savage Mountain. The 1996 WHP report documented three homes (on septic systems) that were within the spring recharge area. A portion of the Savage River State Forest is within the recharge area.

6.0 POTENTIAL SOURCES OF CONTAMINATION

6.1 Non-Point Pollution Sources

Without any urban area in the watershed, Piney Reservoir is not threatened by urban non-point pollution runoff. Analysis of land use data, aerial photography, and watershed surveys show that the watershed does not contain any significant sources of contaminants associated with urban or commercial runoff, such as oil, grease, and toxic chemicals. The data also shows that the watershed is mostly forested with almost a third of land used for agriculture. The EPA considers non-point agricultural runoff (nutrients, sediments, pesticides) the number one water quality impairment of lakes and streams in the United

States. Non-point pollution sources associated with residential, agricultural, and forested land will be discussed below.

6.1.1 Residential Land

Residences in the watershed are not located within a sewer service area (or planned area), and rely on domestic septic systems. Septic systems, especially ones that are not working properly or fail, are potential sources of contamination by pathogenic protozoa, viruses, and bacteria. According to MD DOP 2000 land use data, only 6.5% of the Maryland portion of the watershed is used as residential land, with most located in the main Piney Run sub-watershed. Residences and farmsteads are spread throughout the watershed, but may not be depicted in the land use because of the 30-acre pixel limitation of the MD DOP data. Low-density classified areas are locales where there are several homes in the same vicinity. These depicted areas tend to be along major roads through both sub-watersheds. Most residences are located near Finzel, MD, along county road 546 (Finzel Road) There are also residential areas along the local Finzel Road, which travels east-west through the Piney Creek subwatershed. In Pennsylvania, the small community of Pocahontas is the only noticeable residential area. It should be stated that while these areas are more concentrated with respect to housing in this watershed, they are not at all characteristic of high-density suburban development. Past reports and soil surveys in the watershed indicate that failing or improperly working septic systems occur within the Piney Creek watershed. According to a 1991 watershed management plan by Environs, most of the soils in the watershed have severe limitations for septic fields because of inadequate depth to bedrock, and/or steep topography. The report noted that the Finzel and Pocahontas areas are particularly sensitive because of their locations adjacent to streams and because of high water tables (Environs, 1991).

There are several residences (no more than 4) in the well head protection area that rely on septic system treatment. The springs on Big Savage Mountain depend on relatively shallow groundwater, which is susceptible to any land use disturbance or waste disposal practice up gradient of the springs. There are no documented problems regarding septic discharge in the wellhead area, additional residences on septic systems above the springs may be of future concern.

6.1.2 Agriculture

According to the MRLC land use data, almost 34% of the watershed is used for agricultural purposes (28% cropland, 5% pasture). Land used to grow crops can be a source of nutrients (from fertilizer), and synthetic organic compounds (pesticides). Agricultural land can also be a source of sediment runoff from erosion. Most of the cropland in Garrett County is used for oats or hay production (DOA Census of Agriculture, 1997). However, analysis of aerial photography shows areas of significant row cropping (mostly corn). Most of the land used for agriculture is within the Piney Creek sub-watershed, however, the unnamed tributary sub-watershed has the highest percentage of agricultural land use (see Figure 3). According to the 1991 Environs report, a substantial amount of agriculture in both Garrett and Somerset counties, is occurring on land that exhibits a severe erosion hazard, due to soil type and slope. Some of these areas occur adjacent to streams. Additionally, there are several parcels of agriculture on land classified as having a very severe erosion hazard (these classifications are from the U.S Department of Agriculture – Soil Conservation Service). Erosion of farmland can lead to increased nutrients and sediment loading into the watershed.

Pastures used to graze livestock can be sources of pathogenic protozoa, viruses, and bacteria from animal waste; additionally animal waste from pastures can also contribute to excessive nutrient (nitrogen and phosphorous) loading. If livestock are allowed unfettered stream access, they can also contribute to stream bank erosion. Five feedlots, manure storage areas, or dairy cow holding areas were identified from the road in a 1991 survey, and other feedlots may exist in association with dairy and cattle operations (Environs, 1991). These areas are generally referred to as concentrated agriculture feeding operations, or CAFOs. CAFOs have the potential to be serious pollution sources. In general, they can generate over a 1000 times more nutrients per acre than forested land. Specifically, even though they approximate only 1% percent of the watershed area, it was estimated that they generate 14% of the nutrient load within the Piney Creek system (Envirens, 1991).

According to 2000 MD DOP land use data, the wellhead protection area includes two pastures. Aerial photography shows that at least one farm is located north of the pumping station. The use of these pastures is not certain, but most likely they are used for either hay production or livestock grazing.

6.1.3 Forestry

A timber harvest operation can disturb 8-10% of the total work area by road building and creating landing sites. These areas, if not maintained, can contribute to erosion in streams and sedimentation in receiving waterways. The City of Frostburg owns approximately 1,396 acres of forest land in the Piney Creek watershed, mostly around the reservoir. This accounts for almost 30% of the total forested land in the watershed. The land is timbered to generate revenue for the city, and harvesting follows a management plan designed by the MD Department of Natural Resources (MD-DNR). The city timbers the land regularly (yearly), usually only 15-20 acres, but the predominant practice is clearcutting, which involves removing all the trees from the cut area. Clearcutting is the most controversial method of tree harvesting, and usually increases soil erosion (Envirens, 1991). In addition, the forested slopes in the watershed are generally high, which can escalate the potential problems associated with forestry harvest. Old forest roads are visible in the area between Blandy Run and Piney Dam Road, less than a mile from the reservoir (see Figure 5).

The wellhead protection area for the wells and springs is heavily forested. There is no information of forestry harvests in this area, but portions of the wellhead are within the Savage River State Forest. Sale of timber on state land follows strict guidelines to ensure against environmental degradation, and all permitted harvests on private land in Maryland must comply with state regulations and inspections.

6.1.4 Mining

There are no active mines in the Piney Creek watershed. The watershed lies in an area west of Big Savage Mountain, which in general, is not coal mining area. According to maps by the MD Bureau of Mines, the Piney Creek watershed lies between the Georges Creek and Casselman River coal basins. However, a mining company owns a portion of land in the wellhead protection area. Additionally, there no limestone or gravel mines upstream of the reservoir or within the wellhead area.

6.2 Point Discharge Concerns

There are no known point sources of pollution within the Piney Creek watershed or the wellhead protection area.

6.3 Transportation Related Concerns

Potential contaminants related to transportation include; runoff from paved surfaces, toxic chemicals, and the potential for hazardous spills. There are numerous county and unimproved roads in the Piney Creek watershed, but the only substantial roads are County Route 546 (Finzel Road) and a portion of Interstate 68 and MD Route 40. The 1991 Envirens report noted that several areas in the watershed experience elevated sodium and chloride (salt) concentrations. These areas include surface water from Blandy Run and groundwater wells in the vicinity of Finzel. Reasons for high concentrations may vary from roadway runoff ditches and exposed bedrock, to runoff from Interstate 68 and Route 40. The just completed watershed and reservoir study by the Appalachian Laboratory also found high levels of salt in Blandy Run (Castro, 2002).

Several measures have been undertaken to lessen the contamination of road salt in the watershed. These included reducing the application of salt on roadways by 25%, paving of ditches to prevent direct infiltration, and ditch maintenance practices were modified (Envirens, 1991). However, current data shows that salt contamination in Blandy Run is still problematic.

Another potential area of concern is Piney Dam Road and the unimproved access road along the eastern side of the reservoir. Traffic on Piney Dam Road is most likely limited to local traffic, but a hazardous spill on the reservoir bridge could lead to an immediate water quality problem. The unimproved road along the reservoir is buffered by forest for the most part, but runoff from this road directly into the reservoir could carry sediment and potential oils and grease from automobiles parked in the recreation area.

U.S Interstate 68 is the major east-west transportation artery through western Maryland. The interstate was constructed in sections in the 1980's. Transportation of hazardous materials is a common occurrence along this route. Blandy Run has its headwaters adjacent to I68 and between Rt.40. The reservoir is vulnerable to potential impacts of a spill along I68 and Rt.40, because of these routes close proximity to the reservoir, less than 2 ½ stream miles (see Figure 4).

I68 and Rt.40 both pass through the wellhead protection area. The susceptibility of the wells and springs to a hazardous spill in the protection area is minimal. Both routes are located outside of the 10-yr time of travel zone, in the ultimate recharge area. The distance, along with slower groundwater movement, would allow sufficient time to clean up a dangerous spill. Road salt from these major routes may cause a contamination of groundwater, but there is no data to determine if sodium and chloride concentrations in the groundwater are higher in this area. There are also several small, insignificant, roads in the wellhead area.

6.4 Land Use Planning Concerns

A comparison between 1990 and 2000 MD DOP land use data shows the changes in development over the course of ten years in the Maryland portion of the watershed. Land use percentages are tabled below, along with changes. Red ink depicts decreases, while black ink notes an increase in percentage:

Table 5. Land Use Change

Land Use	Percent of Land in 1990	Percent of Land in 2000	Difference
Residential	3.0	6.5	3.5
Commercial/Open Urban	0.1	0.2	0.1
Cropland	26.3	24.8	1.5
Pasture	5.9	5.5	0.4
Forest	63.9	60.9	3.0
Open Water	0.8	2.0	1.2

According to this data, over the past ten years forested and agricultural lands have given way to increased residential areas. Nutrient and sediment runoff concentrations are lower from forested land when to compared to agriculture and residential development. Consequently, a decrease in forested cover within the watershed would not be beneficial to the reservoir's water quality. Most of the new residences appearing in the land use data are located in the eastern portion of the Piney Creek subwatershed, near Finzel, and west along the local Finzel Road, between Lowery Road and Pocahontas Road. The new residential land is classified as low-density. There was also some growth along Route 40, including several acres of commercial land. Large-scale growth in the watershed is probably not feasible in the near future due to the rugged character of the land and the limiting soil and slope characteristics that make septic system construction difficult.

The decrease in forested land can also be attributable to the expansion of the reservoir with the new dam (in 1991). Historically, Frostburg has harvested trees on approximately one percent of its forested property per year in accordance with its forestry management plan (Envirens, 1991). While these annual harvests are likely to have some effect on the reservoir, a future increase in the amount of acres harvested in the watershed could heighten sediment and nutrient runoff. Logging near the reservoir on steep slopes could also have the same effect.

Agricultural land (crops and pasture) in the watershed experienced a slight decrease from 1990-2000. According to the 1997 Census of Agriculture for Maryland, the amount of farmed acres in Garrett County has slightly increased (<1000) from 1992 to 1997. There has been a decrease in the amount of farms raising livestock (beef and dairy cattle), but a slight increase (<1000) in the amount of animals raised over the same time period. Poultry and hog farms remained constant in the county. Garret County is the largest producer of oats used for grain in the state, but the amount of acres and numbers of farms harvesting this crop have decreased since 1992. Approximately 360 acres of farmland and pasture is included in the Maryland Agricultural Preservation Fund, which designates farmland in preservation districts, promotes agricultural easements, and sometimes excludes land from farming (MD-DNR, Merlin Data). Most of this preserved farmland is located within the Getz Run subwatershed. The amount of land farmed in the watershed would not be expected to change significantly in the near future.

Future land use changes in the Piney Creek watershed have the potential to change the water quality in the reservoir. An increase in residential land, impervious surfaces, and removal of forest may increase the amount of pollutants (i.e., sediment, nutrients, toxics) entering Piney reservoir. The recently completed *Water Quality Assessment of the Piney Creek Reservoir-Watershed System* shows that biological conditions over the past two years in the reservoir are bordering on eutrophic status. A eutrophic lake is considered to be over-enriched with nutrients, and consequently, is susceptible to water quality problems. Trophic state indices (TSI) for the reservoir ranged from 42-60, and averaged 50. A TSI between 50-60 suggests that a water body is showing signs of eutrophication (Castro, 2002). Changes in land use could push the reservoir-watershed system into a detrimental state, degrading the source water, and making water difficult to treat.

Land use in the wellhead protection area is not expected to change in the near future, because of its remoteness and rugged terrain. The city owns a portion of the land around the wells, and the spring recharge area is mostly forested. Portions of the woodlands, in the state forest and possibly the mining company property, may be logged, or mined, if extractable resources (coal) exist. The WHPAs and spring recharge area should be managed to ensure the integrity of the water supply (Wellhead Protection Plan, 1996).

7.0 REVIEW OF WATER QUALITY DATA

Several sources of water quality data were reviewed for the City of Frostburg's source water assessment. Included in the review is data from multiple sources, including MDE and City of Frostburg data, collected as part of the Safe Drinking Water Act amendments, Monthly Operating Reports (MORs) from the City of Frostburg's treatment plant, MDE bacteriological data, a 1988 water quality study of the watershed, the 1991 Enviren's water management plan, and the recently completed *Water Quality Assessment of the Piney Creek Reservoir-Watershed System* conducted by the University of Maryland, Appalachian Laboratory. This last study was designed to assist in the source water assessment of Piney Reservoir. Other goals were to determine a baseline of water quality in the reservoir, so that future changes can be monitored, and to allow the City of

Frostburg to implement a cost-effective watershed management plan to protect water quality.

