Final

Source Water Assessment

for the

Chestnut Point Estates Mobile Home Park Water System

Cecil County, Maryland

Prepared for:

Maryland Department of the Environment
Water Management Administration
Water Supply Program
1800 Washington Boulevard, Suite 625
Baltimore, Maryland 21230-1719

Prepared by:

EA Engineering, Science, Technology, Inc.
15 Loveton Circle
Sparks, Maryland 21152
(410) 771-4950

May 2003

Project No. 61726.01

Final

Source Water Assessment

for the

Chestnut Point Estates Mobile Home Park Water System

Cecil County, Maryland

Prepared for:

Maryland Department of the Environment
Water Management Administration
Water Supply Program
1800 Washington Boulevard, Suite 625
Baltimore, Maryland 21230-1719

Prepared by:

EA Engineering, Science, Technology, Inc.
15 Loveton Circle
Sparks, Maryland 21152
(410) 771-4950

5/30/03

Mike Hertz, P.G.
Task Manager

5/30/03

Kevin Sharpe, P.G.
Project Manager

May 2003

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CHS	Controlled Hazardous Substances
COMAR	Code of Maryland Regulations
DWEL	Drinking Water Equivalent Level
ft	Foot/Feet
gal	Gallon(s)
gpd	Gallon(s) Per Day
gpm	Gallon(s) Per Minute
GPS	Global Positioning System
GPTRAC	General Particle Tracking
GWUDI	Ground Water Under Direct Influence
IOC	Inorganic Compound
L	Liter(s)
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Level
MDE	Maryland Department of the Environment
MGS	Maryland Geological Survey
MHP	Mobile Home Park
mrem	Millirem(s)
PCB	Polychlorinated Biphenyls
PWSID	Public Water System Identification
SDWA	Safe Drinking Water Act
SDWR	Secondary Drinking Water Regulations
SOC	Synthetic Organic Compound
SWAP	Source Water Assessment Plan
SWPA	Source Water Protection Area
µg	Microgram(s)
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WHPA	Wellhead Protection Area

EXECUTIVE SUMMARY

EA Engineering, Science, and Technology was tasked to perform a Source Water Assessment for the Chestnut Point Estates Mobile Home Park (MHP) water system in Cecil County, Maryland. This water system is identified as Public Water System Identification (PWSID) 0070240 by the Maryland Department of the Environment (MDE). EA has performed this study under Purchase Order No. U00P3200205, as authorized by MDE.

The required components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are:

- Delineation of the area that contributes water to the source
- Identification of potential sources of contamination
- Determination of the susceptibility of the water supply to contamination
- Recommendations for protecting the drinking water supply

The source of the Chestnut Point Estates MHP's water supply is the Patapsco Formation, which is an unconfined unconsolidated Coastal Plain aquifer. The Source Water Protection Area (SWPA) for the two ground-water supply wells was delineated using the Wellhead Protection Area (WHPA) Code for unconfined unconsolidated wells. The one-year-time-of travel SWPA, which encompasses both wells, is 9 acres and the ten-year-time-of-travel SWPA is 56 acres.

Potential point and non-point sources of contamination within the assessment area were identified based on site visits, a review of MDE's databases, and a review of sewer service area and land use maps. The only point sources reported or observed within the SWPA were septic systems and a potential polychlorinated biphenyl (PCB) containing electricity transformer. Within two years, the MHP will be served by public sewer, which will substantially reduce the onsite septic systems as potential point sources of contaminants. Forests account for a significant portion of the SWPAs and are not usually considered a non-point source of contaminants. Well information and water quality data were also reviewed.

The susceptibility analysis for the Chestnut Point Estates MHP water supply is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that the Chestnut Point Estates MHP water supply has a low susceptibility to volatile organic compounds, synthetic organic compounds, inorganic compounds, radionuclides, and microbiological contaminants.

Recommendations to protect the ground-water supply include creating a SWPA protection team, resident awareness, and communication with county officials about future planning and land use.

1. INTRODUCTION

EA Engineering, Science, and Technology was tasked to perform a Source Water Assessment for the Chestnut Point Estates MHP water system in Cecil County, Maryland. EA has performed this study under Purchase Order No. U00P3200205, as authorized by the Maryland Department of the Environment (MDE).

The Chestnut Point Estates MHP water system serves the Chestnut Point Estates MHP and seasonal campground in Cecil County. The supply wells for the system are located within the development. The Chestnut Point Estates MHP water system serves a population of 150 with 55 connections. The water is supplied by two wells (Figure 1).

