SOURCE WATER ASSESSMENT

for

DEER CREEK at
the CHAPEL HILL WATER TREATMENT PLANT

Harford County, Maryland

Prepared by
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 of evaluation the vulnerability of a source of public drinking water supply to contaminants. This SWA was completed for Deer Creek which supplies the City of Aberdeen's Chapel Hill Water Treatment Plant. About 12,000 people in the Aberdeen Area of Aberdeen Proving Ground in Harford County are served by this water system.

Deer Creek originates in southwestern Pennsylvania and flows easterly across northern Harford County to its mouth on the Susquehanna River. The source water protection area for the Deer Creek intake encompasses approximately 164 square miles (105,216 acres) of mixed land use. The Deer Creek Watershed above the confluence of the Susquehanna River covers approximately 171 square miles. An evaluation of the 1997 land use/land cover revealed that 60% of the watershed was for agricultural purposes, 30% forested and 9% developed. Changes in land use in the Maryland portion of the watershed between 1997 and 2002 indicate a decrease of about 2,600 acres of cropland and an increase of about 2,400 acres of residential development. Forested land cover did not show a significant change during this period.

Potential sources of contamination for Deer Creek watershed include point and non point sources, including transportation, agriculture and runoff from developed areas. There are three minor industrial and one minor municipal dischargers in the source water assessment area. Colonial Pipeline, an interstate carrier of petroleum products, also crosses the watershed above the Deer Creek Pumping Station. Non-point sources were determined to be the most significant sources of contaminants for the Deer Creek Watershed.

The susceptibility analysis indicates that turbidity (sediment), disinfection byproduct precursors and pathogenic microorganisms are the contaminants of most concern. The results of a two-year sampling program indicate that both *E. coli* and fecal bacteria are present consistently in Deer Creek and that the highest concentrations were coincident with increased stream flow following rainfall. Nutrient enrichment, algal growth and natural organic matter all contribute to the reactive nature of disinfection byproduct precursors. Additional study is needed to better understand the disinfection byproduct precursor sources in the Deer Creek Watershed. High turbidity levels are associated with erosion and transport of sediment during storm flows. Detailed stream surveys are recommended to identify specific tributaries needing greater protection.

Section 8.0 of this report lists specific recommendations for consideration in developing a source water protection plan. The preservation of the rural character of the watershed, addressing non-point sources of contaminants and enhancing forested buffers throughout the watershed are vital to protecting and enhancing the water quality in Deer Creek. Providing critical information for implementing source water protection efforts for Deer Creek is the ultimate goal of this assessment.

1.0 BACKGROUND

The 1996 Safe Drinking Water Act Amendments require states to develop and implement source water assessment programs to evaluate the potential for contaminants to affect the sources of all public drinking water systems. A Source Water Assessment (SWA) follows a process for evaluating the susceptibility of a public drinking water supply to contamination. The assessment does not address the treatment processes or the storage and distribution 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 agency in this SWA 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 the 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 susceptibility 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 water drinking 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 (EPA) in February 1999, and received final acceptance by the EPA in November 1999. 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 INTRODUCTION

The Aberdeen Area of the Aberdeen Proving Grounds (APG) is served by the Chapel Hill Water Treatment Plant, which is owned and operated by the City of Aberdeen. APG is located in Harford County, Maryland and covers an area of over 72,500 acres of land and 44,000 acres of water. Aberdeen Proving Ground comprises two areas, which are combined to form one U.S. Army post. The Aberdeen Area of the Proving Ground is the home of Army Ordinance and is located south of the City of Aberdeen.

Water treated at the Chapel Hill Water Treatment Plant can also supply the City of Aberdeen through a master meter and control valve as an emergency back up supply. The facility was constructed in 1943 by the Department of the Army and operated until the transfer of ownership to the City of Aberdeen in 2000. Currently, this potable water system is serving approximately 12,000 people. The plant was designed for six million gallons per day (MGD) and withdraws from Deer Creek, near Darlington, Maryland. MDE's Water Appropriation and Use Permit #HA1978S028(05) granted a daily average of 3,270,000 gallons on a yearly basis and a maximum daily withdrawal of 4,900,000 gallons from Deer Creek.

A. Description of Surface Water Supply Source

Deer Creek originates in southeastern Pennsylvania near Shrewsbury and flows easterly across Harford County to its mouth on the Susquehanna River. The drainage area above the Deer Creek Pump Station covers approximately 164 square miles, with about 28 square miles of this area extending into Pennsylvania.

The Deer Creek Watershed is located in Piedmont Plateau. The Piedmont Plateau is a very old upland dissected by many small streams and drainage ways. The crystalline rocks in the Deer Creek Watershed are for the most part intensely deformed schist and gneiss. Meta sedimentary rocks (schists) are more prevalent in the upper half of the watershed and plutonic rocks (gneiss) are more prevalent in the lower half of the Deer Creek Watershed. The oldest rock formation in the Harford County Area is the Baltimore Gneiss of Precambrian age.

Harford County has a continental type climate with average annual of 41.5 inches of annual rainfall. The month of highest average rainfall is August, and the month of lowest average rainfall is January.

B. Water Supply Development

The Aberdeen Area of Aberdeen Proving Ground depends on the water supply from Deer Creek and the treatment provided by the Chapel Hill Water Treatment Plant, which started operation in 1943. Treatment includes the conventional processes of coagulation, flocculation, sedimentation, filtration, pH adjustment and disinfection. Gas chlorine, polyaluminum chloride and carbon are added to the raw water at the head of water treatment plant. Poly and ortho phosphates are added following filtration to inhibit the corrosion of piping and plumbing.

Raw water is supplied by the Deer Creek Pumping Station which draws surface water from Deer Creek and conveys it to the treatment plant via a 4.4 mile 20 inch steel pipe. The intake is located on the southern bank of Deer Creek upstream of a boulder dike. Water flows by gravity through a single pipe to the Deer Creek pumping station. A traveling screen operates five minutes per hour. There are four electric pump and one diesel pump. The station normally pumps approximately one MGD, using one pump. Pump, are alternated weekly (MDE, CPE 2002). The intake structure and other raw water facilities are undergoing extensive improvements. The improvements include stream channel modifications, cleaning and refurbishing of sluice gates and the construction of fine screen structure between the water intake and pumping station.

3.0 RESULTS OF SITE VISIT(S)

Water Supply Program (WSP) personnel conducted a site survey of Chapel Hill's Plant water sources and other raw water facilities in order to accomplish the following tasks:

- To collect information regarding the locations of raw water sources and intakes by using Global Positioning System (GPS) equipment.
- To determine the general condition and structural integrity of intakes and other raw water facilities.
- To discuss source water issues and concerns with the APG Aberdeen area water system operators.
- To conduct a windshield survey of the watershed and to document potential problem areas. Additional tours of the watersheds were taken on follow-up visits.

The following concerns were obtained from interviewing the plant operators:

Concerns and Site Observation

- A manure spill from an agricultural facility in the watershed in 1980's forced the plant to shut down for two weeks.
- The application of salt during the winter months especially Route 161 upstream of the intake structure.
- The possible impact on water quality from the horse farms in the watershed.

4.0 WATERSHED CHARACTERISTICS

Source Water Assessment Area Delineation Method (Surface Water)

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

General Characteristics

The drainage area above the Deer Creek intake encompasses approximately 164 squares miles (105,216 acres) of mixed land use in Harford County and southeastern Pennsylvania. Approximately 83% of the watershed is in Harford County. Figure 4.1 shows the land use within the Deer Creek Watershed from above its confluence with the Susquehanna River. The 1997 MD Department of Planning land use/land cover was the basis for the Maryland portion and the Pennsylvania portion is based on a multi federal agency 1997 mapping effort known as the Multi-Resolution Land Characteristics (MRLC) Consortium. Harford County's Master Plan shows that the great majority (all except rural residential zoning near Hickory and Forest Hill and the rural villages of Darlington and Dublin) of the Deer Creek Watershed is agriculturally zoned. Agricultural zoning limits the subdivision of land to one dwelling per ten acres. Consequently, Deer Creek Watershed is primarily rural in character.