7.1 Monthly Operating Reports

7.1.1 Existing Plant Data-Raw Water

The City of Frostburg is required to record and submit water quality testing in a monthly operating report to MDE's Water Supply Program. These reports include some testing of the reservoir and groundwater supplies, or "raw" water. Unfortunately, raw water testing samples are taken at the plant, where the source water from the reservoir and groundwater supplies is mixed. This would prevent us from determining the location of water quality impairment, however, mixed raw water is usually of good quality. Turbidity, pH, Iron, and Alkalinity are the parameters tested daily at the treatment plant. Review of this data shows that the raw water usually have a very low turbidity an acceptable pH. Turbidity is a measure of the waters "cloudiness" and is used as a surrogate indicator of pathogenic organisms, such as bacteria. Raw water turbidity data was analyzed during the 1999 MDE Comprehensive Performance Evaluation of the Frostburg water treatment plant. From March 1998 to April 1999 daily turbidity readings had a mean value of 2.4 NTU, with a maximum value of 6.8 NTU recorded in March 1998. MOR data was also reviewed for 2001 and the first few months of 2002. Turbidity ranged between 1-3 NTU, with no observed spikes. Alkalinity and pH values were within drinking water limits. Iron is usually associated with aesthetic and nuisance effects such as taste and odor problems and fixture staining, but are not necessarily public health concerns. The secondary MCL for Iron is 0.3 mg/L, data from the Frostburg MORs shows that iron concentrations occasionally exceed this standard. In October 2001, the monthly average concentration of iron was 0.49 mg/L.

7.2 Regulated Testing

The City of Frostburg is also required to test for regulated contaminants in its finished water supply produced at the water treatment plant. These contaminants are listed by the EPA as the National Primary Drinking Water Regulations, and have been assigned maximum contaminant levels (MCLs). A large number of these samples are collected by MDE and analyzed by the Department of Mental Health and Hygiene, or a private environmental laboratory. The data is reported to MDE's Water Supply Program. Tests for Synthetic Organic Compounds (SOCs), Volatile Organic Compounds (VOCs), and Inorganic Compounds (IOCs), are required on an annual basis. Below are summaries of these regulated contaminants from Frostburg's treated drinking water.

7.2.1 Inorganic Compounds

IOCs have been annually tested in drinking water for some time, depending on the contaminant. Most metals and nitrates have been tested regularly since 1977, but in 1993, nitrite and several other metals (such as selenium and thallium) were regulated. MDE's Water Supply database contains sample results since 1993.

Nitrate and Nitrite
Since 1993, nitrate is the most commonly sampled and detected IOC in the Frostburg finished drinking water. According to the MDE Water Supply database, there have been 17 detections. The MCL for nitrate is 10 mg/L. The mean concentration of nitrate from these detections was 0.98 mg/L, with a median value of 0.8 mg/L, both well below the MCL. Frostburg is not required to test for nitrite because previous samples were well below the MCL. Three detections of nitrite from the 1990's averaged 0.16 mg/L, significantly below the MCL of 1.0 mg/L. One sample, from 1993, was at 50% of the MCL (0.5 mg/L). Further testing (1996,1997) showed very low concentrations.

Trace Metals
Several metals have been detected in Frostburg's finished water supply including: antimony (once), arsenic (1), barium (4), mercury (1), nickel (1), and selenium (1). All trace metal detections were well below 50% of the MCLs for each metal. Most concentrations were just above the standard detection limit. Barium, the most common detect, had an average concentration of 0.046 mg/L, well below the MCL of 2.0 mg/L.

Radionuclides
Radionuclide testing for Alpha and Beta emitters is required once every four years. There were no detections of alpha emitters in 1996 (the only contaminant then tested), and no detections for any emitters, both short and long-term in 2000.

Other Inorganic Compounds
Several other IOCs have been detected in the finished water supply namely: sodium (8), sulfate (4), and fluoride (4). Some of these contaminants are covered by the secondary drinking water regulations (fluoride has both a primary and secondary standard). Secondary standards are non-enforceable guidelines to limit aesthetic and nuisances effects in drinking water. However, average detection concentrations for fluoride, sulfate, and sodium have been below recommended limits.

7.2.2 Synthetic Organic Compounds

MDE tests for regulated and un-regulated SOCs annually from the finished water supply at Frostburg. Since 1995, there have been 11 detections, including: Dalapon (4), Di(2-ethyhexyl) Adipate (2), Di(2-ethyhexyl) Phthalate (4), and Dinoseb (1). These detections have been significantly less that the regulated contaminant MCLs.

7.2.3 Volatile Organic Compounds

VOCs were regulated in 1993, and several more were added for monitoring in 1998. There have been several regulated VOC detection in the Frostburg's water supply since sporadic testing began in 1989; tests are now conducted on an annual basis. None of the detections for VOCs were within 50% of the MCL for any contaminant. Compounds detected include: 1,1,1-Trichloroethane, Carbon Tetrachloride (2), Methylene Chloride, Toluene (2), and Trichloroethylene. Most of these detections were an order of magnitude less than the MCL, the only notable exception was a detection of Toluene in 1998, which had a concentration of 202.8 μg/L, but still well below the MCL of 1000 μg/L . However, toluene was not detected in samples taken a week before of a month after the single detection. Only two of the VOC detections have occurred after 1998.

7.2.4 Disinfection Byproducts

In addition to the regulated (and un-regulated) VOC testing, compounds known as Trihalomethanes (THMs) are also tested in the Frostburg finished water supply. THMs are the result of residual organic matter combining with chlorine during the disinfection process of water treatment. THMs, of which there is four different recognized compounds, are regulated on a total concentration basis. THM data has been collected since 1991. Since testing began, the total concentration of THMs has averaged 50.95 μg/L, with a maximum total concentration of 92.7 μg/L in September of 1991. The most common of the four compounds detected is chloroform.

Haloacetic acids (HAAs), are another form of disinfection byproducts (DPBs). Like THMs they are regulated on a total concentration basis, and the current MCL of 60 μg/L for HAAs went into effect on January 1, 2002 for systems serving greater than 10,000 people, which includes Frostburg. HAAs have been detected in every sample taken by Frostburg in its distribution system since 1999. The average concentration of HAAs from these samples is 73.6 μg/L. All detections were greater than 50% of the newly established MCL.

7.3 Source Water Assessment Bacteriological Sampling

MDE's Water Supply Program initiated a two-year bacteriological monitoring program for all surface water sources in the state to assist in the source water assessment. Sampling began in September 2000 with bi-weekly samples taken from lakes and reservoirs. Piney Creek Reservoir sampling began in September 2000. Fifty fecal coliform and E. Coli samples were collected between September 2000 and March 2002. Below is a summary of this data:

> Fecal Coliforms –23 of 38 samples had a Mean Probable Number (MPN), (of bacteriological colonies) of less than two. Of the fifteen samples greater than two, the MPN was 26.0.
>
> E.coli. – 25 of 38 samples tested for E.Coli were greater than one MPN. The mean value of these detections was approximately 31 MPN.

During this study period the highest recorded concentrations were on August 13, 2001, for both fecal coliform and E. coli, 130 MPN and 156.5 MPN respectively, which most likely took place after a storm event (there was a total of 4.4 inches of rain recorded at the reservoir in August 2001 – taken from monthly operating report).

7.4 Water Quality Analysis Of Piney Creek Watershed: 1987-1988

Morgan and Murray (1988) conducted water quality sampling on the main stem of Piney Creek and Getz Run during low flow conditions in the summer of 1987 and 1988 (an attempt was made to sample storm events in 1988). Physical measurements (temperature, conductivity, dissolved oxygen, etc) were recorded, and major ions, selected pesticides, and some metals were tested. In general, water quality was good (Morgan, 1988), and there were no detections of pesticides or heavy metals at any sampling stations. Because sampling was conducted during baseflow conditions, groundwater contamination by pesticides and metals, at that time, was not likely.

In August of 1987, there was an accidental spill of liquid manure from a dairy farm on Getz Run. This spill lowered dissolved oxygen levels, and increased suspended solids, total solids, nitrite, nitrate, and phosphorous concentrations in Getz Run. Elevated levels of nitrite and phosphorous were still recorded on Getz Run in July 1988.

In general: (1) Concentrations of iron exceeded the secondary contaminant level (0.3 mg/L) in almost a third of the samples, and was consistently high. (2) Nitrite concentrations were within 50% of the MCL at two stations on Piney Creek, the unnamed tributary, and several stations along Getz Run, especially after the manure spill, when concentrations above the MCL were observed (5.5, 12.3, and 7.6 mg/L). (3) High concentrations of phosphorous were present throughout the watershed (Morgan, 1988).

Other Findings: (1) Elevated concentrations of sodium and chloride were observed in Blandy Run, likely from groundwater inputs. (2) pH values for a number of stations were low and bordered on a critical level to support aquatic life (data ranged from 5.8 – 6.8), authors attributed condition to acid rain and natural low alkalinity of streams. (3) Low dissolved oxygen (less than 5.0 mg/L) was observed in July and August of 1987 in the unnamed tributary.

7.5 Water Quality Assessment Of The Piney Creek – Watershed System (2002)

The City of Frostburg's water system is an important regional source of drinking water in western Maryland. Consequently, this study was undertaken by MDE, University of Maryland-Appalachian Laboratory, and the City of Frostburg to assist in the development of this source water assessment by characterizing the "chemical and biological status of the Piney Creek reservoir and watershed" (Castro, 2002). The goal of this 2-year study was to develop a comprehensive baseline of water quality in the system and to provide the city with the information necessary to develop a cost-effective water quality management plan. Coupled with the information provided in this assessment, the city has a strong background to start a source water protection program for Piney Reservoir. The entire report is included in the Appendix; a summary of important findings is outlined below.

7.5.1 Reservoir

The Piney Creek reservoir is enriched with nitrogen (N) and phosphorous (P) (Castro, 2002). Total concentrations of N and P ranged from 0.79 to 4.1 mg N/L and 10 to 114 µg P/L. Phosphorous was determined to be the limiting nutrient in the Piney Creek Reservoir; the reservoir is over-enriched with nitrogen, so inputs of phosphorous stimulate biological (algae) growth. Phosphorous input comes from the watershed and also from the mixing of thermally stratified bottom water (hypolimnion) with surface waters. In fact, an algae bloom in fall 2001 was stimulated by the mixing of phosphorous rich water from the reservoir bottom (Castro 2002). Like most reservoirs, Piney Creek acts as a sink for nutrients (and most other pollutants, such as sediment). From late spring to late fall the reservoir is thermally stratified, that is, water on the surface (epilimnion) is warmer that water near the bottom (hypolimnion), which limits the amount of nutrient mixing between the surface and bottom. When this stratification breaks down during the colder months, nutrients are present throughout the water column.

Trophic State Indices (TSI) indicate that Piney reservoir is showing signs of eutrophication. The average TSI score over the entire study period was 50. A TSI between 50 and 60 suggests that a water body is showing signs of eutrophication, which was consistent with the Appalachian Laboratory's "observations of heavy macrophyte growth (rooted aquatic vegetation), our measurements of high concentrations of nitrogen (N) and phosphorous (P) throughout the water column, low dissolved oxygen concentrations at depth and the presence of a phytoplankton (algae) community indicative of eutrophic conditions" (Castro, 2002). The TSI of the reservoir may be higher during the growing season (March-October).

Nitrate is the only 'nutrient' with a MCL. During this study period, the maximum concentration of nitrate never exceeded 2.5 mg/L, well below the MCL of 10 mg/L. While nutrients in the reservoir may not pose an immediate health risk to the drinking water supply, (phosphorous does not have an MCL), nutrient concentrations are increasing the biological productivity in the reservoir, leading to eutrophication, and the water quality problems associated with that process.

Eutrophic reservoirs are likely to produce troublesome and costly drinking water quality problems such as taste and odor, algal toxins, and DBP precursors (Cooke, 2001). Eutrophic conditions can lead to increased algae blooms, which can clog water treatment plant filters and cause taste and odor concerns. During this study, the fall algae bloom was co-dominated by the phytoplankton species Microcystis aeroginosa, a species that can produce endotoxins that have harmful affects on humans and animals (Castro, 2002). Microcystis aeroginosa, a blue-green algae, is also a major source of THM precursors (Cooke, 2001). Anoxic conditions in the hypolimnion can release potential contaminants (nutrients, iron, and manganese) from the sediment back into the water column. Increased biological productivity raises the amount of organic matter in the reservoir, which in turn can raise the concentrations of DBPs in the finished drinking water.

The City of Frostburg funded a portion of the study that examined the reservoir for pesticides. The only pesticide that was detected was Atrazine, a herbicide used on row crops. Atrazine was detected in all samples at concentrations around ~ 0.0002 mg/L, which is approximately 10 times lower than the MCL of 0.003 mg/L

The study found relatively high concentrations of sodium and chloride in the reservoir. Concentrations were usually higher at the mid reservoir sampling station and at the intake location. The highest concentrations were observed (250 mg/L Chloride, and 110 mg/L Sodium) near the intake in Spring 2001 (Castro, 2002).