1.1 GROUND-WATER SUPPLY SYSTEM INFORMATION

A review of the well data and sanitary surveys of the system indicates that well numbers 3 and 4 were drilled in 1989 and 2001, respectively, in accordance with the State's current well construction standards, which were implemented in 1973. The wells have a total average yield of 11,500 gallons per day (gpd). An older well (CE811480) was abandoned in 1988. Table 1 below contains a summary of the well construction data.

TABLE 1. WELL INFORMATION

Source ID	Source Name	Permit No.	Total Depth (ft)	Casing Depth (ft)	Aquifer
03	Chestnut Point 3	CE880702	105	95	Patapsco Formation
04	Chestnut Point 4	CE944326	100	80	Patapsco Formation

Each of the wells was completed approximately 2 ft above grade. Both wells were observed secure and in good repair. Well 3 was observed to have an older looking screw-down steel cap. Well 4 was observed to have a newer looking screw-down cap.

According to the MDE Public Water Supply Inspection Report for the water system dated February 2002, the operator of the water system is the owner, Jeffrey Fronheiser.

Currently, the raw ground water is not treated and is stored in a 7,500-gal hydropneumatic tank prior to distribution.

1.2 HYDROGEOLOGY

Cecil County has two distinct physiographic provinces, the Piedmont and the Atlantic Coastal Plain, divided by the Fall Line. In the northern third of the county, Precambrian to early Paleozoic crystalline igneous and metamorphic rock of the Piedmont province are exposed at the surface. In the southern two-thirds of the county, the crystalline rocks are overlain by Coastal Plain deposits consisting largely of unconsolidated pebbly sand, sand, sandy clay, and clay. The deposits form a wedge-shaped mass of materials that range in thickness from inches along the Fall Line to as much as 1,600 ft in the southeastern corner of the County (Overbeck et al. 1958).

The ground water used by the Chestnut Point Estates MHP is from production wells drilled into the Patapsco Formation. The Patapsco Formation is described as "gray, brown, and red variegated silts and clays; lenticular, cross-bedded, argillaceous, subrounded sands; minor gravels" [Maryland Geological Survey (MGS) 1968].

The source of the ground water in Cecil County is from precipitation in the form of rainfall or snow melt (Otton et al. 1988). The ground water in the sands of the Coastal Plain resides in between the grains of the unconsolidated sediment. The water table in the aquifer generally mimics the surface topography. Yields of wells in the Potomac Group, of which the Patapsco Formation is part, range from 0.5 to 703 gallons per minute (gpm) and the median is 30 gpm. Specific capacities range from less than 0.1 to 40 gallons per minute per foot of drawdown and the median is 1.1 gallons per minute per foot of drawdown.

2. DELINEATION OF THE AREA CONTRIBUTING WATER TO SOURCE

For ground-water systems, a Wellhead Protection Area (WHPA) is considered to be the Source Water Protection Area (SWPA) for the system. Consistent with the recommended delineation in the Maryland SWAP (MDE 1999) for an unconfined Coastal Plain Aquifer such as the Patapsco Formation, the USEPA WHPA Code Version 2.0 was utilized. To provide the greatest resolution for the modeling efforts, the semi-analytical General Particle Tracking (GPTRAC) Module was selected. Per the MDE SWAP guidance, a 1-year time-of-travel and a 10-year time-of-travel were assessed.

The semi-analytical GPTRAC module delineates time-related capture zones for pumping wells in homogenous aquifers with steady state and uniform ambient ground-water flow. Effects of well interference are accounted for in this module (USEPA 1991).

The GPTRAC module requires the following inputs:

- Transmissivity in ft^2/day
- Ground-water withdrawal rate in ft^3/day
- Ground-water gradient (ft/ft)
- Ground-water flow angle (degrees)
- Aquifer thickness (ft)

The value used for transmissivity (735 ft^2/day) was chosen based on the average transmissivity values (720 ft^2/day) from pumping tests in Elkton (Otton et al. 1988), the average specific capacity value (3.7 gpm/ft * 192.5 = 715 ft^2/day) from Elkton pumping tests (Overbeck et al. 1958), and average transmissivity values from the U.S. Geological Survey (USGS) website for the Potomac aquifer (approximately 1,000 ft^2/day).