Based on the Maryland Department of Planning 1997 land use data and the MRLC data for Pennsylvania, the land use distribution in the Deer Creek Watershed above its confluence with the Susquehanna River is summarized in Table 4.1. Approximately 4,263 acres (6.66 square miles) of land area below the intake are included in Table 4.1.

Table 4.1. 1997 Land Use in the Deer Creek Watershed

Land Use	Acres	Percent
Barren land	108	0.1%
Commercial	1,051	1.0%
Cropland	54,054	49.4%
Feeding operations	694	0.6%
Forest	33,398	30.5%
High-density residential	21	0.0%
Industrial	115	0.1%
Low-density residential	9,414	8.6%
Medium-density residential	359	0.3%
Open urban land	73	0.1%
Orchards/vineyards/horticulture	425	0.4%
Pasture	9,574	8.7%
Water	114	0.1%
Wetlands	66	0.1%
Total	109,465	100.0%

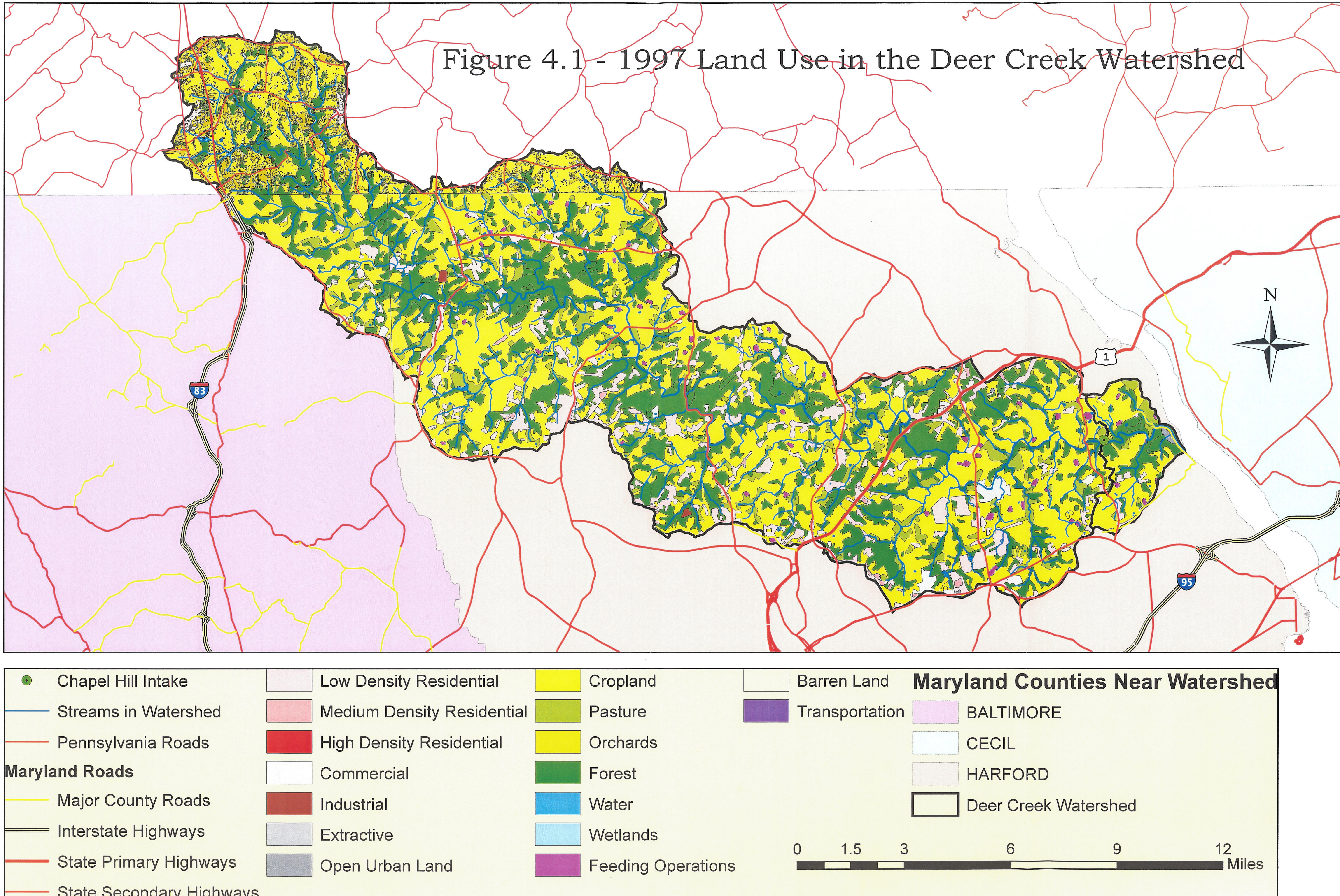


Figure 4.1 - 1997 Land Use in the Deer Creek Watershed

5.0 POTENTIAL SOURCES OF CONTAMINATION

Potential sources of contamination are categorized as either point or non-point sources. Examples of point sources of contamination are industrial discharges, wastewater treatment plants and large scale animal feeding operations. These sites are generally associated with the discharge of significant volumes of wastewater at a particular location and are regulated through a discharge permit specific to the facility. Non-point sources of contamination are associated with certain types of land use practices such as the use of pesticides, application of fertilizers, tilling of fields, spreading of animal wastes, creating impervious surfaces, construction and earth disturbance. Non-point source pollution is generally created as a result of rainfall carrying away nutrients, soil, chemicals, and microorganisms from the land surface to a receiving water body. Figure 5.1 depicts the roads, major pipelines and potential point contaminant sources in the Deer Creek Watershed.

Non-Point Sources in the Watershed

According to the data presented in Table 4.1 (1997 land use), 64,647 acres (about 60% of the watershed) are used for agricultural purposes. Almost half of the watershed (49.4%) is in cropland with 8.7% of the watershed used for pasture. Land used to grow crops can be a source of nutrients (from fertilizer) synthetic organic compounds (herbicides) and sediment load. Pastureland is often a recipient of animal waste and therefore a potential source of nutrients and pathogenic protozoa (giardia and cryptosporidium), viruses and bacteria. Feeding operations (about 700 acres) are also a potential concentrated source of contaminants associated with animal wastes. Developed land (residential, commercial, industrial) accounted for 9,909 acres (9%) of the Deer Creek Watershed in 1997. Sediment, nutrients, pathogens (giardia and cryptosporidium), deicing compounds, and heavy metals are the most significant concerns from runoff in developed areas. Lawn and pavement in residential areas result in increased storm water velocity which leads to streambank and streambed erosion. Forested lands use makes up about 30% of the watershed. In the upper portion of the watershed, forested land is largely restricted to the stream valley. Forested lands provide the most protection from erosion and sediment loss and contribute much less nutrients and pathogens to the streams than the other land uses. Due to the preponderance of agricultural land in the watershed, this land use has the most significant impact on the water quality of Deer Creek.

Point Sources in the Watershed

A review of MDE's municipal and industrial discharge permit programs indicates there are one active and two inactive industrial, and one active municipal discharge located within the source water assessment area (Figure 5.1).

One active industrial permit is for a military research and testing facility located south of Dublin to discharge test vehicle wash water and noncontact cooling water and variable volumes of storm water to Deer Creek. Effluent limitations and monitoring requirements for this permit are established for flow, oil and grease, total suspended solids and pH.

There are two inactive industrial permits (one for the Land of Tranquility Trout Farm and the other for the dewatering of a gas transmission pipeline). The Land of Tranquility Trout Farm from Deer Creek. According to MDE's records, the facility has not been in operation for four years but the owner of the Tranquility Trout Farm had plans to upgrade the facility and resume the operation.

The one active municipal discharge permit is for the Spring Meadows Wastewater Treatment Plant, located at 14111 Dalewood Drive, Jarrettsville, Harford County. The facility's permit is for a 10,000 gallons per day of treated wastewater to discharge into Rock Hollow Branch. A review of the facility performance record from January 2003 through March 2005 indicates that the facility is currently in compliance with the requirements of the permit.