During the reservoir-watershed study, total mercury concentrations were tested in reservoir surface waters and the fillets of several game fish. Average concentrations of mercury in the reservoir surface water were several orders of magnitude lower than the dinking water standard. However, concentrations in Piney Reservoir were ~ two times higher than in other western Maryland lakes (Deep Creek and Lake Habeeb). Data from fish fillets showed that consumption advisories for humans might be needed for some fish species (Castro, 2002).

7.5.2 Watershed

During the study period, Getz Run had the highest nitrate concentrations, ranging from 1.5 to 6 mg/L. The unnamed tributary had the second highest nitrate concentrations in both years. Accordingly, Getz run had the highest nitrate fluxes into the reservoir-watershed system, followed by the unnamed tributary. Blandy Run, the most heavily forested subwatershed in the basin, had the lowest. Both Getz Run and the unnamed tributary have a substantial amount of agricultural land and several dairy/cattle operations within their watersheds. The total nitrogen flux into Piney Creek reservoir was dominated by inputs from Getz Run, the unnamed tributary, and the northern branch of Piney Creek. These three streams accounted for approximately 75% of the total nitrate flux over the entire study period (Castro, 2002).

The unnamed tributary accounted for most of the phosphorous input into the reservoir over the study period. Phosphorous concentrations ranged from 20 to 750 μg/L. This subwatershed is highly agricultural, with pastures, and areas of high-density dairy operations. The unnamed tributary is clearly the dominant source of organic P into the Piney Creek reservoir (Castro, 2002).

Sodium and Chloride were the dominant ions in the watershed tributaries. In both sampling years, Blandy Run was clearly the leading source of both chloride and sodium. Blandy Run accounted for 74% and 90% of the total chloride flux into the reservoir, in 2000 and 2001, respectively (Castro, 2002). Blandy Run accounted for 72% of the sodium input into the reservoir over both years. The results from this study back up previous studies (Morgan, 1988 and Envirens, 1991) that road salt contamination in Blandy Run, which drains both Interstate 68 and Route 40, is a continuing problem. From January to April 2001 chloride concentrations were elevated in Blandy Run, indicating the likely source of these high concentrations was road salt runoff.

Dissolved organic carbon (DOC) was the dominant form of carbon in all streams draining into the Piney Creek reservoir (Castro, 2002). Most concentrations were ~ 5 mg/L, and there were not any observable trends among streams or seasons. There was very little difference in annual flux of DOC, and particulate C, in 2000 and 2002. Getz Run had the lowest fluxes in both years, while the unnamed tributary had the highest flux in 2001 (Castro, 2002).

Total suspended solid concentrations generally ranged from 1 to 10 mg/L, but several times during the spring and summer of 2000 concentrations exceeded 10 mg/L. The highest concentrations were seen in the spring. The north branch of Piney Creek, Piney Creek, and the unnamed tributary had the highest concentrations. Piney Creek and the unnamed tributary had the highest TSS fluxes into the reservoir in 2001 (Castro, 2002).

7.6 Quality Of Groundwater

Little direct testing is performed on the quality of groundwater from Frostburg's springs and wells, because the water is mixed with the surface water from Piney Creek reservoir. According to the 1996 MDE wellhead protection report, operators of Frostburg's system have reported that turbidity is consistently low. Several publications on the quality of the groundwater from the Pocono formation indicate water of good quality, with low concentrations of nitrates and dissolved solids, but some higher concentrations of iron (MDE, 1996).

8.0 SUSCEPTIBILITY ANALYSIS

Each class of contaminants that were detected in the water quality data will be analyzed based on the potential they have of contaminating Frostburg's water supply. This analysis will identify suspected sources of contaminants, evaluate the natural conditions in the watershed that may increase or decrease the likelihood of a contaminant reaching the intake, and evaluate the impacts that future changes may have on the susceptibility of the intake. The ecological status of Piney Creek reservoir will also be addressed.

8.1 Microbial Contaminants

Under current regulations, the City of Frostburg is required to take total coliform samples each month of finished drinking water at the water plant. These bacteriological samples are collected at points in the distribution system. It would be difficult to use this data for the assessment because it does not adequately give an indication of contamination in both raw water supplies. Because of this lack of data, raw water bacteriological monitoring began in September 2000 at the plant. Below is a statistical summary of the data discussed previously in the WATER QUALITY REVIEW (less (>) than figures were given real numbers for statistical purposes):

Table 6. Summary of Bacteria Data

Source	*No. of Samples*	*Fecal coliforms*			*E. coli*		
		Mean	**Median**	**Max**	**Mean**	**Median**	**Max**
Raw Water	38	10.9	1	130	10.2	1	156.5

Concentrations of harmful bacteria in Frostburg's water supply are relatively low. This is most likely attributable to the characteristic of a reservoir (acts as a sink), and the mixing of high quality groundwater into the raw water at the plant. Even the highest concentrations recorded for fecal and E. coli bacteria were below the Maryland use I-P regulations of maximum fecal concentrations at 200 MPN/L, for a portion of samples taken during a given period. However, the sampling period covered since September 2000 was considered relatively dry with the absence of many storm events in the region. Concentrations in the reservoir, like most reservoirs in the state, likely increase during and after high runoff events such as rainstorms and snowmelt.

Streams which receive non-point source water runoff from pastures and concentrated livestock areas can have high concentrations of bacteria associated with eroding soil during periods of high flow. These bacteria can remain viable for long periods of time and attach to soil particles. During a storm, erosion of land surfaces may increase and previously eroded sediment in the streambed can be re-suspended, leading to increased bacteria concentrations. Reservoirs, in general, can reduce the number of viable bacteria within a water body, but this is dependent on many environmental factors. In general, potential sources of non-point sources of pathogenic protozoa, viruses, and bacteria in the Piney Creek reservoir-watershed include pasture (livestock), residential septic systems, and wildlife. Specifically, potential sources include cattle/dairy operations, some which were noted to have direct runoff into tributaries and cattle access to streams (Environs, 1991). Most sub watersheds had pastureland adjacent to streams with direct access by cattle/dairy cows. The unnamed tributary, Piney Creek, and Getz Run were noted to have either feedlots, dairy cow holding areas, or manure storage facilities within 500 feet of streams (Environs, 1991). Additionally, wildlife, especially resident Canadian geese, which are frequent visitors on the reservoir, can be a source of contamination.

Increased development, or improperly functioning septic systems, could increase the amount of bacteriological contaminants entering the ground water supply near the Savage River Pumping station. The wellhead protection area is not suitable for septic systems because of its steep slopes and relatively shallow layer of soil over bedrock. While there has not been a concern in the past with bacteria contamination, the potential exists because of the few residences on septic and the possibility of a livestock farm within Zone 1 of the protection area. Most septic systems over thirty years old have problems associated with them, houses in the wellhead are likely to be that old. Monitoring bacteriological contaminants and development potential within the wellhead protection area should be considered in the future.

Frostburg's raw water supply has never been tested for species of Giardia or Cryptosporidium in the raw water supply. Both of these microscopic protozoa are believed to be fairly common in surface waters of the United States. High turbidity and elevated bacteria concentrations can be an indicator for the presence of these pathogens. Sources of contamination include human and animal waste, including birds. Water filtration does not always provide a 100% effective barrier; especially against the smaller Cryptosporidium oocysts. Most surface water sources in Maryland are potentially susceptible to these pathogens.

At this time, Frostburg's raw water is not susceptible to regular contamination by pathogenic organisms under base flow conditions. Under certain hydrologic conditions, such as snowmelt or a rainstorm, concentrations of these pathogens are expected to increase similar to other reservoirs in the state. Additional data from storm events would help to characterize this risk. Potential sources of these contaminants exist in the source watershed and wellhead protection area, and monitoring should continue after this assessment to ensure that future changes in the raw water quality are recognized.

8.2 Turbidity and Sediment

Highly turbid water can cause additional demands on water treatment plants and sediment can carry harmful microorganisms and compounds into drinking water supplies. Turbidity is used as a surrogate indicator for the presence of Cryptosporidium and Giardia, and increased water turbidity is indicative of elevated bacteria concentrations. Turbidity is caused by erosion of materials from the contributing watershed. Turbidity may be from a wide variety of materials, including soil particles and organic matter created by the decay of vegetation. During storm events and/or snowmelts surface runoff increases. Runoff during a storm event occurs when the rate of precipitation exceeds the rate of infiltration. As runoff increases during a storm and/or snowmelt, the increased flow of water can cause soil and other material to erode, raising the turbidity.

The mostly forested (68%) Piney Reservoir watershed helps mitigate the effect of storm events, evidenced by the fact that raw turbidity levels in the reservoir seldom rise to problematic conditions. In general, lakes and reservoirs provide longer water retention times, allowing the larger suspended solids and organic material that contribute to turbidity to settle out. Likewise, groundwater from the wells and springs has a low turbidity. While both of these factors reduce the raw water turbidity entering the Frostburg plant, data from the recently completed reservoir-watershed study show that total suspended solid (TSS) concentrations from the reservoir's tributaries can be high, especially in the spring, when snowmelt and storm events are most common. TSS concentrations in the reservoir were highest at the deepest sampling locations (Castro, 2002). TSS may not be the best surrogate for suspended sediment, but it has been used as a reference.

There are several factors in the watershed that can contribute to increased turbidity/sediment. Runoff from paved surfaces (residential, commercial, roads) increases the amount of flow in tributaries quickly and leads to bank erosion. Unfettered cattle access to streams destroys protective vegetation along riparian areas where soils can runoff directly into a waterway. Also, row cropping on steep slopes, which is common in the source watershed, increase the likelihood of erosion. And maybe most important, is the continued forestry operations that occur on city owned property. The technique of clear-cutting forested land is a very controversial method of tree removal, and is generally regarded as the worst method of forestry with respect to erosion and water quality. This issue is especially sensitive in the Piney Creek reservoir-watershed system because a lot of the land being forested is close to the reservoir proper.

The wellhead protection area is heavily forested, which provides an asset to ground water quality (MDE, 1996). Groundwater from the springs depend on low impact land use up gradient of the their discharge points. The springs rely on relatively shallow groundwater, which is susceptible to any land disturbance such as mining or logging. Any changes from the current land use could increase the spring water turbidity.

While raw water turbidity is usually low in Frostburg's raw water, the reservoir-watershed system is still susceptible to turbidity, and to an extent sedimentation. The presence of sources within the watershed along with the potential for future contamination (development, agricultural erosion, and forestry) make turbidity an important water quality concern for the Frostburg water supply.

8.3 Inorganic Compounds

Nitrate & Nitrite

Data from Frostburg's water plant indicate that nitrate and nitrite are present in the finished drinking water supply, usually at levels well below 50% of the MCL. Nitrite testing is no longer required; Frostburg received a sampling waiver, because past samples showed low concentration levels.

Data from the Piney Creek Reservoir-Watershed project indicate that nitrate concentrations in the reservoir are generally below 2.5 mg/L, while some tributaries had slightly higher concentrations (ranging from ~ 0 – 6 mg/L). The reservoir is currently over-enriched with nitrogen (Castro, 2002). Dissolved nitrogen (N) accounted for 97% of the N entering the reservoir; nitrate accounted for 70% of dissolved N. Over the two-year study, Getz Run, the unnamed tributary, and the north branch of Piney Creek had the largest nitrogen influxes into the reservoir, respectively. These subwatersheds drain a substantial amount of agricultural land, including dairy/cattle farms. Nitrates from the groundwater sources are probably low (MDE, 1996). This would not likely change in the future unless significant land use changes occur in the wellhead protection area.

At this time Frostburg's water supply is not susceptible to nitrate or nitrite contamination. However, changes in land use, especially de-forestation, could lead to increased input of nitrogen species into the reservoir. Nitrogen flux from the major subwatershed contributors should be monitored. A potential manure spill from concentrated agricultural operations could also result in an acute contamination in the reservoir and watershed, similar to the spill on Getz Run in 1988. While nitrate and nitrite are not a direct threat to the safety of drinking water at this time, nitrogen is directly involved in the ecological processes within the reservoir, which can lead to additional water quality problems.

Trace Metals

While there have been several detections of metals with a primary drinking water standard in the Frostburg water supply, none have been within 50% of the regulated MCL. Without the absence of any point sources in the watershed, most metals are probably naturally occurring. Piney Creek reservoir and the Frostburg groundwater supply are not susceptible to heavy metal contamination.

More work may be needed to determine the sources and fate of mercury in the watershed-reservoir system. An investigation would be more important for recreational and health concerns, more so than for drinking water.