The current Water Appropriation Permit rate issued by the MDE Water Rights Division for the total of the two wells is 11,500 gpd or 1,538 ft^3/day and was used as the ground-water withdrawal rate.

The ground-water gradient of 0.0004 ft/ft was used from a data interpretation from historical ground-water levels (Willey et al. 1987).

A ground-water flow angle of 315 degrees, which is a southeast direction, was selected. This is based on the local ground-water flow direction towards the Northeast River.

Aquifer thickness for each well was based on the total depth minus the bottom of steel casing. The values for total depth and bottom of casing are shown in Table 1.

The capture zones from the WHPA Code model efforts for both the 1- and 10-year time-of-travel scenarios are shown on Figure 2. The 1-year-time-of-travel capture zones overlay and were combined into one capture zone, which is approximately 9 acres. The 10-year-time-of-travel capture zone is approximately 56 acres.

3. INVENTORY OF POTENTIAL CONTAMINANTS WITHIN THE DELINEATED AREA

A field survey was performed on 5 November 2002 to confirm potential sources of contamination identified in MDE databases around the ground-water wells. These databases include Comprehensive Environmental Response, Compensation, and Liability Act Information System the (CERCLIS), which includes National Priority List (Superfund) sites, Maryland Registered Underground Storage Tank (UST) sites, Maryland Leaking Underground Storage Tank (LUST) sites, landfills, pesticide dealers, ground-water discharge permits, Colonial Tanks, and Controlled Hazard Substances (CHS) generator sites.

During the field survey, other sources of potential contamination not in the MDE databases were noted and the location was surveyed using a Global Positioning System (GPS) receiver for mapping purposes (Figure 2).

3.1 POINT SOURCES

Greenbank Substation #332 is approximately 40 ft north of well CE880702. Prior to 1977, many transformers and electrical equipment contained polychlorinated biphenyls (PCB) as an insulator. It is possible that the equipment may contain PCB. If the equipment leaks, the PCB oil could eventually leach through the soil overburden into the ground-water aquifer.

Septic system drain fields were observed on-site. Septic system discharge could contain contaminants if there is insufficient treatment of biological contaminants such as coliforms and inorganic compounds such as nitrogen. Septic system discharge could also contain contaminants that the systems were not designed to treat, such as solvents and fuels. However, the owner of the system stated that, within 2 years, the development should be able to connect to the Charlestown public sewer system. Following connection, septic systems as a point source would be substantially reduced.

3.2 NON-POINT SOURCES

Using the Maryland Office of Planning's 2000 Land Use/Land Cover map for Cecil County, potential non-point sources within the SWPA area were also evaluated by land use designation. This assessment was performed by overlaying the SWPA shape over the land use coverage layer in ArcView GIS (Figure 3). A summary of the percent and acreage of each type of land use is presented in Table 2.

TABLE 2. SUMMARY OF LAND USE IN THE SOURCE WATER PROTECTION AREAS

	One Year-time-of-travel		Ten Year-time-of-travel	
Well	**3,4**		**3,4**	
	Percent	**Acres**	**Percent**	**Acres**
Low Density Residential	21.1	1.9	18.6	10.3
Commercial	46.4	4.1	27.1	15.1
Cropland	0.0	0.0	0.6	0.4
Forest	32.5	2.9	53.7	29.9
Total Acreage		8.8		55.7

From an interpretation of Table 2, commercial (4.1 acres) and forest (2.9 acres) areas account for a majority of the 1-year-time-of-travel source water protection area SWPA (8.8 acres). Forest (30 acres) and commercial (15 acres) areas account for the majority of the 10-year-time-of-travel SWPA (56 acres). Potential sources of contamination in commercial areas within the SWPA are addressed in Section 3.1, Point Sources. The only non-point source of pollution generally associated with forests is from logging activities. Therefore, there is little to no potential for the migration of potential contaminants from non-point sources into the ground water.

Using the 1993 Maryland Office of Planning's Cecil County sewerage coverage, potential non-point sources from other septic system users in the SWPA were assessed (Figure 4). By overlaying the SWPA on the sewerage coverage layer in ArcView GIS, it was determined that approximately 3 percent of the 10 year-time-of-travel SWPA does not have public sewer service, 26 percent is either on public sewer service or is under construction, and 71 percent is scheduled to receive service within 5 years.

