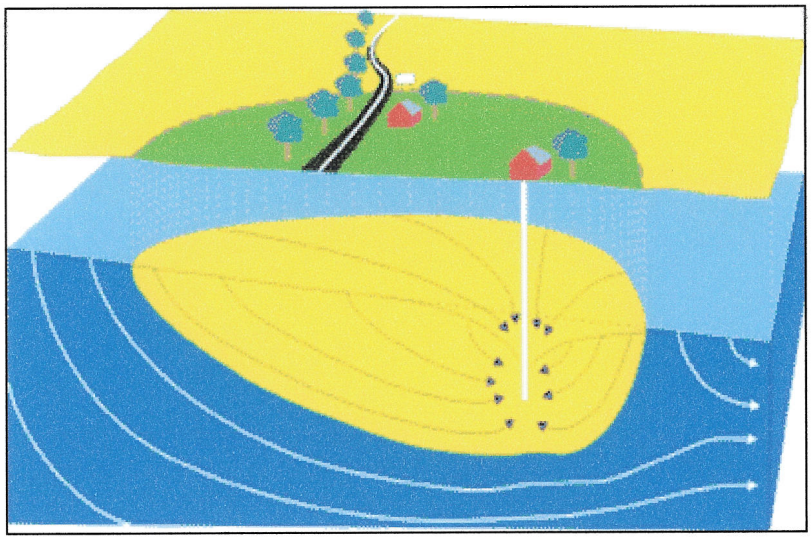
SOURCE WATER ASSESSMENT

FOR LINGANORE HIGH SCHOOL

FREDERICK COUNTY, MD



Prepared By
Water Management Administration
Water Supply Program
March 2006

MDE

Robert L. Ehrlich, Jr.
Governor

Michael S. Steele
Lt. Governor

Kendl P. Philbrick
Secretary

Jonas A. Jacobson
Deputy Secretary

TABLE OF CONTENTS

SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for the water system at the Linganore High School in Frederick County, Maryland. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The sources of the school's water supply are wells in unconfined fractured-rock aquifers. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for this source type.

Point sources of contamination were identified within the assessment area from field inspections, contaminant inventory databases, and previous studies. The Maryland Department of Planning's 2002 digital land use map for Frederick County was used to identify non-point sources of contamination. Well information and water quality data were also reviewed. Maps showing potential contaminants sources and land use within the Source Water Assessment areas are included in the report.

The susceptibility analysis is based on a review of the existing water quality data for the school's water system, the presence of potential sources of contamination in the WHPA, well integrity, and the inherent vulnerability of the aquifer. As the school obtains its water from a water table fractured aquifer, it is vulnerable to contamination from various sources. There have been no contaminants above 50% of an MCL in the well head protection area (WHPA).

INTRODUCTION

The Water Supply Program has conducted Source Water Assessment for the water system of the Linganore High School. The school is located at 12013 Old Annapolis Road, 0.3 mile east of the junction of Old Annapolis Road and MD Route 75, about three miles north of New Market, Frederick County, in a fractured rock aquifer of the Frederick Valley. The system serves a population of 1436 people.

WELL INFORMATION

Well information was obtained from the Water Supply Program's database, site visits, well completion reports and sanitary survey inspection reports. A review of the well completion reports and sanitary surveys indicates that all, but, possibly, the pumphouse one, of the potable supply wells in use were installed after 1973, when the State's present well construction regulations went into effect, and should meet construction standards for grouting and casing. A summary of the well information is located in Table 1. The Pressbox well is a separate system serving a concession stand, as well as providing irrigation water, at an athletic field.

PLANT ID	SOURCE ID	USE CODE	WELL NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	YEAR DRILLED
01	02	PRODUCTION	Running Track	FR-73-2406	300	23	1974
01	03	PRODUCTION		FR-73-2413	400	56	1974
01	04	PRODUCTION	Pumphouse	No Tag	N/R	N/R	N/R
02	01	PRODUCTION	Pressbox	FR-81-4783	357	55	1987

Table 1. Well Information Linganore High School

HYDROGEOLOGY

The Linganore High School is located in Frederick County and within the western portion of the Piedmont physiographic province. The underlying bedrock is composed of Paleozoic Libertytown Metarhyolite rocks in an unconfined, fractured rock aquifer. Fractures provide most of the generally limited permeability and porosity in these types of formations. Due to the low primary porosity, large production wells are not common in this formation unless significant, water-bearing fractures are encountered.