Iron is a common element in western Maryland waters, and can be associated with aesthetic and nuisance effects such as taste and odor problems and fixture staining, but high concentrations are not necessarily a public health concern. The secondary drinking water standard for Iron is 0.3 mg/L. Raw water data from the Frostburg water plant, and data from the 1988 watershed study showed high concentrations of iron in the reservoir and tributaries. As stated in the water quality review section, for the month of October 2001 the average concentration of iron in the raw water from Frostburg averaged ~ 0.5 mg/L, this coincidentally occurred when thermal stratification in the Piney Reservoir broke down. Anoxic conditions in the hypolimnion during the summer months probably result in the release of stored iron from the sediments. It appears that when the water becomes mixed (usually in the fall), the concentration of iron entering the water supply increases.

Sodium and Chloride

These two elements were the dominant cation and anion detected in the reservoir. High concentrations of sodium and chloride were detected as far back as the 1988 study, when Blandy Run was first identified as a potential source of these ions to the reservoir. The recently completed 2000-2001 study reinforced this determination. The data demonstrated higher concentrations of both elements during the winter and spring months of 2001, indicating that direct runoff may contribute to the elevated concentrations in Blandy Run and the reservoir. Concentrations of chloride in the reservoir were below the secondary standard of 250 mg/L. Some samples taken from Blandy Run exceeded the secondary MCL, including a sample from March 2001 that was above 4000 mg/L. There is no secondary standard for sodium. The sodium chloride contamination of Blandy Run from road salt should be addressed in a future management plan for the reservoir-watershed system.

Radionuclides

The Frostburg water supply is not susceptible to any form of radionuclides. There are no known point sources in the watershed or wellhead area, and radionuclide detections are most likely from the natural breakdown of elements in the watershed. Detections have been well below 50% of the MCLs. Data will continue to be collected by MDE, and if sample concentrations increase, a more detailed investigation into potential sources will be done.

Other Inorganic Compounds
No sources of cyanide or asbestos were found within the watershed or wellhead protections area. Fluoride was detected three times by MDE in Frostburg's finished water supply, well below the primary and secondary standard of 2.0 mg/L and 4 mg/L, respectively. Data from the Piney Creek Reservoir-Watershed study indicated that fluoride is present in the reservoir at concentrations from 0.01 to 0.05 mg/L. The data did not show any consistent temporal or spatial patterns (Castro, 2002). Fluoride is most likely a naturally occurring source in the watershed, and is present in the drinking water supply due to the fluoridation process in plant treatment. The Frostburg water supply is not susceptible to these types of contaminants.

8.4 Volatile Organic Compounds

There have been only two annual VOC detections in the Frostburg water supply since 1998. Most contaminant detections were an order of magnitude below corresponding MCLs. The only potential point source of VOCs in the watershed is a small automobile repair shop near Piney Creek in the Pennsylvania portion of the watershed, but this is not likely a major source. The only VOC threat to the watershed and the wellhead protection is the potential of a hazardous spill. This is discussed in detail under the Transportation Related Concerns in the Potential Sources of Contamination section. Frostburg's water supply is nor susceptible to regular VOC contamination.

Disinfection Byproducts
During the water treatment process disinfectants, like chlorine, interact with naturally occurring organic matter (NOM) in the raw water to produce disinfection byproducts, which are associated with human health risks (Cooke, 2001). Testing for Trihalomethanes and Haloacetic acids are required by state and federal regulations.

Since 1991, total THM concentrations in collected samples from Frostburg have averaged 50.95 μg/L, which is within 50% of the established MCL of 80 μg/L (MDE Database). Since testing began in 1999, HAAs concentrations have averaged 73.6 μg/L (MDE Database). The MCL for HAAs under the Disinfection Byproduct Rule is 60 μg/L. Collected data indicates that the finished water supply has a problem with DBP formation.

Total Organic Carbon (TOC) is used as a surrogate to determine the amount of NOM in a water body. Data from the Piney Creek Reservoir-Watershed study indicate that most of the TOC (~100%) in the reservoir and tributaries is composed of Dissolved Organic Carbon (DOC). TOC concentrations in the reservoir ranged from ~2.5 mg/L to ~10 mg/L. Reservoir DOC concentrations exhibited a consistent seasonal pattern in both years of the study, with concentrations lowest in the spring and gradually increasing through the fall season (Castro, 2002). Concentrations were highest in the hypolimnion at sampling site three during the fall seasons.

The Disinfection Byproducts Rule requires that a percentage of influent TOC be removed during treatment. A TOC concentration of greater than 2.0 mg/L in a system's raw water

Susceptibility Analysis Summary Table - City of Frostburg

Contaminant	*Water Quality* (50% MCL Exceeded?)	*Potential Sources*	*Natural Attenuation in Watershed*	*Evaluation of Change to Natural Conditions*	*Intake Integrity*	*Currently Susceptible?*
Volatile Organic	N	Spills, Tanks	Y	P	N	N
Synthetic Organic	N	Agriculture, Lawns	Y	P	N	N
Heavy Metals	N	Natural Deposits	Y	P	N	N
Nitrate/Nitrite	N	Agriculture/Septic	N	P	N	N
Fluoride	N	Natural Deposits	NA	P	N	N
Cyanide	N	None	Y	P	N	N
Asbestos	N	None	NA	P	N	N
Radionuclides	N	Natural Deposits	Y	P	N	N
Total/Fecal Coliform	Y	Agriculture/Septics	N	N	N	Y
Protozoa	I	Agriculture/Septics	N	N	N	Y
Viruses	I	Agriculture/Septics	N	N	N	Y
Disinfection Byproducts	Y	Organic Material	N	N	N	Y
Turbidity	Y	Erosion, Storm Water	N	N	N	Y

is the trigger for implementation of enhanced treatment techniques (usually increased coagulation) to lower the amount of DBP precursors. The reservoir's TOC concentrations from 2000 to 2001 were consistently above this trigger level. Because the raw water from the reservoir and groundwater supply has a low alkalinity (<60), Frostburg is required to remove 35-50% of the Total Organic Carbon entering the water treatment plant.

The amount of organic matter in Piney Creek reservoir is probably high due to the nature of the watershed and the existing condition of the reservoir (borderline eutrophic). The watershed is a major source of DBP precursors. The Piney Creek watershed includes approximately 93% agricultural and forested areas (MRLC 1997 data), and runoff from these areas contribute to the delivery of particulate and dissolved organic matter to the lake. There were **no** distinct patterns or seasonal trends between streams and TOC flux into the reservoir. This may indicate that in-reservoir processes are producing a significant amount of DBP precursors. The reservoir is in the early stages of eutrophication, and the enrichment of the reservoir with phosphorous and nitrogen seems to be driving this process. Since phosphorus appears to be the limiting nutrient for algae growth in Piney Creek Reservoir, watershed management efforts should concentrate on control of this nutrient to reduce biological productivity, and hopefully decrease the amount of DBP precursors. In the meantime, the Frostburg plant should not take water from its lowest intake, to avoid high TOC concentrations in the hypolimnion, especially during late summer and fall.

8.5 <u>Synthetic Organic Compounds</u>

All of these detections were significantly lower than the MCL regulation and 50% trigger for each contaminant. The most common compound found, Dalapon, was detected four times from 1996-2000, and is a herbicide commonly used on right-of-ways and transportation corridors. Concentrations of Dalapon averaged 1 μg/l, well below the MCL of 200 μg/L. Di(2-ethylhexyl) Adipate and Phthalate are resins commonly found in plastics. Its prevalence in plastics makes it a hard substance to sample and test. Because this compound appears in laboratory blanks when detected, the reported quantities are not likely reflective of levels in the environment, but rather laboratory artifacts.

A list of pesticides sampled in the reservoir during the Piney Creek Reservoir-Watershed study is included in the appendix of that report (which is included in this assessment's Appendix). The only pesticide detected, Atrazine, is a herbicide used on row crops. All samples contained minute concentrations of Atrazine, but were well below the regulated MCL (see Water Quality Review above).

Frostburg's water supply is not currently susceptible to SOC contamination. It is unlikely that the threat of SOCs entering the water supply will increase in the future, unless major land use changes occur and/or pesticide application to crops and residential yards increase dramatically. SOCs will continue to be sampled annually by MDE, and if detections become more frequent or concentrations increase, a further investigation could be undertaken.

8.6 Reservoir Eutrophication

The expanded Piney Creek reservoir is just over a decade old and is already showing signs of eutrophication (the reservoir's volume increased by 370 million gallons of water). Eutrophication can be defined as the addition of dissolved and particulate organic and inorganic materials to a reservoir or lake at rates sufficient to increase biological production and decrease storage due to sedimentation (Cook, 2001). The flux of nutrients into the reservoir from the watershed, and the possible cycling of nutrients from the reservoir sediments, is driving the eutrophication process in Piney Creek. The increase in biological productivity can negatively effect water quality in the reservoir and make it increasingly difficult to treat properly. If conditions in the watershed and reservoir remain the same or worsen due to adverse land use changes, taste and odor problems, increased DBPs, and algae blooms are likely to continue and become more frequent in the future. The Piney Creek reservoir is susceptible to water quality impacts associated with eutrophication.

9.0 RECOMMENDATIONS FOR A SOURCE WATER PROTECTION PLAN

This report has presented a comprehensive picture of the risks to the City of Frostburg's water supplies. A source water protection plan for Piney Creek reservoir and the Savage River Pumping station's groundwater sources is the underlying goal of this assessment. The City of Frostburg has the information needed to begin to implement a protection program. Both a watershed management plan and a wellhead protection plan have both been produced for the city. The wellhead plan was finished in March of 1996. As part of the permit for constructing the new Piney Dam, the city was required to have a watershed management plan, which was completed by the consulting firm, Environs, Inc. in 1991. With the completion of the WATER QUALITY ASSESSMENT OF THE PINEY CREEK – WATERSHED SYSTEM (2002), and this assessment, the apparent problem areas in the watershed and wellhead areas have been thoroughly documented. Water quality conditions in the reservoir would be expected to become worse than current conditions, without implementation of a watershed protection program, which will lead to increased costs in treating water for the public supply (Castro, 2002).

Frostburg, with the support of key partners, such as Frostburg State University, UMD-Appalachian University, the Soil Conservation District, and forestry managers, should use the recommendations mentioned in previous management plans to form a new source water protection plan for both sources. The recommendations are still valid, and should be looked at in a new light, since conclusions from the recently completed water quality study have spotlighted areas of concern. Specific source water protection recommendations included in previous reports are included in the appendices of this report.

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Other Sources of Information and Data

- MDE Water Supply Inspection Reports
- MDE Water Supply reader file for the City of Frostburg (PDWIS ID 0010011)
- MDE Water Supply Program Oracle Database (PDWIS)
- City of Frostburg Monthly Operating Reports (MORs) and Self-Monitoring Reports
- MD Department of Natural Resources Digital Orthophoto Quads for Garrett and Allegany Counties
- MD Department of Natural Resources, Protected Lands GIS database, from MERLIN
- Digital USGS Topographic 7.5-Minute Quadrangles, SureMaps Raster
- Maryland Office of Planning 1990, 1997, and 2000 Garrett County Land Use data
- EPA Chemical Fact Sheets, http://www.epa.gov/safewater/mcl.html.