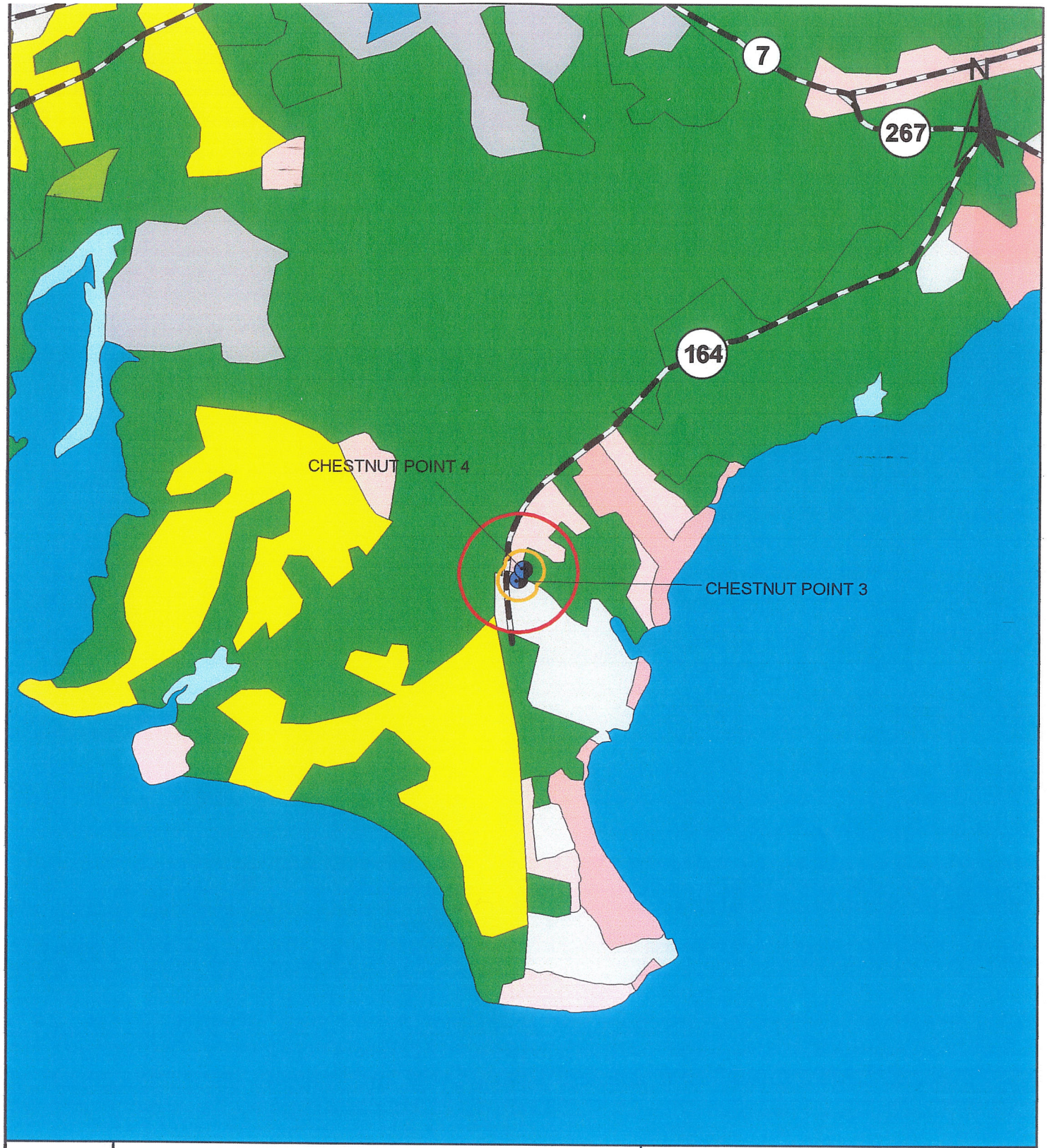

Figure 3. Chestnut Point Estates MHP
Land Use Map of the
Source Water Protection Area

Source Water Assessment Program
2003

Scale: 1000 0 1000 2000 Feet

Source: Maryland Office of Planning, 2000.