Groundwater systems in crystalline rock tend to be localized and flow is within topographic divides towards the nearest perennial stream. The water table is generally in the weathered zone (saprolite + weathered bedrock), which is characterized by high porosity and thus, the amount of storage often depends on the thickness of this zone. Stream valleys tend to follow fracture traces and as a result wells drilled in draws and stream valleys tend to have higher yields than those on hilltops and slopes. Wells located along fracture traces in stream valleys may be hydraulically connected to the stream.

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered the source water assessment area for the system. The High School has two water appropriation permits. FR1973G016 is for the main potable supply and has a permitted use of 13,000 gpd avg; however, pumpage reports indicate that the actual use is less than 5000 gpd avg. FR1989G005 is for a potable supply for a concession stand and irrigation of a playing field and is permitted for 2500 gpd avg. No pumpage reports are required for this permit; however, monthly operating reports indicate that water use is a few hundred gallons per day. From these data, it is estimated that the potable use for the school is less than an annual average of 10,000 gallons per day (gpd). As defined in Maryland's SWAP, the wellhead protection areas for "small" public water systems using an average of less than 10,000 gpd, in unconfined, fractured-rock aquifers, is a fixed radius of 1,000 feet around each well. This radius is based on calculating the land area needed to provide a yield of 10,000 gpd, assuming a drought annual average recharge rate of 400 gpd avg per acre and a safety factor. The WHPA for the school is shown in figures 1.

POTENTIAL SOURCES OF CONTAMINATION

Potential sources of contamination are classified as either point or non-point sources. Examples of point sources of contamination are leaking underground storage tanks, landfills, discharge permits, large-scale feeding operations, and CERCLA sites. These sites are generally associated with commercial or industrial facilities that use chemical substances that may, if inappropriately handled, contaminate ground water via a discrete point location. Non-point sources of contamination are associated with certain types of land use practices such as use of pesticides, application of fertilizers or animal wastes, or septic systems that may lead to ground water contamination over a larger area.

Point Sources

A review of MDE contaminant databases revealed no potential point sources of contamination within the Linganore High School WHPA.

Non-Point Sources

The Maryland Department of Planning's 2002 digital land use coverage of Frederick County was used to determine the dominant types of land use in the WHPA (Figure 1). The land use summary is given in Table 2. The WHPA is made up of cropland, pasture, deciduous forest and institutional uses.

Use Code	Land Use Type	Total Acres	% WHPA
16	Institutional	22.0	17.8
21	Cropland	83.1	67.2
22	Pasture	5.5	4.4
41	Deciduous forest	13.1	10.6
	Total	123.7	100

Table 2. Land Use Summary Linganore High School

Croplands represent a potential source of nitrate to ground water and also represent a potential source of SOCs depending on and use of pesticides and herbicides. Areas without sewer service may be a source of nitrate from septic systems. In this case, An MDE inspection report dated 2/4/2005 indicates that the school's septic system has been condemned (as of 02/2004), holding tanks must be pumped out daily, and the school must build a WWTP or connect to public sewer. Additionally, institutional areas may be a source of nitrate and SOCs, if fertilizers, pesticides, and herbicides are not used carefully in lawns and gardens.

The Maryland Department of Planning's 2002 digital sewer map of Frederick County shows that all of the school's WHPA has no planned sewer service.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database for Safe Drinking Water Act (SDWA) contaminants. The State's SWAP defines a threshold for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is greater than 50% of a MCL, this assessment will describe the sources of such a contaminant and if possible, locate the specific sources that are the cause of the elevated contaminant level. All data reported is from the finished (treated) water unless otherwise noted. The treatment methods for the school supplies are outlined in Table 3.