APPENDIX

A. Figures

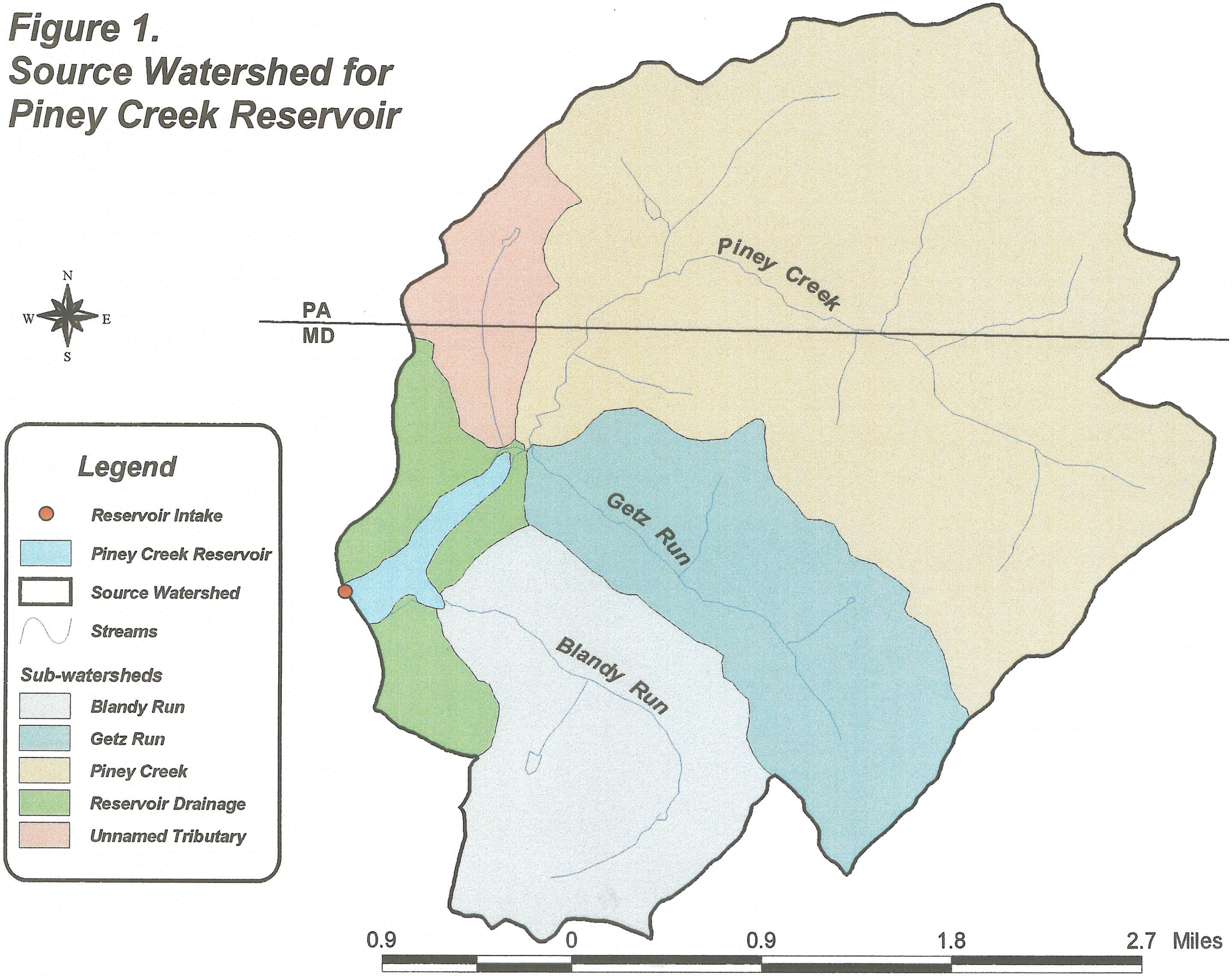
B. Photos

C. Executive Summary: "Water Quality Assessment of the Piney Creek Reservoir and Watershed" Appalachian Laboratory, 2002

D. Executive Summary: "Piney Creek Reservoir Watershed Management Plan" Envirens, 1991

E. MDE Well Head Protection Plan for the City of Frostburg, 1996

Figure 1. Source Watershed for Piney Creek Reservoir



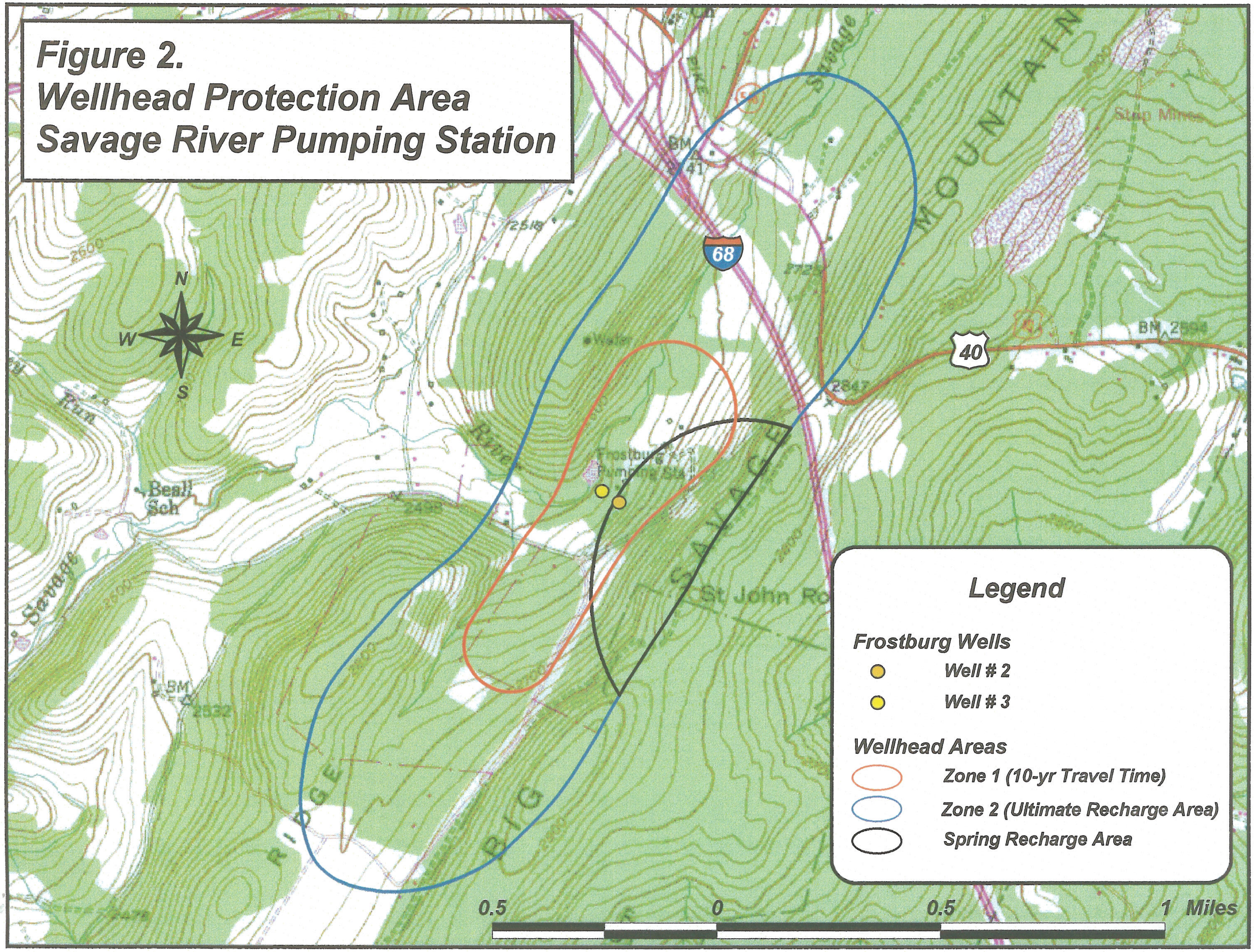


Figure 2.
Wellhead Protection Area
Savage River Pumping Station
N
S
E
W
Legend
Frostburg Wells
Well # 2
Well # 3
Wellhead Areas
Zone 1 (10-yr Travel Time)
Zone 2 (Ultimate Recharge Area)
Spring Recharge Area
0.5
0
0.5
1 Miles
68
40
BIG SAVAGE MOUNTAIN
RIDGE
St John Rd
Beall Sch
Savage
Frostburg Pumping Sta

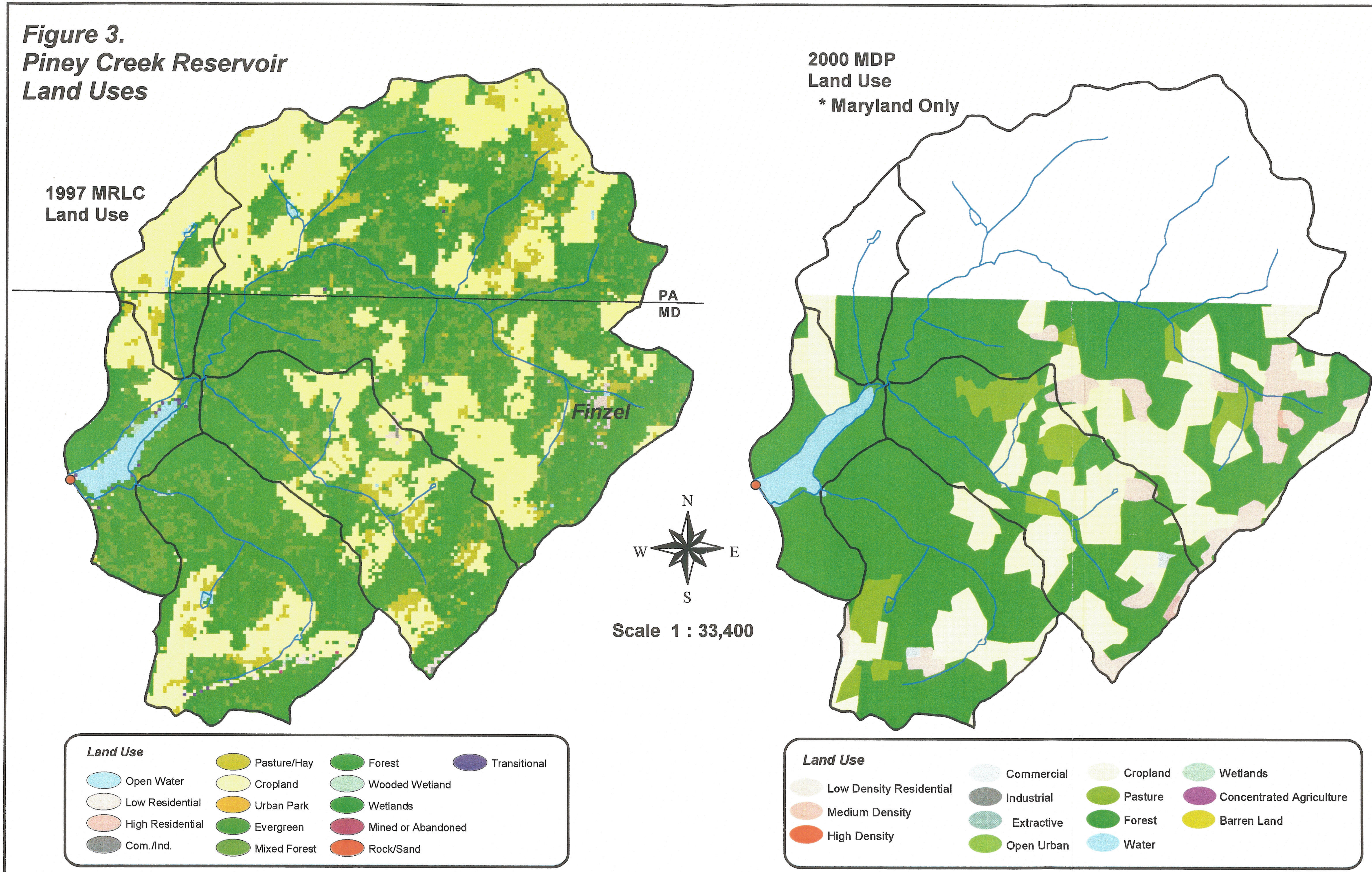
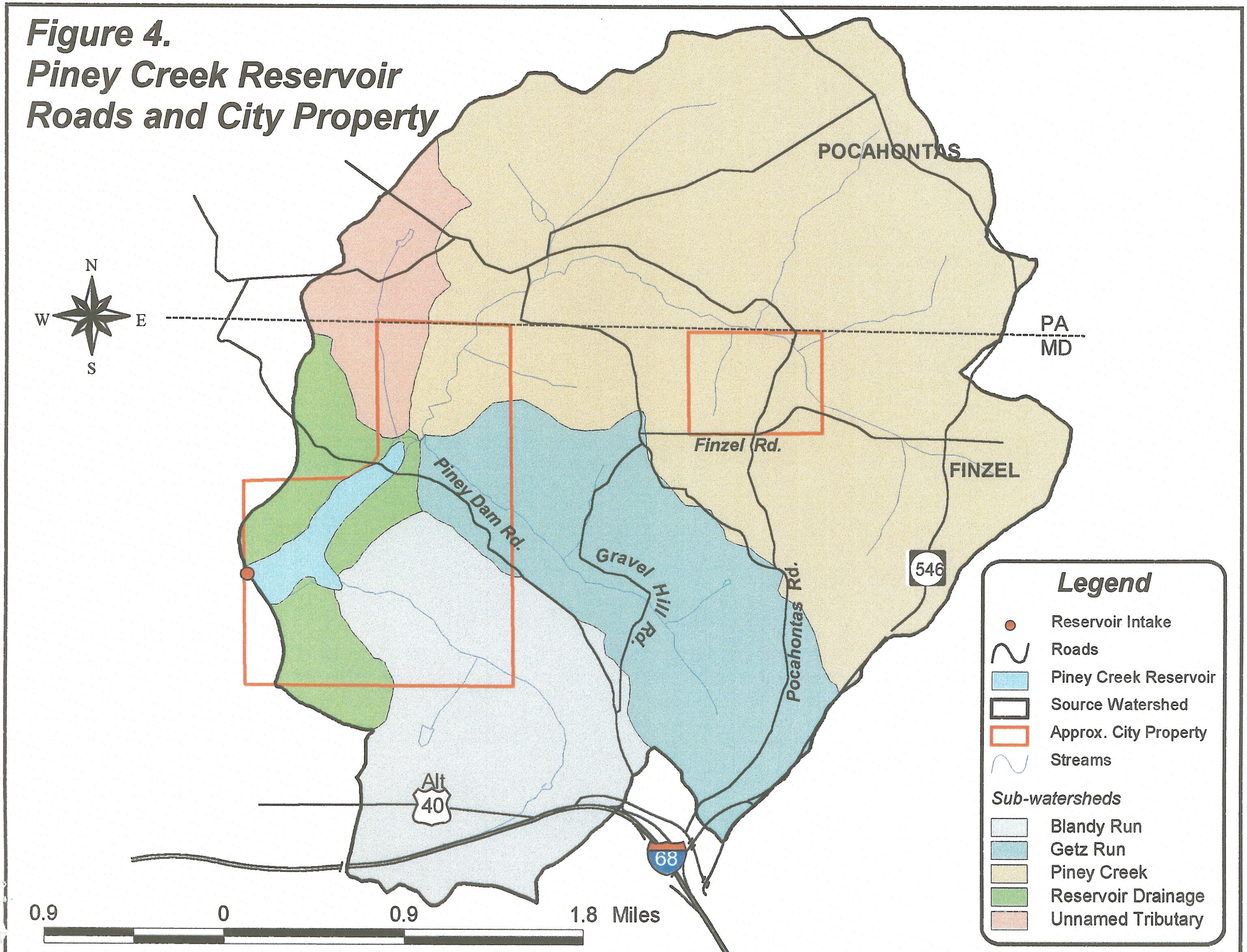
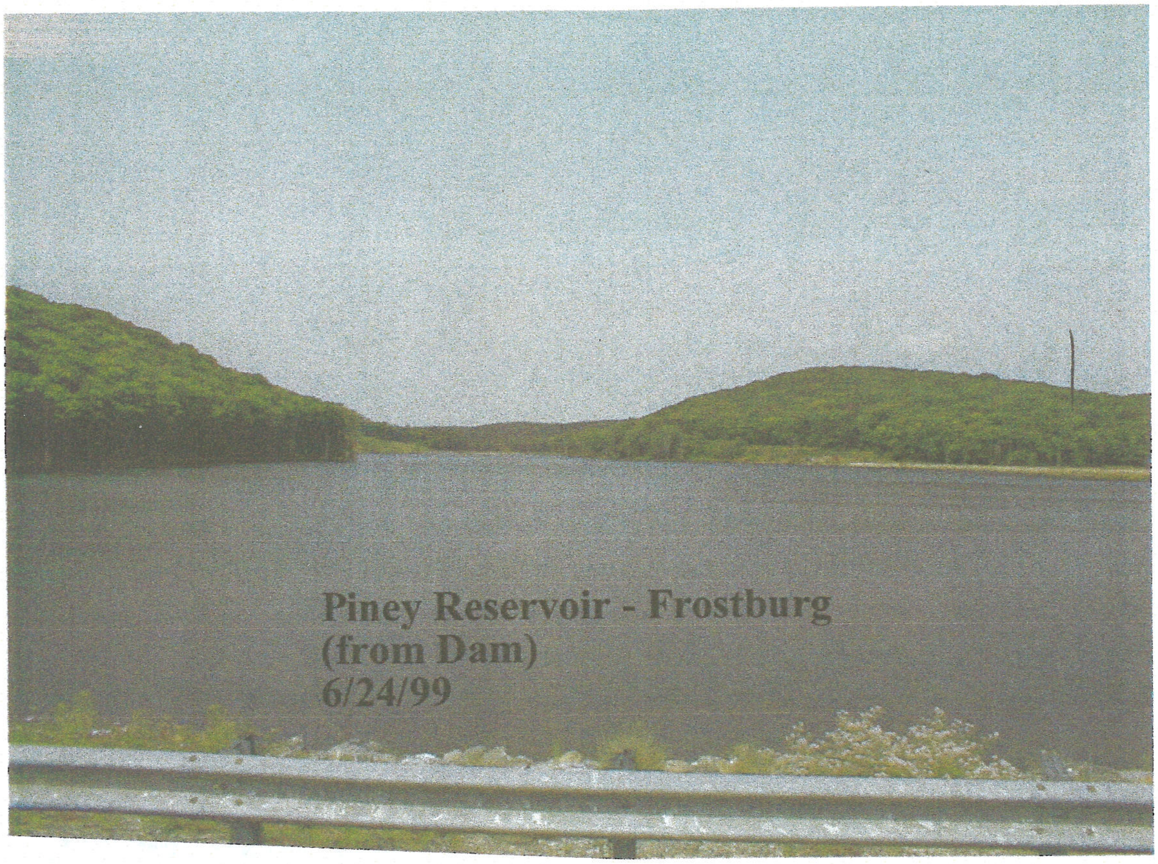