Legend:

- MHP Wells
- SWPA Boundary, 1 yr Time of Travel
- SWPA Boundary, 10 yr Time of Travel
- Major Roads

Land Use

- Low Density Residential
- Medium Density Residential
- Commercial
- Extractive
- Cropland
- Pasture
- Forest
- Water
- Wetlands

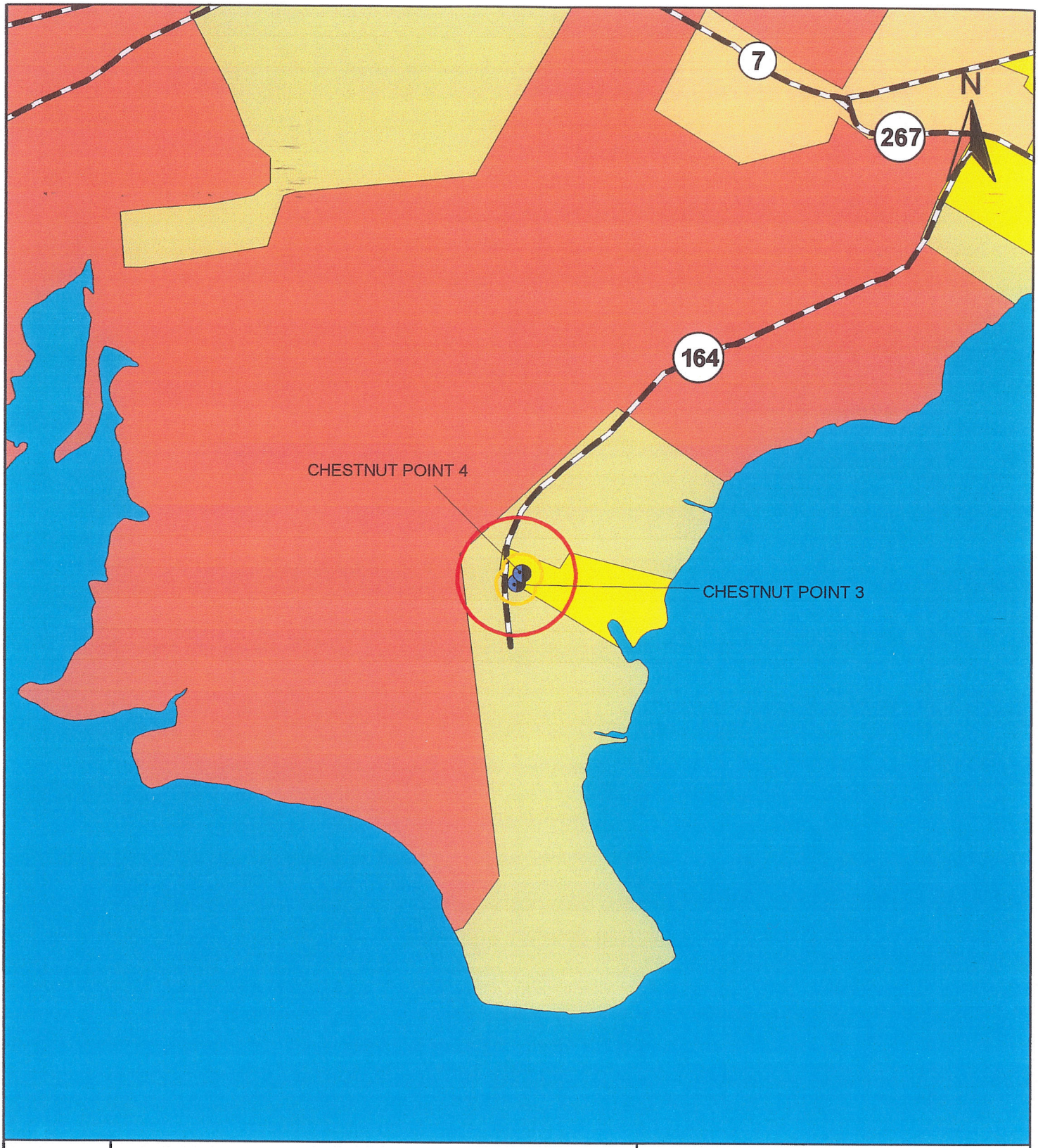

Figure 4. Chestnut Point Estates MHP Sewer Service Map of the Source Water Protection Area

Source Water Assessment Program
2003

Legend:

- MHP Wells
- SWPA Boundary, 10 yr Time of Travel
- SWPA Boundary, 1 yr Time of Travel
- Major Roads

Sewer

- No planned service area
- Existing service area
- Area programmed for service within 5 years
- Area programmed for service within 5 to 10 years
- Water

Source: Maryland Office of Planning, 1993.