Transportation Related Concerns

A significant potential source of contamination to the Deer Creek intake is created by the network of transportation infrastructure including State primary and secondary highways and major county roads. US Route 1, MD Routes 543, 161, 165, 136, 24 and 23 cross the main stem of Deer Creek. I-83 also crosses the furthest upstream portion of the watershed in Maryland and Pennsylvania. In addition to concerns related to the affect of the application of deicing compounds on water quality, the roads provide for the bulk movement of hazardous materials. At the locations where each of these routes cross Deer Creek or a tributary feeding Deer Creek, there is the potential for a spill of hazardous materials to cause significant damage. U.S. Route 1 and MD Routes 136 and 161 are the closest to the intake and therefore of greatest concern.

Colonial Pipeline, an interstate carrier of petroleum products, crosses the entire width of the lower part of Deer Creek Watershed above the intake of Chapel Hill Water Treatment Plant. Pipeline accidents and leaking of petroleum products can cause contamination of raw water with petroleum and associated volatile organic compounds.

Land Use Planning Concerns

A comparison between the 1997 and 2002 Maryland Department of Planning (MDOP) land use data for the Maryland portion of watershed shows an increase of developed land in the watershed. The amount of change for each category of land use is shown in Table 5.1.

Table 5.1. Change in Maryland Land Use from 1997 to 2002				
Land Use	**1997 Acres**	**2002 Acres**	**Change in Acres**	**% Increase**
Barren land	108	97	-11	-9.8%
Commercial	1,051	1,046	-5	-0.5%
Cropland	45,328	42,697	-2,631	-5.8%
Feeding operations	694	690	-4	-0.6%
Forest	29,636	29,503	-133	-0.4%
Industrial	90	110	20	22.4%
Low-density residential	9,087	11,461	2,374	26.1%
Medium-density residential	359	387	28	8.0%
Open urban land	73	223	150	203.8%
Orchards/vineyards/horticulture	425	389	-36	-8.5%
Pasture	6,235	6,452	217	3.5%
Water	70	77	7	10.4%
Wetlands	-	13	N/A	N/A

According to the Harford County Area Master Plans, agricultural preservation is a priority in the Deer Creek Watershed. In the Norrisville area (upstream portion of the watershed), over 30% of the planning area is protected by agricultural preservation. In the Dublin and Darlington area (lower portion of the watershed), 25% of the area is in agricultural preservation. In addition, the Lower Deer Creek Rural Legacy Program is preserving land for water quality benefits. Nonetheless, the most significant changes noted from Table 5 are the increase in residential land use and loss of cropland over these five years. According to MDOP classification, there are about 2,400 acres of new residential land and a decrease of about 2,600 acres of cropland. We do not have statistics on the portion of the watershed in Pennsylvania. Personal observation indicates that there is an increase in development near the I-83 corridor of both commercial and residential land use. Both Harford County's Master Plan and local zoning and the zoning in Pennsylvania's Townships are important components of any source water protection efforts.

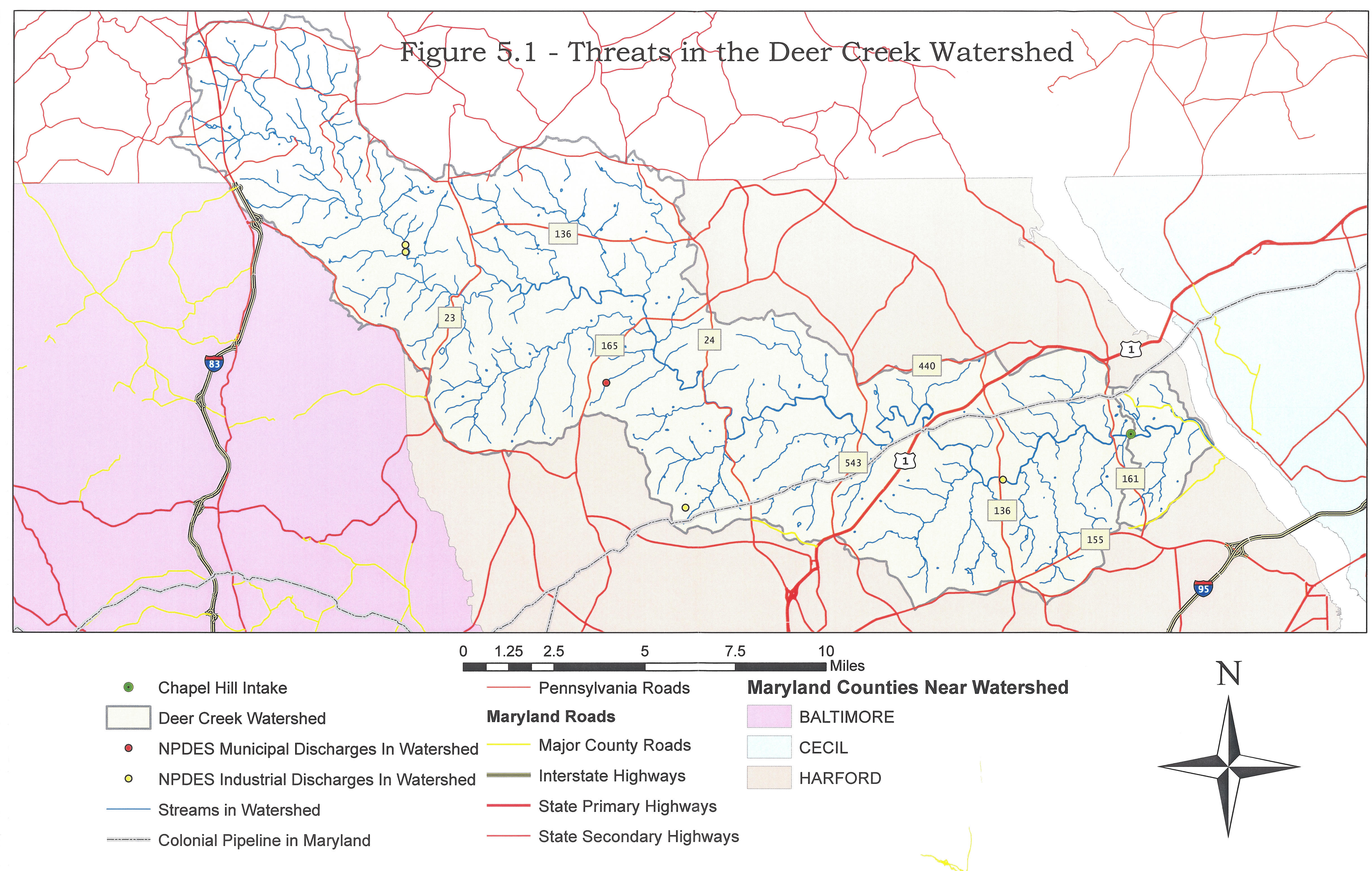


Figure 5.1 - Threats in the Deer Creek Watershed
136
23
165
24
440
1
83
543
1
161
136
155
95
0 1.25 2.5 5 7.5 10
Miles
Chapel Hill Intake
Deer Creek Watershed
NPDES Municipal Discharges In Watershed
NPDES Industrial Discharges In Watershed
Streams in Watershed
Colonial Pipeline in Maryland
Pennsylvania Roads
Maryland Roads
Major County Roads
Interstate Highways
State Primary Highways
State Secondary Highways
Maryland Counties Near Watershed
BALTIMORE
CECIL
HARFORD
N

6.0 REVIEW OF WATER QUALITY DATA

Several sources of water quality data were reviewed for this source water assessment. These include MDE Water Supply Program's database for safe drinking water contaminants and monthly operating reports from the Chapel Hill Water Treatment Plant. Data from the United States Geological Survey was also reviewed.

Water quality data for Chapel Hill was compared with the maximum contaminant levels (MCLs) set by the U.S. Environmental Protection Agency. MCLs are established to ensure that drinking water is safe for human consumption. If the monitoring data shows that any contaminant is greater than 50% of a MCL for at least 10% of the available data points, a detailed susceptibility analysis will be performed for that contaminant and its potential sources.