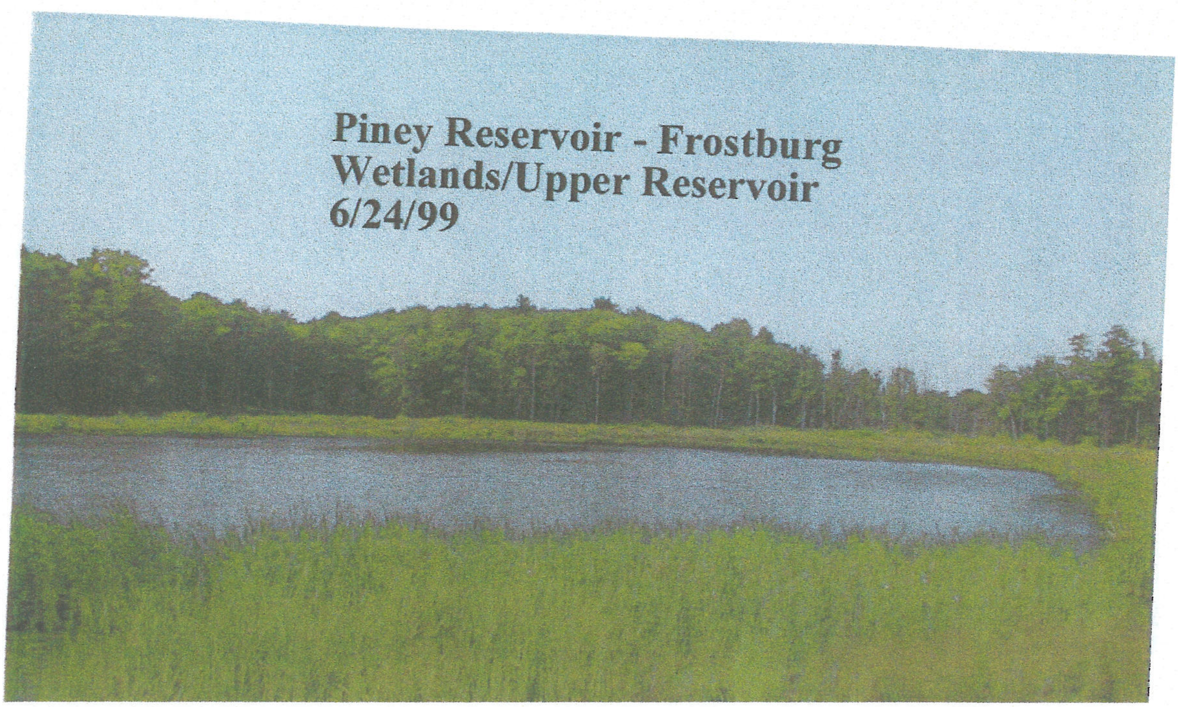
Figure 3.
Piney Creek Reservoir
Land Uses

Figure 4.
Piney Creek Reservoir Roads and City Property



Appendix B. PHOTOs






Blandy Run – near sampling site


Getz Run – near sampling site

WATER QUALITY ASSESSMENT OF THE PINEY CREEK RESERVOIR AND WATERSHED IN WESTERN MARYLAND

Final Report

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Maryland Department of the Environment
Water Management Administration
Water Supply Program
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EXECUTIVE SUMMARY

The overall goal of this study was to characterize the chemical and biological status of the Piney Creek reservoir. This reservoir is an important drinking water source and recreational fishery in western Maryland. We measured numerous chemical and biological parameters in the reservoir and tributaries that drain into the reservoir in 2000 and 2001. These two years were relatively dry. We had approximately 200 mm less precipitation than the long-term average annual precipitation input. As a result, our study is representative of relatively dry conditions.

Trophic state indices (TSI) ranged from 42 to 60 and the average was 50. A TSI between 50 and 60 suggests that the water body is showing signs of eutrophication, which is consistent with our observations of heavy macrophyte growth, our measurements of high concentrations of nitrogen (N) and phosphorus (P) throughout the water column, low dissolved oxygen concentrations at depth and the presences of a phytoplankton community indicative of eutrophic conditions. From amongst the phytoplankton community, two phytoplankton species, *Asterionella formosa* and *Microcystis aeroginosa* are very important. *Asterionella formosa* is the dominant algal species in the Piney Creek reservoir. It is one of the worst culprits for clogging filters and producing disagreeable taste and fishy odor in treated water. More importantly, however, certain strains of *Microcystis aeroginosa* produce endotoxins that have neurotoxic affects on humans and animals. *Microcystis aeroginosa* was a co-dominant algal species during the fall 2001 bloom. More research is urgently needed to understand the dynamics and importance of *Microcystis aeroginosa* in the Piney Creek reservoir and the finished drinking water because the endotoxins of *Microcystis aeroginosa* may not be removed during water treatment.

The Piney Creek reservoir is enriched in N and P. Total N and P concentrations ranged from 0.79 to 4.1 mg N/L and 10 to 114 ug P/L, respectively. Total N flux into the Piney Creek reservoir was dominated by inputs from Getz Run, the unnamed tributary and North tributary. These three streams accounted for 75% of the total nitrate flux into the reservoir in 2000 and 2001. The unnamed tributary was also the most important source of orthophosphate. In 2000 and 2001, the unnamed tributary accounted for 58% and 56% of the orthophosphate inputs to the reservoir, respectively. The unnamed tributary drains croplands (50% of area), pastures (23% of area) and a high-density dairy farm. Getz Run drains a watershed dominated by upland forests

(62% of total area) with moderate amounts of cropland (27% of total area) and has a high concentration of dairy cows.

Nitrogen to P ratios in the reservoir ranged from ~50 to ~250. All of our N:P ratios were significantly greater than the Redfield N:P ratio of 16:1. This suggests that P is limiting phytoplankton growth. As a result, P inputs into surface waters of the Piney Creek reservoir will stimulate primary production. In fact, the phytoplankton bloom in fall 2001 may have been stimulated by the input of P from the P enriched bottom waters associated with the fall turnover. This bloom altered the phytoplankton communities and shifted them towards more harmful species, such as *Microcystis aeroginosa.*

Fish surveys indicate that the fish populations in the Piney Creek reservoir are not balanced. There are considerably more panfish, particularly, yellow perch, pumpkinseed and bluegill in the reservoir then is needed to support the largemouth bass fishery. In fact, reductions in the panfish populations are needed to improve the largemouth bass fishery.

We detected low concentrations of atrazine, fluoride and mercury in the Piney Creek reservoir. Concentrations of atrazine, fluoride and mercury were below the national primary drinking water standards. Atrazine is a herbicide used on row crops that has toxic effects at high concentrations. Fluoride is found naturally in certain rocks and soils and is good for teeth at low concentrations, but can have toxic effects at high concentrations. Although mercury concentrations were below the drinking water standards, we found mercury in the filets of largemouth bass, yellow perch and bluegill. Concentrations of mercury in filets from yellow perch and bluegill were below the national consumption advisory of 0.5 ug g^{-1}, but mercury concentrations in largemouth bass greater than 38 cm in length exceeded this consumption advisory. It should be noted that the consumption advisory of 0.5 ug g^{-1} is likely to be reduced to 0.3 ug g^{-1}. If this change occurs then most harvestable yellow perch and largemouth bass in the Piney Creek reservoir will exceed the lower (0.3 ug g^{-1}) mercury consumption advisory limit.

We found relatively high concentrations of sodium and chloride in the reservoir. Since there are few natural sources of sodium chloride in the watershed, human activities are responsible for the increased sodium chloride inputs to the reservoir. The observed spatial and temporal patterns suggest that road salt (road salt = sodium chloride) runoff from Interstate 68 (I-68) and Route 40 and direct inputs to the reservoir from contaminated groundwater were the major sources.

Runoff from Blandy Run, the stream that drains the watershed adjacent to I-68 and Route 40, accounted for ~ 72% of the total stream water input of sodium chloride in 2000 and 2001.

In summary, the Piney Creek reservoir currently has several water quality problems: elevated N and P concentrations, harmful algal blooms, unbalanced fish populations, mercury contamination of game fish and elevated sodium chloride concentrations. As a result, the City of Frostburg needs to implement their existing watershed management plan that addresses these problems. If this watershed management plan is not implemented then we would expect the quality of water in the Piney Creek reservoir to become worse than current conditions, leading to increased costs for water treatment.

INTRODUCTION

PINEY CREEK RESERVOIR
WATERSHED MANAGEMENT PLAN

April 16, 1991

EXECUTIVE SUMMARY

I. Introduction

Envirens, Inc. was contracted by Whitman Requardt for the City of Frostburg to develop a watershed management plan in order to assure the protection of the water quality of the Piney Creek reservoir. The plan is a condition of the U.S. Army Corps of Engineers Section 404 permit for construction of a new dam and the associated secondary environmental impacts of increasing the surface area from 37 acres to 116 acres. The capacity of the reservoir will increase from 30 million gallons to 400 million gallons in the spring of 1991, flooding approximately 42 acres of wetlands.