Scale: 1000 0 1000 2000 Feet

4. REVIEW OF WATER QUALITY DATA

Water quality data was obtained from the MDE Water Supply Program database of Safe Drinking Water Act (SDWA) contaminants. The results reported are for finished (treated) ground water (unless noted).

A review of the water quality data from 1991 to 2002 has been performed for Chestnut Point Estates MHP's finished water samples. All detected compounds from ground-water samples collected are shown in Appendix A.

Ground-water analytical results were compared to 50 percent of the United States Environmental Protection Agency (USEPA) Maximum Contaminant Levels (MCLs) or the USEPA Secondary Drinking Water Regulations (SDWR). If no MCL or SDWR is available, the Drinking Water Equivalent Level (DWEL) was substituted as recommended by the USEPA Office of Water.

4.1 GENERAL WATER QUALITY PARAMETERS

One ground-water sample collected on 21 November 1996 was reported with a pH of 5.5 units. This is below the SDWR range of 6.5 to 8.5 units. SDWR parameters are non-enforceable federal guidelines regarding cosmetic effects, such as tooth or skin discoloration, or aesthetic effects, such as taste, odors, or color.

4.2 VOLATILE ORGANIC COMPOUNDS

No VOCs were reported in any of the water samples collected and analyzed.

4.3 SYNTHETIC ORGANIC COMPOUNDS

No synthetic organic compounds (SOCs) were reported in the ground-water samples above 50 percent of the USEPA MCL.

The herbicides dalapon and picloram were reported in the 14 August 2000 water sample with concentrations of 2.17 and 0.13 µg/L, respectively. The MCL for dalapon and picloram are 200 and 500 µg/L, respectively.

4.4 INORGANIC COMPOUNDS

No inorganic compounds (IOCs) were reported in the ground-water samples above 50 percent of the USEPA MCL. Only nitrite, sulfate, and sodium were reported in the samples analyzed. All

the reported concentrations were within normal ranges for the Potomac aquifers (Otton et al. 1988).

4.5 MICROBIOLOGICAL CONTAMINANTS

No total or fecal coliform has been detected in ground-water samples of the water system's finished water from January 1997 to August 2002.

To assess the potential of Ground Water Under the Direct Influence (GWUDI) of surface water, ground-water sampling records (during dry and storm conditions) in MDE databases were assessed and information from Public Water Supply Inspection Reports were reviewed.

If significant variances in the ground-water results from dry and storm conditions are observed, it is possible that the ground water is under the direct influence of surface water. Surface water that directly recharges the aquifer does not pass through the soil overburden that both filters and contains beneficial microorganisms that break down potential contaminants.

From an assessment of the GWUDI ground-water results by MDE, the ground-water supply for Chestnut Point Estates MHP is not under the direct influence of surface water.

4.6 RADIONUCLIDES

No radionuclides were reported above 50 percent of the MCLs. However, no radon-222 data is available for this system to date.

Gross alpha was reported in two water samples collected in February 1997 and October 1992. The reported gross alpha concentrations [1 and 2 picocuries per liter (pCi/L)] are well below the MCL of 15 pCi/L.

Gross beta was also reported in one water sample collected in June 2001. The reported gross beta concentration (3 pCi/L) is below the MCL of 50 pCi/L.

5. SUSCEPTIBILITY ANALYSIS

To evaluate the susceptibility of the ground-water source to contamination, the following criteria were used:

1. available water quality data
2. presence of potential contaminant sources in the SWPA
3. aquifer characteristics
4. well integrity
5. the likelihood of change to the natural conditions

The aquifer that supplies Chestnut Point Estates MHP's drinking water is an unconfined aquifer.

For the Susceptibility Analysis in this report, rankings of "high," "moderate," and "low" susceptibility to contamination were utilized after a review of current information. However, other SWAP reports for the State of Maryland also utilized rankings of "is," "may be," and "is not" susceptible to contamination. For consistency between the ranking systems, the following details their equivalence. The ranking of "highly susceptible" is equivalent to "is susceptible," "moderately susceptible" is equivalent to "may be susceptible," and "low susceptibility" is equivalent to "is not susceptible."

5.1 VOLATILE ORGANIC COMPOUNDS

No VOCs have been reported in any of the water samples collected. The only reported or observed source of VOC is the Chestnut Point Marina USTs. However, the USTs are approximately 2,000 ft downgradient of the supply wells.