Existing Plant Data

Chapel Hill Water Treatment Plant's operators routinely test raw and treated water at the plant for various contaminants. MDE also periodically analyze samples of the raw and treated water for contaminants regulated under the Safe Drinking Water Act. Raw water samples are collected at the plant prior to treatment. Treatment samples are collected after the water passes through the treatment plant.

Turbidity

Turbidity is described as a measure of cloudiness of water. It is used to indicate water quality and treatment effectiveness. Higher turbidity level is often associated with higher levels of disease causing microorganisms such as viruses, parasites and bacteria. Turbidity is measured in the raw water at the Chapel Hill Water Treatment Plant on continuous basis. The monthly summary statistics for each month during the year 2004 is presented in Table 6.1. For this period, the average monthly turbidity from January to December ranged between 2 and 34 nephelometric turbidity units (NTU), the minimum turbidity measured was 1 NTU, and the maximum turbidity measured was 385 NTU. Rapid changes in turbidity are experienced in response to runoff from rain events. These changes present water treatment challenges.

Table 6.1. Chapel Hill Raw Water Average Monthly Turbidity for Year 2004			
Date	Avg. Monthly Value Turb. NTU	Maximum/Month Turb. NTU	Minimum/Month Turb. NTU
January	6	43	2
February	22	146	3
March	6	51	1
April	16	110	2
May	19	146	3
June	34	385	3
July	13	64	1
August	22	145	3
September	14	152	2
October	2	7	1
November	13	156	1
December	14	141	2

Inorganic Compounds (IOCs)

Chapel Hill plant regularly tests for presence of nitrate and other inorganic compounds in finished drinking water. The treatment process will not remove dissolved inorganic ions, so finished water is generally reflective of raw water for these compounds. Fluoride, however, is added during the treatment process so the values listed below reflect that addition. Nitrate is consistently present in the raw water, generally around 30% to 40% of the maximum contaminant level. No inorganic constituents exceeded 50% of a maximum contaminant level.

Table 6.2 Detection of IOCs at the Chapel Hill Water Treatment Plant

Contam Name	Sample Date	Result	Units	MCL
ARSENIC	02/08/1995	0.001	mg/L	0.01
ARSENIC	06/29/2004	0.005	mg/L	0.01
BARIUM	01/11/1994	0.019	mg/L	2
BARIUM	03/31/1994	0.012	mg/L	2
BARIUM	02/08/1995	0.019	mg/L	2
BARIUM	02/07/1996	0.017	mg/L	2
BARIUM	02/12/1997	0.02	mg/L	2
BARIUM	02/12/1998	0.016	mg/L	2
BARIUM	06/30/1999	0.013	mg/L	2
BARIUM	03/29/2000	0.018	mg/L	2
BARIUM	06/24/2003	0.018	mg/L	2
BARIUM	06/29/2004	0.015	mg/L	2
CADMIUM	06/24/2003	0.00072	mg/L	0.005
CHROMIUM	02/08/1995	0.034	mg/L	0.1
CHROMIUM	02/07/1996	0.001	mg/L	0.1
CHROMIUM	02/12/1997	0.0027	mg/L	0.1
CHROMIUM	02/12/1998	0.0009	mg/L	0.1

Contam Name	Sample Date	Result	Units	MCL
CHROMIUM	06/30/1999	0.0015	mg/L	0.1
CHROMIUM	03/29/2000	0.0002	mg/L	0.1
FLUORIDE	09/07/1994	0.11	mg/L	4
FLUORIDE	02/08/1995	0.7	mg/L	4
FLUORIDE	02/12/1997	0.7	mg/L	4
FLUORIDE	05/20/1997	0.53	mg/L	4
FLUORIDE	02/12/1998	0.9	mg/L	4
FLUORIDE	06/15/1998	0.96	mg/L	4
FLUORIDE	08/18/1998	0.62	mg/L	4
FLUORIDE	06/30/1999	0.5	mg/L	4
FLUORIDE	03/29/2000	0.8	mg/L	4
FLUORIDE	03/21/2001	0.6	mg/L	4
FLUORIDE	05/07/2001	0.73	mg/L	4
FLUORIDE	04/09/2002	0.72	mg/L	4
FLUORIDE	06/25/2002	0.8	mg/L	4
FLUORIDE	06/24/2003	0.3	mg/L	4
FLUORIDE	06/29/2004	0.4	mg/L	4
MERCURY	02/12/1998	0.0004	mg/L	0.002
NICKEL	02/12/1998	0.0018	mg/L	
NICKEL	03/29/2000	0.0009	mg/L	
NITRATE	02/10/1993	4.5	mg/L	10
NITRATE	04/20/1993	3.9	mg/L	10
NITRATE	08/16/1993	2.59	mg/L	10
NITRATE	10/05/1993	3.68	mg/L	10
NITRATE	03/31/1994	2.6	mg/L	10
NITRATE	06/29/1994	3.05	mg/L	10
NITRATE	09/07/1994	2.88	mg/L	10
NITRATE	02/08/1995	4.3	mg/L	10
NITRATE	02/07/1996	4	mg/L	10
NITRATE	02/22/1996	3.9	mg/L	10
NITRATE	02/12/1997	3.8	mg/L	10
NITRATE	05/20/1997	3.5	mg/L	10
NITRATE	02/12/1998	3.5	mg/L	10
NITRATE	06/15/1998	3	mg/L	10
NITRATE	08/18/1998	3	mg/L	10
NITRATE	06/30/1999	2.2	mg/L	10
NITRATE	03/29/2000	2.7	mg/L	10
NITRATE	03/21/2001	3.7	mg/L	10
NITRATE	05/07/2001	3.4	mg/L	10
NITRATE	04/09/2002	2.9	mg/L	10
NITRATE	10/25/2002	2.5	mg/L	10
NITRATE	04/28/2003	3.2	mg/L	10
NITRATE	06/24/2003	2.8	mg/L	10

Contam Name	Sample Date	Result	Units	MCL
NITRATE	03/24/2004	3.4	mg/L	10
NITRATE	06/29/2004	3.1	mg/L	10
NITRITE	06/15/1998	0.002	mg/L	1
SELENIUM	04/09/2002	0.025	mg/L	0.05
SODIUM	05/20/1997	18.53	mg/L	
SODIUM	06/15/1998	24.4	mg/L	
SODIUM	08/18/1998	19.8	mg/L	
SODIUM	05/07/2001	13.2	mg/L	
SODIUM	04/09/2002	13.2	mg/L	
SODIUM	04/28/2003	16.3	mg/L	
SULFATE	03/31/1994	37.1	mg/L	
SULFATE	02/08/1995	18	mg/L	
SULFATE	02/07/1996	24	mg/L	
SULFATE	02/22/1996	64	mg/L	
SULFATE	05/20/1997	24.6	mg/L	
SULFATE	06/15/1998	36.5	mg/L	
SULFATE	08/18/1998	24.6	mg/L	
SULFATE	05/07/2001	12.6	mg/L	
SULFATE	04/09/2002	14.6	mg/L	

Synthetic Organic Compounds (SOCs)

Chapel Hill Water Treatment Plant operators and MDE collect SOC samples. Table 6.3 is a summary of SOCs detected for the years 1993-2005. No synthetic organic compounds exceeded 50% of a MCL in at least 10% of the samples collected. Detections included commonly used herbicides such as simazine and atrazine, metolachlor, dalapon and 2, 4-D. Di(2-ethylhexyl)phthalate was reported in ten samples but also reported in organic free laboratory blanks run concurrently with the analysis. The result of di(2-ethylhexyl)phthalate are therefore not believed to represent the actual water quality at Chapel Hill.