SYSTEM	PLANT ID	TREATMENT	PURPOSE
WELLS 2-4	01	PH ADJUSTMENT	CORROSION CONTROL
WELLS 2-4	01	HYPOCHLORITE	DISINFECTION
WELLS 2-4	01	INHIB., ORTHOPHOSPHATE	LEAD ABATEMENT
WELL 1	02	UNKNOWN	

Table 3. Treatment Methods in Linganore High School Plants

A review of the monitoring data since 1993 was completed for the school. The water quality sampling results are summarized in Table 4. There is no data for Plant 02, as this source is not currently regulated as a public water system.

	Plant 01	
Contaminant Group	No. of Samples Collected	No. of Samples > 50% of an MCL
Inorganic Compounds (w/o nitrates)	8	0
Nitrates	21	0
Volatile Organic Compounds	9	0
Synthetic Organic Compounds	3	0

Table 4. Summary of Water Quality Samples for Linganore High School

Inorganic Compounds (IOCs)

None of the levels for inorganic compounds, including nitrates, have exceeded 50% of an MCL at the Linganore High School. There is no data for Plant 02, but that is considered to be a transient, non-community system.

Volatile Organic Compounds (VOCs)

A review of the data shows that VOCs have not been detected above 50% of an MCL. There is no data for Plant 02, but that is considered to be a transient, non-community system.

Synthetic Organic Compounds (SOCs)

A review of the data shows that SOCs have not been detected above 50% of an MCL. There is no data for Plant 02, but that is considered to be a transient, non-community system.

Microbiological Contaminants

Raw water bacteriological data were reviewed for evaluation for ground water under the direct influence of surface water (GWUDI). MDE has previously determined that the three wells serving Plant 01 are not GWUDI sources. Well 2 did have a one positive total coliform result (3.1 col/100ml on 01/22/03); however, follow-on samples detected no coliform bacteria. There is no data for Plant 02, but that is considered to be a transient, non-community system. Also, no GWUDI data has been collected since the school's septic system failed; however, 224 routine individual Bacti samples were collected during the period 10/1996-03/2006 producing no positive results.

SUSCEPTIBILITY ANALYSES

The wells serving the school draw water from an unconfined fractured-rock aquifer. Wells in unconfined aquifers are generally vulnerable to any activity on the land surface that occurs within the wellhead protection area. Therefore, continued monitoring of contaminants is essential in assuring a safe drinking water supply. The *susceptibility* of the source to contamination is determined for each group of contaminants based on the following criteria: 1) the presence of potential contaminant sources within the WHPA, 2) water quality data, 3) well integrity, and 4) the aquifer conditions.

In the non-carbonate areas of the Piedmont region, if a well is constructed properly with the casing extended to competent rock and with sufficient grout, the saprolite serves as a natural filter and protective barrier for some contaminants. Properly constructed wells with no potential sources of contamination in their WHPA should, generally, be well protected from contamination. There are, however, dozens of cases in Maryland (such as Taneytown well 13, Poolesville well 2, Fountaindale well A and Oaks Landfill) where detailed studies were completed and the contamination that occurred could not be directly related to well construction. In these cases, short-circuits due to vertical fractures or open boreholes may have provided the pathways for the contamination to enter the affected wells. In addition all, except, possibly the Pumphouse

one, of the Linganore High School's potable supply wells in use were installed after 1973, when the State's present well construction regulations went into effect, and would meet construction standards for grouting and casing. There have been no water quality data reported for plant 02; as it is not regulated as a public water system. The susceptibility of the school's water supply to the various types of contaminants is summarized in Table 5.

Inorganic Compounds

All results were less than 50% the MCL for all inorganic compound levels, including nitrates. Sources of nitrate can generally be traced back to land use. Fertilization of agricultural fields and lawns, septic systems, and areas with high concentrations of livestock are common sources of nitrate loading in ground water. There is no planned sewer service is in the WHPA and the school's septic system has been condemned. Cropland is another sources of nitrate to the water supplies.

Levels of nitrate in the school wells would suggest that those sources are **not** susceptible to this contaminant. However, due to the vulnerability of the aquifer to land activity, and the presence of nitrate sources in those WHPAs, the nitrate levels should be monitored closely to ensure that they do not rise.