Based on the water quality data reviewed and the absence of any known sources or facilities that may cause VOC contamination in the 1-year and 10-year SWPAs, the water supply at Chestnut Point Estates MHP has a low susceptibly to VOCs.

5.2 SYNTHETIC ORGANIC COMPOUNDS

The only potential source of SOCs is a potential PCB oil-containing transformer located within the SWPA. However, no synthetic organic compounds were reported in the water samples collected above 50 percent of the MCL. Low-level concentrations of two herbicides were reported in one water sample in August 2000. These compounds are likely the result of an over application of herbicides in the past.

Most SOCs, including PCB, have a high affinity to sorb to soil particles rather than dissolving into water. According to the well information, there is approximately 80 ft of unconsolidated

material between the surface and the top of the well screens in the aquifer. Therefore, it is unlikely that minor surface spills or applications of SOCs would affect the ground-water quality.

Based on the water quality review, it does not appear that the potential PCB oil-containing transformer observed is impacting the ground water with SOCs. Therefore, the water supply at Chestnut Point Estates MHP has a low susceptibility to SOCs.

5.3 INORGANIC COMPOUNDS

Residential and commercial areas account for a majority of the 1-year and the 10-year SWPA. No point sources or non-point source areas such as pastures and/or croplands were identified in the SWPA that may impact the ground water with IOCs such as nitrate. No IOC concentrations were reported greater than 50 percent of the MCL and nitrate has not been reported in any of the ground-water sample analyses. In addition, the MHP is scheduled to connect to the Charlestown sewer system within two years substantially reducing septic systems as potential sources of nitrate contamination.

Based on the water quality data reviewed and the absence of any known sources or facilities that may cause IOC contamination in the 1-year and 10-year SWPAs, the water supply at Chestnut Point Estates Home Park has a low susceptibility to IOCs.

5.4 RADIONUCLIDES

The presence of gross alpha and beta particles is generally attributed to decay of naturally occurring minerals like uranium in the aquifer sediments (Bolton 1996). Based on the aquifer characteristics and the available water quality data, the water supply at Chestnut Point Estates MHP has a low susceptibility to radionuclides.

5.5 MICROBIOLOGICAL CONTAMINANTS

No coliform bacterium has been detected in the water samples since 1997. From an assessment of GWUDI ground-water results by MDE, the ground-water supply for Chestnut Point Estates MHP is not under the direct influence of surface water. Both of the supply wells were constructed after 1973, the year that current well construction standards were required. Both of the wells were secure and appeared to be in good repair.

Based on the water quality review and the condition and construction of the wells, the water supply at Chestnut Point Estates MHP has a low susceptibility to microbiological contaminants.

6. RECOMMENDATIONS FOR PROTECTING THE WATER SUPPLY

With the information contained in this report, Chestnut Point Estates MHP has a basis for better understanding of the risks to its drinking water supply. Being aware of the SWPA, knowing potential contaminant sources, evaluating current and future development, working with agricultural producers and soil conservation agencies, and effective outreach and education are examples of management practices that will help protect the water supply.

Recommendations for the protection of the ground-water supply are intended for the mobile home park owner and its residents. Specific management recommendations for consideration are listed below.

6.1 PROTECTION TEAM

The management of the mobile home park should be aware of the SWPA limits and evaluate the possible effects to the quality of the ground water prior to building or making any changes.

The management of the mobile home park should also contact the owner of the electricity transformers observed on-site to assess whether they contain PCB oil.

6.2 PUBLIC AWARENESS AND OUTREACH

The management of the mobile home park should consider discussing with property owners and businesses located within the SWPA of the activities that may have impacts to the ground water and its quality.

The management of the mobile home park should also consider sending pamphlets, flyers, or bill stuffers to its residents to educate them about the SWPA. An example pamphlet, "Gardening in a Wellhead Protection Area," is an example that is available from MDE. The residents should also be encouraged to notify the mobile home park management of any significant spills from gasoline or any other potentially hazardous substances.

Placing signs at the SWPA boundaries is an effective way to make the public aware of protecting their source of water supply, and to help in the event of spill notification and response.

The Executive Summary of this report should also be listed in the Consumer Confidence Report for the water system, and should also indicate that the report is available to the general public by contacting the MHP owner, the local library, or the MDE.

6.3 PLANNING/NEW DEVELOPMENT

The mobile home park should also inform the Cecil County Health and Planning Departments of any concerns to future development or zoning changes of properties that are within the SWPA.