The drainage basin of the Piney Creek Reservoir is 7,550 acres and is located in two counties of two states- Garrett County, Maryland and Somerset County, Pennsylvania. The City of Frostburg, who built the dam and uses the water from the reservoir, is in Allegany County. Envirens, Inc. developed the watershed management plan in consultation with representatives of the three participating jurisdictions.

The goal of the plan is to inform local government administrators and watershed residents about the factors which affect water quality of the Piney Creek reservoir and advise the City of Frostburg about what actions need to be taken to protect the water quality of the reservoir from pollution throughout the watershed.

II. Piney Creek Reservoir as an Ecological System

Piney Creek Reservoir is a dynamic ecosystem and reservoir management should be based on an understanding of the ecosystem because managing any of its components will affect the other parts. Some fundamental concepts about reservoir ecosystems are introduced in Chapter II, including: the relationship of the reservoir to its watershed, reservoir processes, and lake aging.

If the lake ecosystem is affected and water quality degrades due to inputs from the watershed, the costs of treatment may increase and public health may be threatened. The watershed management plan examines the watershed inputs to the reservoir and makes recommendations for protecting the water quality from existing and potential impacts.

III. Water Quality Criteria

Surface water quality of the State of Maryland is regulated by the Maryland Department of the Environment through the Code of Maryland Regulations (COMAR 26.08.02 Water Quality). Piney Creek Reservoir is classified as Use I-P: water contact recreation, protection of aquatic life, and public water supply. Appendix C summarizes the water quality parameters enumerated in the State regulation to assure a healthy ecosystem and safe drinking water supply.

IV. Existing Water Quality of Piney Creek Reservoir and its Tributaries

Comprehensive data for the Piney Creek Reservoir is limited. Available data indicates that the water quality is generally good as a source for drinking water, however, there are significant indicators of negative impacts on the water. The watershed is relatively small and thus vulnerable to impacts.

The reservoir itself may be experiencing elevated nutrient levels. The streams show various degrees of problems associated with sedimentation, low pH, low dissolved oxygen, elevated salt levels, and presence of nitrites. Nitrites and low dissolved oxygen may be indicators of pollution through disposal of sewage, organic wastes and/or nutrients. In order to understand in a quantitative way the relationship between the water quality of Piney Creek Reservoir and the inputs from the watershed, additional data would be useful. Data needs are identified in the plan recommendations (Chapter IX).

V. Sensitive Areas

Chapter V discusses how the natural characteristics of the Piney Creek watershed affect the vulnerability of areas to disturbances which potentially affect water quality. An analysis was performed of the soils and surface waters of the Piney Creek watershed in order to assess the relative vulnerability of areas to construction, agriculture, septic fields and other practices. Soil type and proximity to water served as the two primary indicators of sensitivity and these areas were mapped.

Approximately 75% of the soils of the watershed have at least a severe erosion hazard, mostly due to steep slopes. Most soils of the watershed are also vulnerable to the impacts of failing septic fields due to shallow depth to bedrock or slope. Both of these factors may affect water quality.

The Piney Creek Watershed is finely dissected by numerous first and second order streams flowing into Piney Creek, a third order stream. Sediment and contaminants which enter these streams may be transported to the reservoir. Streams in the watershed, adjoining buffer areas, and soils with a seasonal high water table ranging from 0 to 2 feet deep, are shown on the sensitive areas map (Figure 5.1).

VI. Pollution Sources in the Piney Creek Watershed.

The Piney Creek watershed has an assortment of land uses which are predominated by forest (58 percent) and agriculture (39 percent). Residential and park properties comprise two percent of the watershed and commercial and institutional properties comprise less than one percent of the area. These land uses affect water quality by generating pollutants.

Most of the pollutants in the watershed are non-point source pollutants which enter waterways diffusely, traveling either above the ground through runoff during storms or below the ground through the groundwater. Chapter VI discusses the non-point source pollutants of the Piney Creek watershed, estimates the nutrient and sediment export of each land use, identifies the types of pollutants associated with each land use, and discusses other existing and potential pollution problems. The three major types of potential non-point source pollutants in the Piney Creek watershed are: (1) nutrients, (2) sediments, and (3) toxic substances.

VII... Existing and Potential Problem Areas

The significance of existing and potential impacts to water quality in the Piney Creek watershed depends on the type of pollution and where it is located in the landscape. In Chapter VII, Envirens, Inc. examined the relationship between pollution sources and sensitive areas by overlaying the land cover map on the sensitive areas map. Figure 7.1 shows the location of potential sources of pollution, including sites where land disturbing activities are occurring on sensitive areas.

Agriculture is the most significant potential impact to water quality in the Piney Creek watershed. Agricultural practices result in inputs of nutrients, sediments, and toxic substances to the watershed through the application of fertilizers pesticides and animal waste and activities that disturb land such as tilling. The relative significance of practices are affected by the soils, proximity to stream, type of agricultural use, and on-site management practices. Dairy cow holding areas may be the greatest potential polluter per acre in the watershed.

One of the wide-ranging potential impacts to water quality of the reservoir is the future conversion of forest land to other land uses. Forest cover in the watershed consists of 1,396 acres owned by the City of Frostburg and 2,998 acres under private ownership. Most of this land protects sensitive areas in the watershed. Poor timber harvest practices are also a potential impact on these lands.

The City of Frostburg owns one third of the total forest acreage in the Piney Creek watershed. This land is timbered to provide revenue to the City. The timber harvest management is prescribed by a plan designed by Maryland Forest Parks and Wildlife Service. This plan was reviewed, potential impacts to water quality from timber harvesting practices were discussed, and alternative forest management practices were summarized.

Road runoff on state and county roads is a potential and existing impact to water quality. Road salt contamination from state roads has been observed in both surface water and groundwater, contaminating residential wells. U.S. Route 40/48 crosses the southern part of the watershed. This major highway provides for the possibility of a hazardous materials spill occurring at some time in the future. The Piney Creek Reservoir is vulnerable to the potential impacts of a spill because Blandy Run flows immediately adjacent to the highway which is only two miles upstream from the reservoir.

Historical documents and soils conditions of the area indicate that improperly functioning septic systems may exist in the watershed. Two particularly sensitive areas are properties in Finzel and Pocahontas near tributary streams.

VIII. Federal, State and Local Programs Which Affect Watershed Management

Chapter VIII reviews selected federal, State of Maryland, Commonwealth of Pennsylvania, and Garrett and Somerset Counties programs which are germane to the issues of watershed management planning and implementation.

The governmental programs available in the four jurisdictions of the Piney Creek watershed offer many opportunities to protect the reservoir. Many of these programs could be utilized more effectively than they are presently. The local jurisdictions involved have few regulatory mechanisms in place for managing land uses in the watershed. The land use in the watershed and throughout much of Garrett and Somerset Counties is presently rural or undeveloped land and the water quality of the reservoir is relatively good. As a result, there has been little incentive to actively manage activities in the watershed and historically there has been a resistance to land use regulation in the region. The fact that neither Garrett County or Somerset County has a building permit process is one example that demonstrates there are few mechanisms in place to monitor, guide, plan for, or regulate land use or activities in the watershed.

Garrett County has a number of local environmental protection programs which it administers, and land use regulation in parts of the county. These programs may be better utilized and expanded to protect the Piney Creek Reservoir. Greenville Township, Pennsylvania has no locally run programs for environmental protection or land use regulation and so will need to work with Somerset County and the Commonwealth of Pennsylvania if improvements are to be made in the protection of the watershed.

IX. Recommendations

Chapter IX outlines goals, objectives, and a strategy for implementation of the Piney Creek Watershed Management Plan.

A. Goals

The goal for managing the Piney Creek Watershed is to reduce existing impacts and minimize future impacts to water quality through a combination of regulatory and non-regulatory programs which balance the rights of individual land owners and the economic development needs of local jurisdictions, with the protection of water quality of the Piney Creek Reservoir. The water quality goal for the reservoir is to maintain the present quality and improve the existing quality to the degree possible, in order to protect public health and minimize the input of resources for water treatment.

B. Objectives

Fifteen objectives were identified in order to move towards this goal. These objectives address the issues which have been described in the watershed management plan. The means to attain the objectives are addressed in Chapter IX through various mechanisms of implementation.

- Establish a multi-jurisdiction governing body to address watershed management issues;
- Increase the existing water quality data of the reservoir and other data as necessary to guide management decisions;
- Promote land use patterns and practices that will accommodate growth while protecting water quality;
- Conserve existing forest lands to the degree reasonable, encourage reforestation, especially in stream buffer areas, and insure proper forest management on public and private lands;
- Encourage the conversion of cultivated agricultural land on sensitive areas to permanently vegetated land or forest;
- Prohibit or discourage incompatible land uses throughout the watershed, especially on sensitive areas;
- Prohibit or control the handling and storage of hazardous materials in the watershed;
- Establish and protect "primary management areas" which are most sensitive to disturbance including a streamside buffer, steep slopes and areas adjoining these sites;
- Encourage best management practices on agricultural lands uses with particular attention to manure and fertilizer management, managing cattle access to streams, pesticide use, and erosion and sediment control;
- Encourage best management practices also on non-agricultural land uses with particular attention to stormwater management (including runoff pollution control), sediment and erosion control, and hazardous materials handling.
- Provide greater opportunities to properly dispose of used oil;
- Guard against the possible effects of a hazardous materials spill;

- Prevent or reduce salt contamination of groundwater and surface water;

- Provide adequate controls to guard against pollution from on-lot sewage disposal;

- Provide environmental education opportunities for land owners in the watershed.

C. Mechanisms of Implementation

The objectives above can be attained through six basic mechanisms, which served as the organizing framework for recommendations in Chapter IX:

1. Establish a Piney Creek Reservoir Watershed Commission;
2. Implement a data collection and planning strategy;
3. Establish land use regulations;
4. Establish a land acquisition and easement program;
5. Utilize and improve existing regulatory programs;
6. Utilize and target non-regulatory programs;
7. Establish a public education campaign for watershed residents.

MARYLAND DEPARTMENT OF THE ENVIRONMENT
Water Management Administration

MDE

A Wellhead Protection Plan for The City of Frostburg

March 1996

Prepared by:
Public Drinking Water Program

Parris N. Glendening
Governor

Jane Nishida
Secretary

Executive Summary

The Maryland Department of the Environment's Public Drinking Water Program (PDWP) initiated a statewide project of identifying water supplies relying on ground water, that serve at least 1,000 persons, and whose wells or springs obtain water from unconfined aquifers. Water supplies in unconfined aquifers may be subject to contamination from land use activities. The City of Frostburg was identified as one of these systems since a significant portion of its water supply comes from ground water. On the basis of this report, the PDWP recommends that Frostburg develop a locally based wellhead protection program, to protect the current and future quality of its ground water supplies.

This report was developed for the City of Frostburg to assist it in developing a local wellhead protection program. Based on information provided by the City, other programs at MDE, Maryland and United Geological Surveys' reports and maps, consultants' reports, and our site visits, we have:

a) mapped areas around the wells and springs that indicate where the ground water being supplied by Frostburg originates (see figure 1), base on all reasonably available data. These areas are referred to as wellhead protection areas (WHPAs) and spring recharge areas.

b) identified potential contaminant sources within the WHPAs and spring recharge areas (see page 4).

c) made recommendations for managing these areas (see pages 4, 5 and 6).

Our key findings and recommendations are described below:

1) The total area that the PDWP identified as needing protection for Frostburg's ground water supplies is about 1 square mile, all of which is in Garrett County.

2) The springs are believed to be more sensitive because of their dependance on shallow ground water. There are several property owners within the spring recharge area - the City, a mining company, the Department of Natural Resources, and private individuals. Opportunities for land purchase and/or development restrictions should be pursued.

3) The system is vulnerable to contamination and any major land activity in the WHPA and spring recharge area must be carefully monitored.

4) The City should form a local wellhead protection team to review the enclosed report and develop a local priority plan.

CITY OF FROSTBURG

Introduction

The City of Frostburg, located in western Allegany County, supplies drinking water to approximately 11,000 customers. The water system uses both ground water and surface water as its sources. Currently, the City is in the process of building a new water treatment plant with a capacity to supply 3.0 million gallons a day (mgd).

This study address the protection of the City's ground water sources. Frostburg's ground water sources are located northwest of the City, in Garrett County. They consist of numerous springs located on the western slopes of Big Savage Mountain and two wells (Nos. 2 and 3) located in the Savage River basin. The main supply well is No. 2 with No. 3 being the standby well.

Hydrogeology

Frostburg's wells obtain water from the Pocono formation. According to Meiser and Earl (1978), the Pocono formation is 800 feet thick, and crops out as Little Savage Mountain and Fourmile Ridge and dips to the east beneath the Savage River and Little Savage River Valleys at about 20 degrees. The formation consists mainly of olive-brown and yellow-green, jointed and cross-bedded sandstone interbedded with some siltstones and shales (Amsden et al, 1954).