The water supplies are **not** susceptible to inorganic compounds other than nitrate, based on water quality data and lack of potential contaminant sources within the WHPA.

Volatile Organic Compounds

The water supply is **not** presently susceptible to contamination by VOC's, based on water quality data and the lack of potential contaminant sources within the WHPA.

Synthetic Organic Compounds

The wells at the school are **not** presently susceptible to synthetic organic compounds. Potential sources of SOCs in the WHPAs may be pesticide or herbicide use in agricultural areas or on the school property. The level of SOCs that were detected were significantly below MCLs and are not likely to rise due to long term trends of reduced herbicide usage.

Microbiological Contaminants

The Linganore High School completed GWUDI testing and the sources were determined to be non-GWUDI (except plant 02, which is a transient non-community system). No GWUDI testing has been conducted since the school's septic system failed; however, all Bacti samples collected to date have produced no positive results. All of the school's potable wells post-date the State's construction standards, except, possibly, for the Pumphouse well.

Contaminant Group	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected Above 50% of MCL?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible?[1]
Nitrate	YES	NO	NO(2)	YES	NO
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Radiological Compounds	NO	NO	NO	NO	NO
Volatile Organic Compounds	NO	NO	NO	YES	NO
Synthetic Organic Compounds	NO	NO	NO	YES	NO
Microbiological Contaminants	YES	NO	NO(2)	YES	NO

Table 5. Susceptibility Analysis Summary.

1. At present time. No data is available for Plant 02 (a transient, non-community supply).
2. Poor construction of well 4 (Pumphouse) is possible, but the well is a non-GWUDI source.

MANAGEMENT OF THE WHPA

Contaminant Source Inventory/Well Inspection

- Periodic inspections and a regular maintenance program for the potable supply wells will ensure their integrity and protect the water supply from microbial contamination.
- Ensure that any storage of pesticides and fertilizers does not present a risk to ground water.
- Ensure that pesticide and fertilizer application for agricultural land use, landscaping and property maintenance are according to best management practices.
- Arsenic containing compounds are not recommended for application as these have affected ground water quality in other areas.

Cooperative Efforts with Other Agencies

- Work closely with the Frederick County Heath Department to identify any unused wells in the WHPA and to ensure that they are abandoned and sealed in compliance with the State's well construction standard
- Work with the local Soil Conservation District or Cooperative Extension to implement Best Management Practices for pesticide and nutrient applications to lawns and agricultural lands.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.
- Carefully monitoring the nitrate data to determine whether there is a change in levels over time.

Changes in Use

- Any increase in pumpage or addition of new wells to any of the systems may require revision of a WHPA. Such a system is required to contact the Water Supply Program when an increased pumpage is applied for or when new wells are being considered.

REFERENCES

Bolton, D.W., 1996, Network Description and Initial Water-Quality Data from a Statewide Ground-Water-Quality Network in Maryland: Maryland Geological Survey Report of Investigations No. 60, 167 pp.

Committee on Health Risks of Exposure to Radon, 1999, Health Effects of Exposure to Radon: BEIR VI, (http://www.epa.gov/iaq/radon/beirvi1.html).

Duigon, M.T. and Dine, J.R., 1987, Water Resources of Frederick County: Maryland Geological Survey Bulletin 33, 102 p.

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

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

OTHER SOURCES OF DATA

Public Water Supply Sanitary Survey Inspection Reports
MDE Water Supply Program Oracle® Database
MDE Waste Management Sites Database
USGS Topographic 7.5 Minute Quadrangles for Frederick County
Maryland Office of Planning 2002 Frederick County Digital Land Use Map
Maryland Office of Planning 2002 Frederick County Digital Sewer Map