Table 6.3 Detections of SOCs at the Chapel Hill Water Treatment Plant

Contam Name	Sample Date	Result	Units	MCL
DALAPON	05/20/1997	0.42	ug/L	200
DALAPON	06/15/1998	0.77	ug/L	200
DALAPON	08/18/1998	1.11	ug/L	200
DALAPON	05/01/2000	1.01	ug/L	200
DALAPON	04/28/2003	1.58	ug/L	200
SIMAZINE	07/23/1997	0.17	ug/L	4
SIMAZINE	06/15/1998	0.91	ug/L	4
DI(2-ETHYLHEXYL) PHTHALATE	02/22/1996	0.53	ug/L	6
DI(2-ETHYLHEXYL) PHTHALATE	06/15/1998	1.11	ug/L	6
DI(2-ETHYLHEXYL) PHTHALATE	08/18/1998	2.6	ug/L	6
DI(2-ETHYLHEXYL) PHTHALATE	05/01/2000	0.5	ug/L	6
DI(2-ETHYLHEXYL) PHTHALATE	05/01/2000	1.4	ug/L	6
DI(2-ETHYLHEXYL) PHTHALATE	05/07/2001	1.4	ug/L	6

Contam Name	Sample Date	Result	Units	MCL
DI(2-ETHYLHEXYL) PHTHALATE	05/08/2002	1	ug/L	6
DI(2-ETHYLHEXYL) PHTHALATE	04/28/2003	0.5	ug/L	6
DI(2-ETHYLHEXYL) PHTHALATE	04/26/2004	0.7	ug/L	6
DI(2-ETHYLHEXYL) PHTHALATE	12/21/2004	1.6	ug/L	6
METOLACHLOR	02/12/1997	0.1	ug/L	
METOLACHLOR	04/20/1998	0.2	ug/L	
METOLACHLOR	06/15/1998	1.43	ug/L	
METOLACHLOR	04/26/2004	1.7	ug/L	
ATRAZINE	06/14/1996	0.8	ug/L	3
ATRAZINE	04/20/1998	0.2	ug/L	3
ATRAZINE	06/15/1998	1.49	ug/L	3
ATRAZINE	06/28/2000	0.01	ug/L	3
2,4-D	04/26/2004	0.37	ug/L	70
BENZO(a)PYRENE	05/07/2001	0.1	ug/L	0.2
PENTACHLOROPHENOL	04/28/2003	0.04	ug/L	1

Volatile Organic Compounds (VOCs)/Disinfection Byproducts (DBPs)

No volatile organic compounds other than disinfection byproducts have exceeded more than 50% of a MCL in 10% or more of the collected samples. Disinfection byproducts are created by the reaction of chlorine with natural organic matter. Table 6.4 shows the results of DBP monitoring in the distribution system from 2000 through March 2005. The DBPs are total trihalomethanes (TTHMs) and haloacetic acids (HAA5). The sum of concentration of four compounds: chloroform, bromochloromethane, dibromochloromethane, and bromoform comprise TTHMs. The sum of five compounds mono, di, and ti-chloroacetic acids, and mono- and di-bromoacetic acids comprise HAA5. In addition, organic carbon is monitored in raw and treated water. These date indicate that changes will be needed to the Chapel Hill Water Treatment Plant to consistently meet the current standards of 80.0 ug/L for total THM and 60.0 ug/L for HAA at all locations in the distribution system.

Table 6.4 Results of Disinfection Byproducts in Chapel Hill Water System (all results in ug/l)

DATE	LOCATION	Total Trihalo-methanes	Haloacetic acids
01/10/00	BLDG 631 (MDE SAMPLING SITE) ABERDEEN PROVING GROUND	48.5	
03/06/00	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	19.3	37
03/06/00	BLDG 631 (MDE SAMPLING SITE) ABERDEEN PROVING GROUND	21.2	42
03/06/00	BUILDING 1089 ABERDEEN PROVING GROUND	24.7	42
03/06/00	BUILDING 2501 ABERDEEN PROVING GROUND	23.9	40
03/06/00	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	19.3	37.5
03/06/00	BUILDING 2501 ABERDEEN PROVING GROUND	23.9	40.3
03/06/00	BUILDING 631 ABERDEEN PROVING GROUND	21.2	42
03/06/00	BUILDING 1089 ABERDEEN PROVING GROUND	24.7	42.5
06/28/00	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	67.2	
06/28/00	BUILDING 631 ABERDEEN PROVING GROUND	137.9	

DATE	LOCATION	Total Trihalo-methanes	Haloacetic acids
06/28/00	BUILDING 1089 ABERDEEN PROVING GROUND	158.7	
06/28/00	BUILDING 2501 ABERDEEN PROVING GROUND	110.4	
09/07/00	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	122.6	
09/07/00	BUILDING 1089 ABERDEEN PROVING GROUND	4.5	
09/07/00	BUILDING 2501 ABERDEEN PROVING GROUND	3.2	
09/07/00	BUILDING 631 ABERDEEN PROVING GROUND	5	
10/06/00	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	52.5	
11/06/00	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	46.4	
11/13/00	WTP	44.2	
11/13/00	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	44.4	
11/13/00	BUILDING 631 ABERDEEN PROVING GROUND	58.2	
11/13/00	BUILDING 631 ABERDEEN PROVING GROUND	71.8	
11/13/00	BUILDING 2501 ABERDEEN PROVING GROUND	59.6	
11/13/00	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	56.4	
11/13/00	BUILDING 1089 ABERDEEN PROVING GROUND	70.4	
11/13/00	BUILDING 1089 ABERDEEN PROVING GROUND	58	
11/13/00	BUILDING 2501 ABERDEEN PROVING GROUND	50.3	
11/22/00	WATER TREATMENT PLANT	23.6	
11/29/00	WTP	28	
01/24/01	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	52.4	
02/14/01	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	42.8	
03/27/01	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	32.7	
04/11/01	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	27.2	
05/09/01	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	51.5	
06/13/01	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	56.5	
06/26/01	BUILDING 631-boat dock ABERDEEN PROVING GROUND	362.9	
08/22/01	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	78	
09/27/01	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	87.5	
09/27/01	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	93.7	
09/27/01	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	127.6	
09/27/01	BUILDING 631-boat dock ABERDEEN PROVING GROUND	97.5	
09/28/01	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	76.8	
09/28/01	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	113.6	
09/28/01	BUILDING 631-boat dock ABERDEEN PROVING GROUND	107.8	
11/14/01	CHAPEL HILL WTP (BLDG 10101) ABERDEEN PROVING GROUND	34.7	
12/12/01	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	26.7	
12/12/01	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	36.3	
12/12/01	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	44.8	
12/12/01	BUILDING 631-boat dock ABERDEEN PROVING GROUND	37.5	
12/13/01	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	27.2	
12/13/01	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	35.5	
12/13/01	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	53.6	
12/13/01	BUILDING 631-boat dock ABERDEEN PROVING GROUND	36.4	
02/14/02	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	13.3	24

DATE	LOCATION	Total Trihalo-methanes	Haloacetic acids
02/14/02	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	19.4	25.2
02/14/02	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	19.4	26.8
02/14/02	BUILDING 631-boat dock ABERDEEN PROVING GROUND	22.8	28.2
05/24/02	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	46	42
05/24/02	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	58.1	52
05/24/02	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	57	46
05/24/02	BUILDING 631-boat dock ABERDEEN PROVING GROUND	66.1	55
08/29/02	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	84	18
08/29/02	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	126	18
08/29/02	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	140.9	82.9
08/29/02	BUILDING 631-boat dock ABERDEEN PROVING GROUND	162.4	24.4
11/19/02	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	50.6	
11/19/02	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	39.2	
11/19/02	BUILDING 631-boat dock ABERDEEN PROVING GROUND	73.5	
11/19/02	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	69.5	
01/31/03	BUILDING 2501-kirk army ABERDEEN PROVING GROUND		11.7
01/31/03	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND		11.3
01/31/03	BUILDING 1089-loop rd ABERDEEN PROVING GROUND		12.1
01/31/03	BUILDING 631-boat dock ABERDEEN PROVING GROUND		11.9
03/31/03	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	36.4	42.5
03/31/03	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	42	44.2
03/31/03	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	58.8	53.5
03/31/03	BUILDING 631-boat dock ABERDEEN PROVING GROUND	44.6	44.5
05/27/03	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	82.3	58.8
05/27/03	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	74.2	59.5
05/27/03	BUILDING 631-boat dock ABERDEEN PROVING GROUND	89.6	62.1
05/27/03	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	89.5	55.4
09/13/03	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	77.9	53.7
09/13/03	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	122.2	79.7
09/13/03	BUILDING 631-boat dock ABERDEEN PROVING GROUND	134.1	68.8
09/13/03	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	107.3	69.5
12/29/03	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	11.8	19
12/29/03	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	14.9	20.1
12/29/03	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	13.4	50.3
12/29/03	BUILDING 631-boat dock ABERDEEN PROVING GROUND	17.3	11.8
03/23/04	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	25.8	6.2
03/23/04	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	31.6	6.7
03/23/04	BUILDING 631-boat dock ABERDEEN PROVING GROUND	39.6	6.5
03/23/04	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	35.3	6.2
06/29/04	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	50	32
06/29/04	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	64.5	18.5
06/29/04	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	53.4	26.3
06/29/04	BUILDING 631-boat dock ABERDEEN PROVING GROUND	72.3	16.1
09/07/04	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	48.8	17