6.4 MONITORING

The management of the mobile home park should continue to monitor the ground water for all SWDA contaminants as required by MDE.

Annual raw water sampling for microbiological contaminants is a good way to check the integrity of the well.

6.5 CONTINGENCY PLAN

As required by the Code of Maryland Regulations (COMAR) 26.04.01.22, all water system owners are required to prepare and submit for approval a plan to provide safe drinking water under emergency conditions.

6.6 CHANGES IN USES

The management of the mobile home park should inform the Water Supply Program at MDE of any changes to pumping rates and when a change in the number of wells used is anticipated. Any changes to the pumping rate and/or the number of supply wells will affect the size and shape of the SWPA.

6.7 CONTAMINANT SOURCE INVENTORY UPDATES/INSPECTIONS

The management of the mobile home park should conduct its own survey of the SWPA to ensure that there are no additional potential sources of contamination.

A regular inspection and maintenance program of the supply wells should be considered to prevent a failure in the well's integrity, which may provide a pathway for contaminants to the aquifer.

Unused wells that are no longer connected to the distribution system should be abandoned and sealed as per COMAR 26.04.04.11. Unused wells can provide a pathway for contaminants to the aquifer. No unused wells were observed during the site visit. However, an unused well is listed in the MDE PDWIS database.

Depressions around the wellheads should be filled and graded to prevent surface water ponding that may occur during rain events. This will help to prevent surface water infiltration into the well.

7. REFERENCES

The following sources of information were consulted as a part of this investigation:

1. Bolton, David W. 1996. *Network Description and Initial Water-Quality Data From a Statewide Ground-Water Quality Network in Maryland.* Maryland Geological Survey Report of Investigations No. 60.

2. Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 pp.

3. Maryland Geologic Survey (MGS). 1968. *Cecil County Geologic Map adapted from Maryland Geological Survey's Geologic Map of Maryland.*

4. Otton, E. G, R. E Willey, R. A McGregor, G. Achmad, S. N. Hiortdahl, J.M. Gerhart. 1988. *Water Resources and Estimated Effects of Ground-Water Development, Cecil County, Maryland.* United States Department of the Interior, Geologic Survey. Bulletin 34.

5. Overbeck, R.M., T.H. Slaughter, and A.E Hulme, 1958. *Water Resources of Cecil, Kent, and Queen Annes Counties.* Maryland Department of Geology, Mines and Water Resources Bulletin No. 21.

6. United States Environmental Protection Agency (USEPA). 1991. *WHPA – A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas, Version 2.0.* Office of Water. Office of Ground-Water Protection.

7. United States Environmental Protection Agency (USEPA). 2001. *A Small Systems Guide to the Total Coliform Rule.* Office of Water. EPA 816-R-01-017A. June.

SOURCES OF DATA

Water Appropriation and Use Database.
Public Water Supply Inspection Reports
Monitoring Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Maryland Office of Planning 2000 Cecil County Land Use Map
Maryland Office of Planning 1993 Cecil County Land Use Map
USGS Topographic 7.5 minute Quadrangle Map – 1992 North East, Maryland Quad
USGS Topographic 7.5 minute Quadrangle Map – 1992 Havre de Grace, Maryland Quad

Appendix A

Detected Compounds in Ground-Water Samples

SUMMARY OF DETECTED COMPOUNDS IN CHESTNUT POINT ESTATES WATER SAMPLES				
Plant ID	**Sample Date**	**Contaminant Name**	**Result**	**Unit**
Synthetic Organic Compounds				
01	14-Aug-00	DALAPON	2.27	ug/L
01	14-Aug-00	PICLORAM	0.13	ug/L
Inorganic Compounds				
01	21-Nov-96	NITRITE	0.003	mg/L
01	21-Nov-96	SODIUM	2.8	mg/L
01	14-Aug-00	SODIUM	400	mg/L
01	21-Nov-96	SULFATE	3.4	mg/L
General Water Quality Parameters				
01	21-Nov-96	pH	5.5	s.u.
Radionuclides				
00	28-Oct-92	GROSS ALPHA	1	pCi/L
00	04-Feb-97	GROSS ALPHA	2	pCi/L
01	16-Jul-01	GROSS ALPHA	3	pCi/L
01	16-Jul-01	GROSS BETA	3	pCi/L

s.u. – standard units.