In the Frostburg area, several springs are located in the Pocono formation. Thirty to forty separate springs are known to be present near the western base of Big Savage Mountain (Amsden et al, 1954). These springs are the main source of Frostburg's ground water supply. The springs occur at the contact between the Pocono formation and the limey shales of the Greenbriar formation. Meiser and Earl (1978) have classified several springs at the Savage River pumping station as originating from the Greenbrier formation.

Frostburg's wells and springs are located in the Savage River valley, between Big Savage Mountain and Fourmile Ridge-Little Savage Mountain. According to Meiser and Earl (1978), "recharge on the western slopes of Big Savage Mountain and the eastern slopes of Little Savage Mountain-Fourmile Ridge is funneled down the mountain flanks and discharges into the narrow, elongated Savage River Basin and Little Savage River Basin".

According to the semi-annual water withdrawal reports for 1992, 1993 and 1994, the combined daily average withdrawal from the springs and wells is nearly 350,000 gallons per day (gpd), with the springs contributing 86% of this quantity. Based on aquifer tests conducted in the Pocono formation, the average transmissivity was determined to be 2049 gallons/day/foot (274 ft^2/day). The porosity of the aquifer was estimated to be 15%.

Water Quality

Frostburg's finished water meets the primary drinking water standards. Treatment consists of prechlorination, precipitation using liquid alums or other coagulants such as poly alum chloride, pH adjustment using hydrated lime, flocculation, sedimentation, filtration, postchlorination and stabilization by the addition of a corrosion control chemical (Whitman, Requardt and Associates, 1995).

Frostburg's ground and surface water sources are combined together prior to treatment. All the available sampling data is on the finished water. No sampling data was available from the Public Drinking Water Program's files on the quality of the ground water source. Operators of the Frostburg system indicate that the ground water sources have consistently low turbidity which aids in the treatment of the City's surface water. Published chemical analyses of ground water from the Pocono formation (Amsden et al, 1954), (Meiser and Earl, 1978), indicate water of good quality, low in nitrates and dissolved solids, with some high iron levels.

Recent sampling results of Frostburg's finished water indicates no detects of regulated volatile organic compounds (VOCs), inorganics or pesticides.

Wellhead Protection Area (WHPA) and Spring Recharge Area Delineation

WHPAs were delineated for Frostburg's wells using the WHPA Code and topographic divides (watershed boundaries). The WHPA Code is an EPA approved two-dimensional ground water flow model, which gives a simplified picture of generally a more complex ground water flow system. When used within its limitations, the WHPA Code can delineate manageable time related WHPAs.

One limitation of the WHPA Code is that only one ground water flow direction can be input into the model. Based on their location, there are two primary zones of contribution (northeast and southwest) to the wells. In order to account for the two directions of ground water flow, two independent model runs were made, one for each direction. The WHPAs produced from these runs were then combined to produce one larger area. The pumpage used for the modeling was 100,000 gallons per day (13,369 ft^3/day), which is the permitted daily average quantity from the Water Appropriation Permit. The WHPAs obtained for the main well (No.2) were also overlaid on the backup well (No.3). The WHPAs from the two wells were merged into one larger WHPA to ensure protection to the backup well in case it is ever used as the primary well.

Zone 1: Zone 1 is the WHPA delineated using a 10 year TOT criterion. Any contaminant (which moves at the same rate as the ground water) present at the Zone 1 boundary would take 10 years to reach the well. Zone 1 provides adequate time for facilities outside the WHPA to address chemical contamination before it could reach the well. A single Zone 1 WHPA was produced by combining the WHPAs for the two wells. The WHPA is elongated in the northeast-southwest chemical contamination before it could reach the well. A single Zone 1 WHPA was produced by combining the WHPAs for the two wells. The WHPA is elongated in the northeast-southwest direction parallel to the ground water flow (see figure 1). It is more elongated on the southern side due to a steeper gradient. The WHPA is approximately 4,250 ft. long with a maximum width of 1,400 ft. All the springs serving the water system are located within the Zone 1 WHPA.

Zone 2: The Zone 2 WHPA is the ultimate recharge area for the wells and springs. The top of Big Savage Mountain is the eastern boundary and the top of Fourmile Ridge-Little Savage Mountain is the western boundary of the WHPA. The northern and southern boundaries are approximately 5,500 ft. from the wells (figure 1).

Springs Recharge Area: The water from Frostburg's springs issues from openings at, or close to, the contact between the Pocono formation and the overlying Greenbrier formation at the base of the western slope of Big Savage Mountain (Amsden et al, 1954). The primary recharge area for the springs is the area upgradient of them (the western slope of Big Savage Mountain). The delineated springs recharge area is a bowl-shaped area with the bottom of bowl at the springs discharge points and the top of the bowl at the top of Big Savage Mountain (figure 1). The springs recharge area is located in both Zones 1 and 2 and should be considered a special zone within these WHPAs.

Potential Contamination Sources

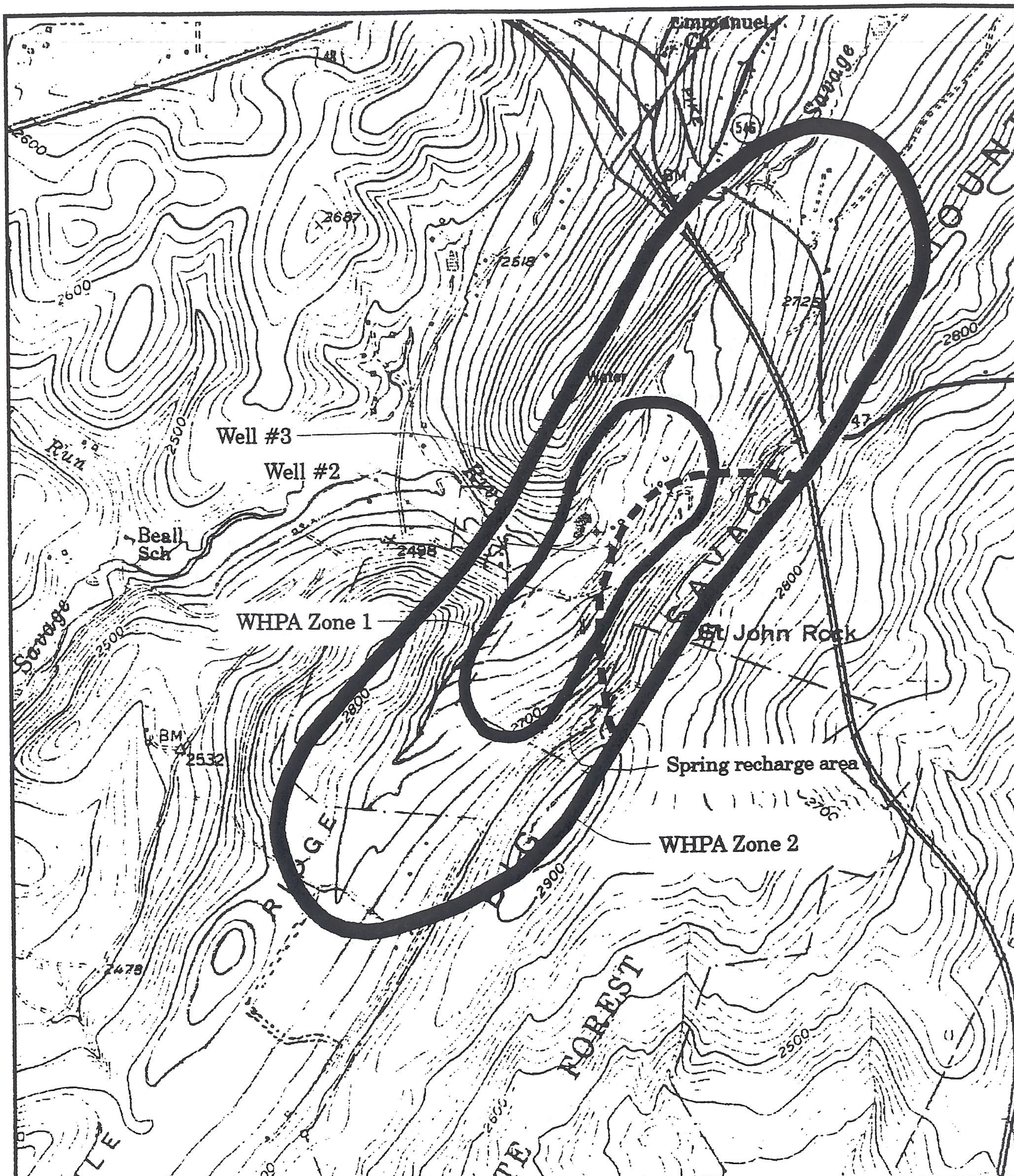
Frostburg's wells and springs lie in a relatively undeveloped area of the Little Savage River Valley predominantly surrounded by forest. A database search indicated that no MDE regulated potential contamination sources were found within the WHPA. The high percentage of natural land cover is an asset to ground water quality.

Certain activities such as agriculture, clear cut logging and mining could be detrimental to ground water quality and should be monitored to ensure that best management practices(BMPs) are being implemented. Individual homes with septic tanks could impact the wells and springs. Locations of septic tanks in the WHPA should be noted. From the tax maps only three homes are located within the primary spring recharge area.

Management of the Wellhead Protection Areas

The City of Frostburg has used its ground water supply for over 100 years. It continues to be an important component of its total supply (approximately 35%). The WHPAs and the spring recharge areas should be managed to ensure ongoing integrity of the supply.

In particular, the springs quality and quantity depend on low impact land use upgradient



Legend

Well	⊕
WHPA Boundary	▬▬
Spring Recharge Area	■ ■ ■

Figure 1 Map showing Frostburg wells number 2 and 3 with their Wellhead Protection areas. (not to scale)

(uphill) of their emanation for the ground. The springs rely on relatively shallow ground water, which is susceptible to any land disturbance and waste disposal practices upgradient of this discharge.

Our review of the tax map showed five other landholders own land in the primary spring recharge area in addition to the City (see Table 1). One of these landholders is a mining company. One sure way to ensure control over the future quality and quantity of the spring flow would be for the City to purchase such parcels (or parts of) when available. Since the Savage River State Forest is already located within the spring recharge area, the Department of Natural Resources (DNR) may be interested in increasing its holdings. If costs were shared between the City and DNR, both parties would receive benefit at reduced costs. Private conservation agencies, such as the Nature Conservancy may also have an interest in such a project.

The City could also contact the Garrett County Planning Department to determine current zoning status of the land within its WHPAs. Conservation zoning would provide a lot of protection to the City's ground water sources.

The main spring collection receiver is located in a remote place and is protected by a locked chain link fence. If the City were to cover this receiver with a roof (and locked entry way), it would provide additional safeguard against the purposeful introduction of contamination into the water system. In addition, the roof would keep out animals which could fall into the receiver and decay, and reduce maintenance costs of removing debris from the structure.

Table 1
Property Owners in Frostburg's Spring Recharge Area

Parcel #	Owner
146	David L. and Cheryl M. Puckett
55	Diana Dawson
150	Charles Stump
99	Borden Mining Co.
---	City of Frostburg
---	Department of Natural Resources (Savage River State Forest)

Recommendations and Conclusions:

1. Frostburg should form a local planning team to begin to implement a wellhead protection plan for its wells and springs.

2. The City should conduct its own detailed field survey of the WHPA to ensure that there are no unregulated potential sources of contamination within the WHPA.

3. The City should cover its spring collection receiver.

4. The City should evaluate the feasibility of purchasing land within the primary spring recharge area, due to its extremely sensitive nature.

5. Frostburg should work with Garrett County Planning Department regarding land use within the WHPA since the wells and springs are located in Garrett County. Conservation zoning is recommended.

6. The management strategy adopted by Frostburg should be consistent with the level of resources available for implementation. By consulting with other jurisdictions involved in this process, Frostburg can benefit from lessons learned by others. MDE remains available to assist in anyway to help this process.

7. Frostburg should have a Contingency Plan for its water system. COMAR 26.04.01.22 requires all community systems to prepare and submit for approval a plan for providing a safe and adequate drinking water supply under emergency conditions.

8. It is recommended that Frostburg contact MDE's Public Drinking Water Program when there are any significant changes in pumpage. WHPAs are affected by pumpage, and any changes in pumpage would most likely require modification of Zone 1.

REFERENCES

Amsden, T.W., Overbeck, R.M., and Martin, R.O. R., 1954, Geology and Water Resources of Garrett County: Maryland Department of Geology, Mines and Water Resources Bulletin 13, 349 p.

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Slaughter, T.H., and Darling, J.M., 1962, The Water Resources of Allegany and Washington Counties: Maryland Department of Geology, Mines and Water Resources Bulletin 24, 408 p.

Whitman, Requardt and Associates, 1995, City of Frostburg Water Treatment Plant and Related Improvements Preliminary Design Report, 36 p.

Other Sources of Data

Water Appropriation and Use Permit Nos. GA79G012 and GA85G007
Water Treatment Plant Inspection Reports
Monthly Operating Reports
Drinking Water Monitoring Reports
MDE Community Wells Database
MDE Waste Management Sites Database
Well logs and drillers reports
Semi-annual water withdrawal reports