DATE	LOCATION	Total Trihalo-methanes	Haloacetic acids
09/07/04	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	65.4	14.6
09/07/04	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	52.7	17.6
09/07/04	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	71.3	18.9
12/07/04	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	16.3	19.9
12/07/04	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	19.8	17.6
12/07/04	BUILDING 631-boat dock ABERDEEN PROVING GROUND	34.4	26
03/22/05	BUILDING 2501-kirk army ABERDEEN PROVING GROUND	10	9.3
03/22/05	BUILDING 30 - top of the bay ABERDEEN PROVING GROUND	11.6	5.5
03/22/05	BUILDING 1089-loop rd ABERDEEN PROVING GROUND	11.7	9
03/22/05	BUILDING 631-boat dock ABERDEEN PROVING GROUND	14.1	9.9

Fecal Coliform/E. coli

At the request of MDE, the Chapel Hill Water Treatment Plant operators began a raw water monitoring program starting in October 2000. The raw water samples were collected weekly and tested for fecal and E. Coli until September 2002. Figures 6-1, 6-2 shows the results in most probable number/100 ml from November 2000 through August 2002 for fecal coliform and E. coli. The flow in Deer Creek as measured at Rocks, Maryland is also plotted with the microbiological results. About forty percent (40%) of the samples were greater than the former fecal coliform water quality standard of 200 MPN/100 ml that was in effect at the time of sampling. A similar percentage exceeds the current standard for E. coli of 126 MPN/100 ml. We did not evaluate the data, however, to determine compliance with the water quality standard, as compliance is based on the geometric mean of five samples collected over a 30-day period. A comparison of the flow data with the water quality results show that each of the values of 500 MPN and higher can be linked to a storm event, as evidenced by the peaks in the stream hydrograph.

USGS Water Quality Data

The following data was obtained from reviewing the results from samples collected at the Deer Creek Gage at Rocks, Maryland. The data shows that the water quality in Deer Creek is a well oxgenated soft water, at near neutral pH, with high contents of iron and manganese. The fecal coliform concentrations showed a similar range as the data discussed above.

Table 6.5 - Selected Water Quality Data from USGS
USGS Gage number 01580000 (DEER CREEK AT ROCKS, MD)
Summary of Water Quality Data Collected from 7/25/1972 thru 8/18/1995

Parameter	Average	Max	Min	Count	Units
Alkalinity	24.0	26	21	3	mg/l* as calcium carbonate
Aluminum	75.0	100	0	4	mg/l
Calcium	8.1	13	6.2	19	mg/l
Chloride	10.3	25	6	19	mg/l
Color	12.8	100	0	16	platinum cobalt units
Dissolved oxygen	11.4	14.6	9.3	13	mg/l
Fecal coliform	452.3	1300	17	13	colonies/100 ml
Fluoride	0.1	0.2	0	18	mg/l
Hardness	30.6	35	25	16	mg/l as calcium carbonate
Iron (filtered)	0.07	.14	.01	18	mg/l
Iron (unfiltered)	2.4	19	0.03	12	mg/l
Magnesium	3.2	4.8	2	19	mg/l
Manganese (filtered)	.04	.06	.02	18	mg/l
Manganese (unfiltered)	.087	.47	.01	12	mg/l
Nitrate	2.4	2.5	2.3	4	mg/l as nitrogen
Nitrite	0.0	0.02	0.007	4	mg/l as nitrogen
pH	7.4	8.6	6.5	46	standard units
Phenolic compounds	3.3	11	0	4	mg/l
Phosphorus	0.1	0.3	0.01	16	mg/l
Potassium	1.8	3.2	1	19	mg/l
Residue (sum of constituents)	50.5	61	42	16	mg/l
Residue	28.5	109	8.26	16	tons per day
Silica	7.1	8.5	5.3	19	mg/l
Sodium	5.4	10	3.7	19	mg/l
Specific conductance	103.4	180	84	46	microsiemens/cm
Sulfate	5.1	8	2.1	19	mg/l

*mg/l – milligrams per liter

Figure 6-1 Fecal Coliform Assay for Chapel Hill (APG-Deer Creek)