FIGURES

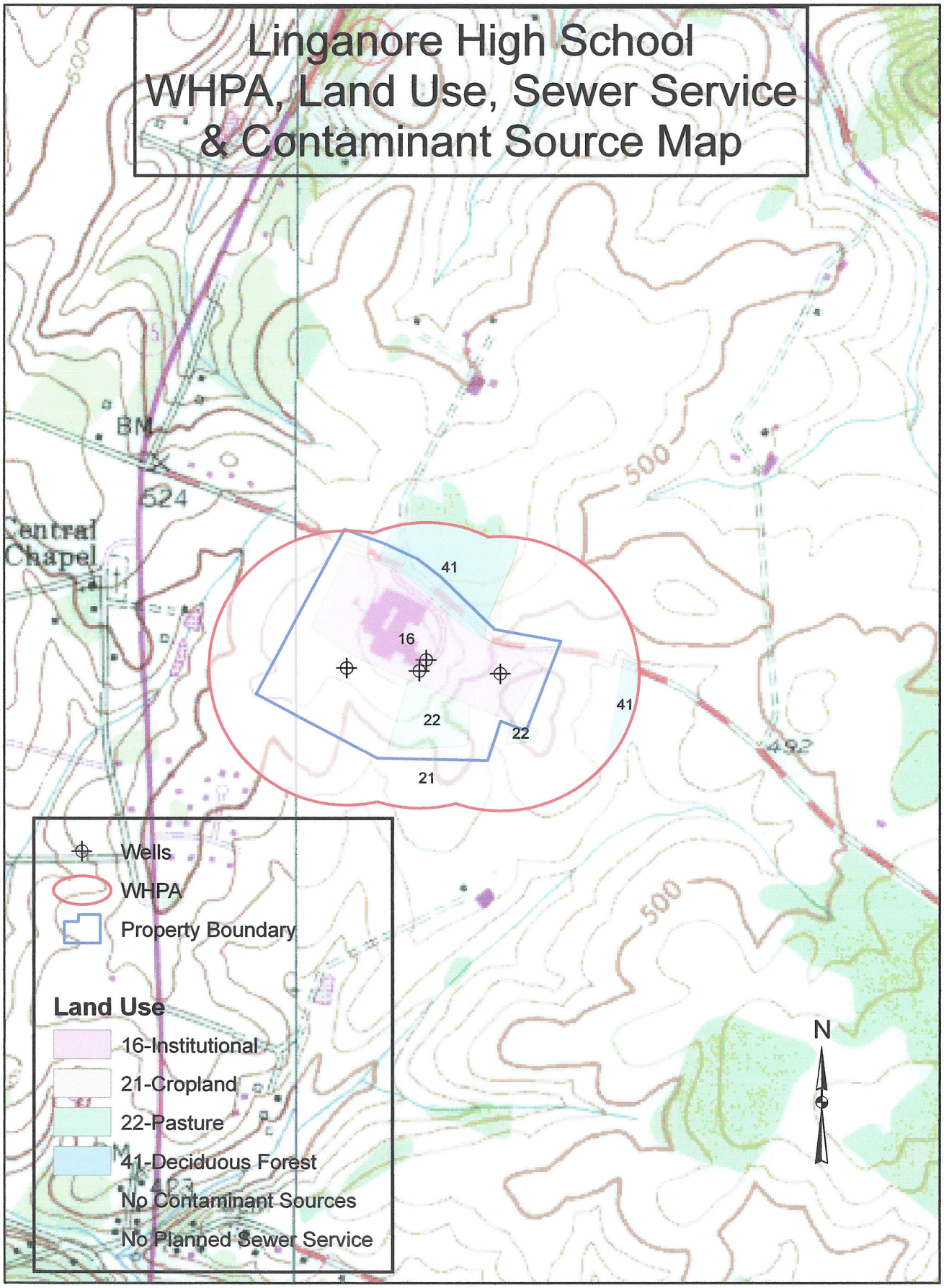

Linganore High School
WHPA, Land Use, Sewer Service
& Contaminant Source Map
BM
524
Central
Chapel
500
41
16
22
22
41
21
492
Wells
WHPA
Property Boundary
Land Use
16-Institutional
21-Cropland
22-Pasture
41-Deciduous Forest
No Contaminant Sources
No Planned Sewer Service
N
0
600
1,200 Feet

Figure 1