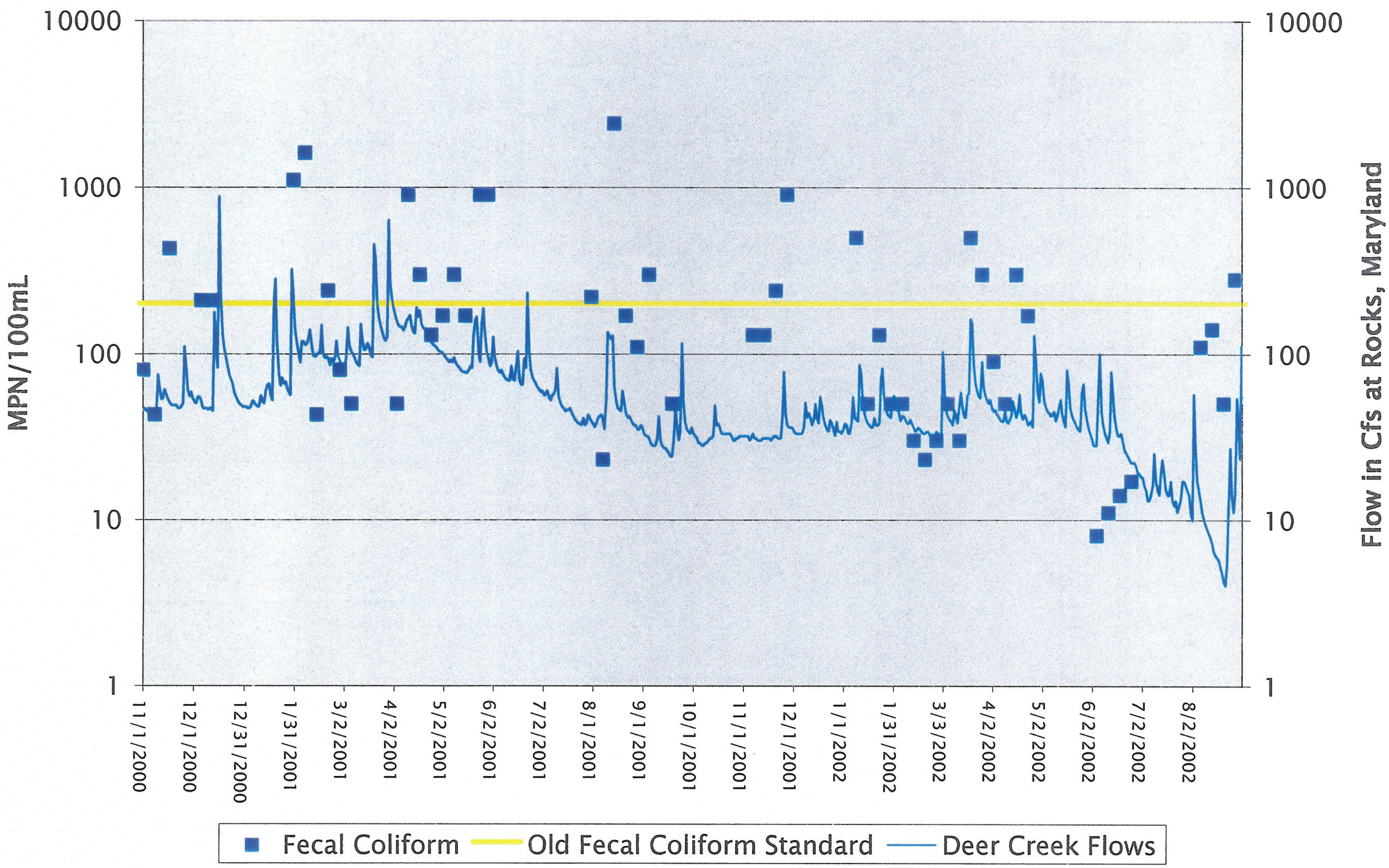
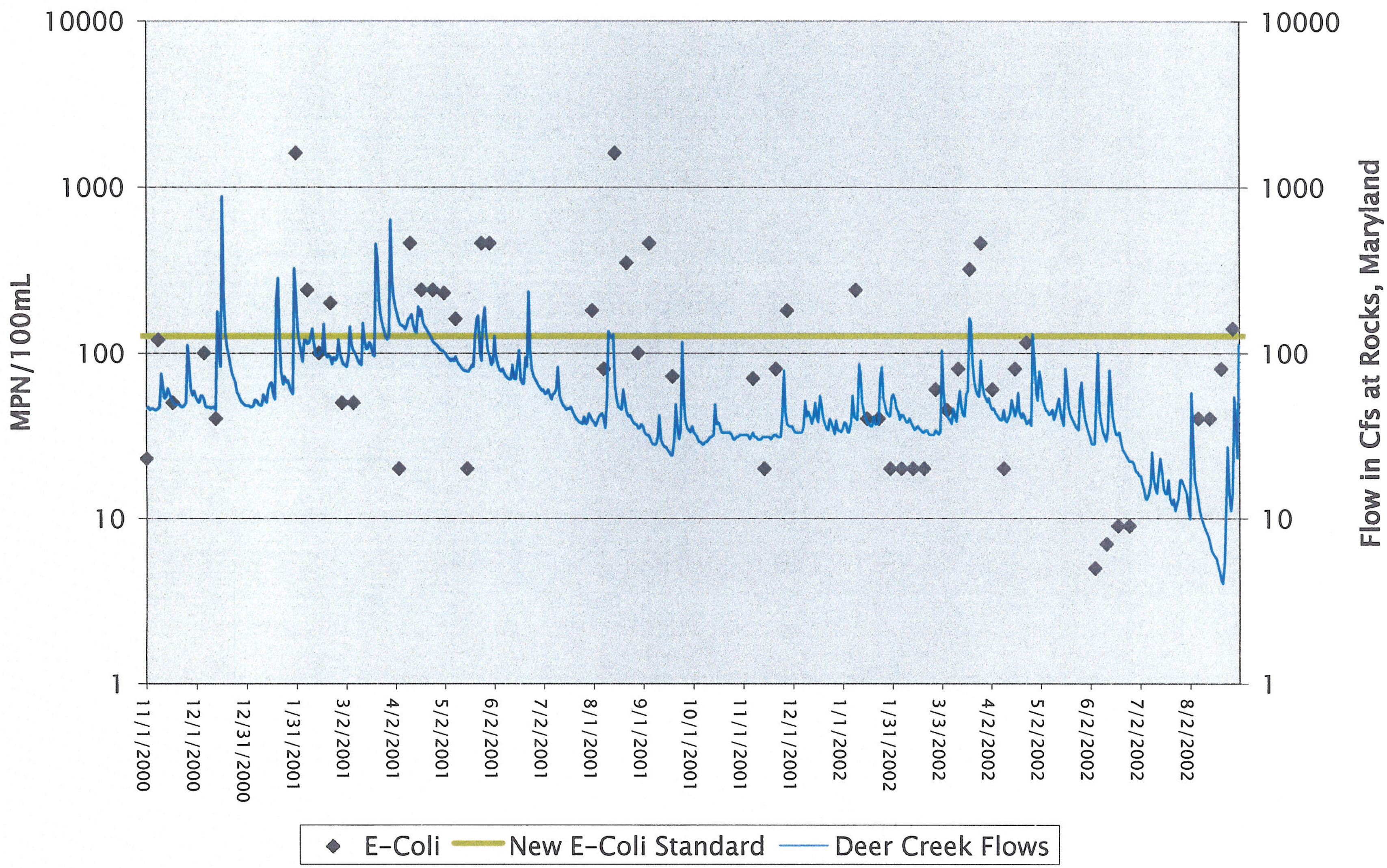


Figure 6.2 – E-Coli Assays for Chapel Hill (APG-Deer Creek)



7.0 SUSCEPTIBILITY ANALYSIS

Each class of contaminants was evaluated for their potential for contaminating the Chapel Hill intake on Deer Creek. This analysis identified suspected sources, evaluated the natural conditions that may decrease or increase the likelihood of contaminants reaching the intake, and evaluated the impacts that future changes within the watershed may have on the susceptibility of the water intake.

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 suppliers. 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 the transport and/or 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, increasing suspended solids and raising the turbidity.

There are several factors in the watershed that can contribute to increased turbidity/sediment. Runoff from paved surfaces and compacted earth increases the amount of flow in tributaries quickly and leads to bank erosion. Allowing cattle and other livestock unfettered to streams destroys protective vegetation along riparian areas where soils can runoff directly into a waterway. In addition, row cropping on steep slopes and forestry operations throughout the watershed may contribute to increased sediment and turbidity.

Because of the occurrence of high turbidity during and after storms, the Chapel Hill intake on Deer Creek is susceptible to turbidity contamination.

Inorganic Compounds (IOCs)

Several inorganic compounds (IOCs) have been detected below the maximum contaminant level in the finished water from Chapel Hill Water Treatment Plant. No concentrations exceeded 50% of a Maximum Contaminant Level (MCL). Nitrate levels are not expected to increase over time given the focus on reducing nutrient loadings to the Chesapeake Bay. The Chapel Hill intake on Deer Creek is not currently susceptible to IOC contamination.

Synthetic Organic Compounds (SOCs)

There are several synthetic organic compounds (SOCs) that were detected at the Chapel Hill plant, but all results were less than 50% of a MCL. Herbicide levels are not expected to increase given the reduced application rates over the past two decades in Maryland. Di(2-ethylhexyl)phthalate was detected 10 times with no result exceeding 50% of the MCL. Di(2-ethylhexyl)phthalate is a resin commonly used in plastics and is classified as a probable human carcinogen in the EPA Toxic Release Inventory. The prevalence of di(2-ethylhexyl)phthalate in plastics makes it a hard substance to sample and test. As explained in

Section 6, the reported quantity is not believed to reflect the actual levels in the environment. The Chapel Hill intake on Deer Creek was determined to not be susceptible to regular SOC contamination. The possibility exists, however, that a spill of pesticides or other chemicals could impact the intake on Deer Creek.

Volatile Organic Compounds (VOCs)
As discussed in Section 6.0, no VOCs other than disinfection byproducts (which are discussed separately) exceeded 50% of a MCL. A spill from a transportation accident or a leak or failure in the Colonial Pipeline could however significantly impact Deer Creek with volatile organic chemicals. As there were no significant discharges of volatile organic compounds and the watershed is very rural, the Chapel Hill intake on Deer Creek is not susceptible to regular VOC contamination.

Disinfection Byproducts (DBPs)
Trihalomethanes (THMs) and Haloacetic acids (HAAs) both exceeded 50% of the MCLs from water treated at the Chapel Hill Plant. In some samples, concentrations were well in excess of maximum contaminant levels.

While DBPs are not present in the raw water, they are created by the reaction of chlorine with natural organic matter in the raw water. In addition to MCLs, the EPA regulations require the use of treatment techniques to reduce DBP precursors and to minimize the formation of unknown DBPs. It requires that a specific percentage of influent total organic carbon (TOC) be removed during treatment. The treatment technique uses TOC as a surrogate for natural organic natter (NOM), the precursor material for DBPs. A TOC concentration of greater than 2.0 mg/l in a system's raw water is the trigger for implementation of the treatment technique. Required removal of TOC by enhanced coagulation for plants using conventional treatment is shown in the table below:

Table 7.1 Required Removal of TOC by Enchanced Coagulation for Plants Using Conventional Treatment.

Source Water TOC (mg/l)	Source Water Alkalinity (mg/l as CaCo3)		
	0-60	>60 to 120	>120
>2.0 – 4.0	35%	25%	15%
>4.0 – 8.0	45%	35%	25%
>8.0	50%	40%	30%

We evaluated the available TOC data from the Chapel Hill water plant (from January 2001 through April 2005). Paired samples were collected each month for both raw water and treated water. As the average source water alkalinity was between 0 and 60 mg/l, and the average TOC was between 2 and 4 mg/l; the required removal of TOC as a running annual average is 35%. To examine seasonal changes, the data for all years was grouped into three-month quarters (see Table 7.2). The highest percent removal was during the second (April-June) and first quarters (Jan.-March). These quarters also have significantly lower average raw water TOC levels than the third and fourth quarters. Storm event monitoring (pre, peak and post) is recommended to better understand TOC variability in Deer Creek.

Table 7.2 TOC Removal from Chapel Hill Water Treatment Plant (Jan. 2001 – April 2005)							
Quarter	**Raw Water TOC (mg/l)**			**Treated Water TOC (mg/l)**			**Percent TOC Removed**
	Min	**Max**	**Average**	**Min**	**Max**	**Average**	**Average**
1	<.5	4	1.88	<.5	1.9	1.02	39.8%
2	0.87	4	2.24	0.4	4	1.20	47.9%
3	1.7	7.8	3.11	0.6	4.7	2.12	34.5%
4	1.2	11	3.39	0.9	3.5	1.86	33.3%
Total	0.5	11	2.54	0.4	4.7	1.45	39.6%

Data from the measurement of January 2004, TOC levels were below the detection limit of .5 mg/l are treated as .5 in the TOC average and are not included in computations of percent removed.

Over 90% of the source water assessment area for the Deer Creek intake consists of agricultural and forested lands which are major sources of disinfection byproduct precursors. The runoff from these areas contribute to the delivery of nutrients, particulate and dissolved organic matter to Deer Creek. Nutrients play a role in stimulating algal growth which contributes to TOC in the water column. While the results of the average raw water TOC levels are relatively low, some of the TOC concentrations are quite high.

Due to the nature of the watershed, the consistent presence of total organic carbon, occasionally high sample concentrations of source water TOC and finished water DBP results, disinfection byproducts precursors are contaminants of concern for the Chapel Hill intake on Deer Creek.

<u>**Microbiological Contaminants**</u>

The consistent presence of fecal coliform and E.coli bacteria in Deer Creek indicates susceptibility to pathogenic microorganisms. All of the higher measurements of fecal coliform were associated with higher flows. Deer Creek, like most surface water sources in Maryland, is potentially susceptible to these contaminants. The potential non-point sources of pathogenic protozoa, viruses, and bacteria in the source water of Deer Creek include livestock, pets, failing residential septic system and wildlife. Further study is needed to determine the most significant sources of pathogens in the Deer Creek Watershed.

8.0 RECOMMENDATIONS FOR SOURCE WATER PROTECTION PLAN

This section of the report is intended to provide guidance to the City of Aberdeen and Harford County for enhancing watershed protection efforts within Deer Creek from a water supply perspective. These ideas can serve as a starting place for beginning a source water protection partnership. Additional data is needed to further understand progress and to establish specific source water protection goals.

Form a Local Planning Team

- While it is recognized that there is controversy surrounding the use of Deer Creek as a drinking water supply, a watershed team can bring together many stakeholders under a common goal. A team that includes City officials, representatives from the Harford County government, Maryland Department of Natural Resource, Harford County Soil Conservation District, the Maryland Department of the Environment, farmers and interested members of the public, and other environmental groups can work together to further improve the raw water quality of this very significant natural resource.
- Once a group is established, it would be helpful to develop a formal or informal agreement to engage officials from the County, the City, and State on a continuing basis.
- Establish clear and achievable goals, objectives, and milestones to ensure the highest quality raw water. The goals should build on the efforts such as Harford Land Trust, the Lower Deer Creek Valley Rural Legacy Area and other environmental groups to preserve the rural and agricultural landscape.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE, including raw water when feasible.
- Continue to monitor for fecal coliform and E.coli in the Deer Creek raw water.
- More frequent monitoring of sodium and chloride is recommended, particularly during winter time to track trends in sodium and chloride levels.
- Consider bacterial source tracking and monitoring of tributary streams or other means to identify sources of fecal contamination.
- Additional monitoring is needed to better understand the sources of disinfection byproduct precursors. Monitoring for total organic carbon before, during and after storm events may help determine what sources are significant.

Public Awareness and Outreach

- Future Consumer Confidence Reports need to include a summary of this report and indicate that the entire report is available to the public at the Harford County Public Library, or by contacting the City of Aberdeen, or the Water Supply Program at MDE.
- Road signs explaining to the public that they are entering a protected drinking water watershed is an effective way of keeping the relationship of land use and water quality in the public eye, and help in the event of a spill notification and response.
- Build on efforts of local environmental and watershed protection groups to sustain public support for maintaining the rural character of Deer Creek Watershed.

Land Acquisition and Easements

- The City is eligible to receive loans for the purchase of land conservation or easements to protect the watershed. Loans are offered at zero percent with no administration costs. Sensitive properties could be targeted for such loans. The loans are available from MDE under the authority of the Safe Drinking Water Act.

- In cooperation with conservation organizations establish forested buffers where lacking along Deer Creek and tributary streams. The greatest benefits are generally achieved along first and second order streams.
- Work with Harford County and MD DNR to promote agricultural preservation districts and easements throughout the watershed.
- Work with the Harford County Soil Conservation District through Soil Conservation Reserve Enhancement Program (CREP) to establish forested buffers in the watershed.
- Support efforts of the Harford County Soil Conservation District to implement agricultural Best Management Practices that control sediment erosion, keep livestock out of streams and provide for management of animal wastes.

<u>Contaminant Source Inventory Updates</u>

- A detailed field survey of the watershed could be used to identify tributary streams that are in need of greater protection efforts.
- Seek the assistance of Harford County Environmental Health Department to identify areas of failing septic systems.
- Update MDE on potential land use changes that may increase the susceptibility of the drinking water sources to the contaminants.

<u>Planning/New Development</u>

- Harford County should maintain agricultural or more protective zoning to preserve the rural nature of the Deer Creek Watershed.

REFERENCES

Aberdeen Comprehensive Plan, 2001.

Deer Creek Scenic River, Revised Edition 1979.

Harford County Water and Sewerage Plan, 2002.

Harford County 2004 Master Plan and Land Use Element Plan, www.co.ha.md.us/PlanningZoning/LandUsePlan.

Maryland Department of the Environment (MDE), *Maryland's Source Water Assessment Plan*, Water Supply Program, February 1999.

Maryland Department of the Environment (MDE), Comprehensive Performance Evaluation of Chapel Hill Water Treatment Plant, March 2002.

Soil Survey of Harford County Area, Maryland, U.S. Department of Agriculture, Soil Conservation Service, December 1975.

OTHER SOURCES OF INFORMATION AND DATA

EPA's *Guidance Manual for Source Water Assessments*
MDE Waste Management Sites Database
MDE Water Appropriation and Use Permits
MDE Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
Chapel Hill Water Treatment Plant Monthly Operating Reports (MORs) and Self Monitoring Reports