Final

Source Water Assessment

for the

Cecil Woods 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:

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(410) 771-4950

May 2003

Project No. 61726.01

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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
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
mg	Milligram(s)
MGS	Maryland Geological Survey
MHP	Mobile Home Park
NaOH	Caustic Soda
PCB	Polychlorinated Biphenyls
pCi	Picocurie(s)
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
UST	Underground Storage Tank

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

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 Cecil Woods Mobile Home Park (MHP) water system in Cecil County, Maryland. This water system is identified as Public Water System Identification (PWSID) 0070244 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 Cecil Woods MHP's water supply is the Port Deposit Gneiss, which is an unconfined crystalline rock aquifer. The Source Water Protection Area (SWPA) for the two ground-water supply wells was delineated using the watershed delineation method for fractured bedrock wells. The area of the SWPA is based on land topography, nearby streams, and a calculation of the total ground-water contributing area during a drought. The SWPA is approximately 154 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. Potential polychlorinated biphenyl (PCB) containing electricity transformers and septic systems were observed on site. In addition, a number of automobile repair, sales, or gasoline stations were observed within or adjacent to the SWPA. Residential areas account for a significant portion of the SWPA and can be a non-point source of contaminants when nitrogen-based fertilizers are used. Well information and water quality data were also reviewed.

The susceptibility analysis for the Cecil Woods 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 Cecil Woods MHP water supply is moderately susceptible to volatile organic compounds and radon-222 and has a low susceptibility to inorganic compounds, synthetic organic compounds, other 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 Cecil Woods Mobile Home Park (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 Cecil Woods MHP water system serves the Cecil Woods MHP in Cecil County. The water treatment plant and the supply wells for the system are located within the development. The Cecil Woods MHP water system serves a population of 200 with 128 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 1 and 2 were drilled in 1987 and 1989, respectively, in accordance with the State's current well construction standards, which were implemented in 1973. Wells 1 and 2 have pumping rates of 45 and 38 gallons per minute (gpm), respectively. Table 1 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
01	Cecil Woods 1	CE812944	200	60	Port Deposit Gneiss
02	Cecil Woods 2	CE880594	240	80	Port Deposit Gneiss

Both of the wells were completed above grade. Each well was observed secure and in good repair. Well 1 was observed inside a pump house. Well 2 was observed inside a small protective wooden structure.

Currently, the raw ground water is treated with caustic soda (NaOH) for corrosion control, sodium hypochlorite (bleach) for disinfection, and potassium permanganate for iron oxidation (removal). The ground water is also filtered through greensand for additional iron removal. The finished water is stored in 4,000-gal hydropneumatic tanks or a 7,200-gal above ground storage tank prior to distribution.

According to the MDE Public Water Supply Inspection Report for the water system dated February 2002, the operators of the water system are David Hollenbach and Walter Vannoy.

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 Cecil Woods MHP is from production wells drilled into the Port Deposit Gneiss formation. The Port Deposit Gneiss Formation is described as a "moderately to strongly deformed intrusive complex composed of gneissic biotite quartz diorite, hornblende-biotite quartz diorite, and biotite granodiorite, with all rocks foliated and some strongly sheared" [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. The water table in the aquifer generally mimics the surface topography. The availability of ground water in the crystalline rock of the area depends on the nature and distribution of secondary openings resulting from fracturing and weathering. The yield of a well in crystalline rock depends primarily on the amount of fracture openings penetrated by the well. The well yield range of 43 wells in the Port Deposit Gneiss ranges from 2 to 100 gallons per minute (gpm) with 35 percent of the wells having well yields greater than 10 gpm. The range of specific capacity, which relates well yield to drawdown, of 43 wells in the Port Deposit Gneiss range from less than 0.1 to 4.0 gallons per minute per foot of drawdown (Otton et al. 1988).

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), the watershed drainage area that contributes ground water to the supply wells methodology was used.

This original delineation shape was then modified by accounting for surface water bodies, topography, significant land features, and by using a conservative calculation of total ground-water recharge during a drought. For conservative purposes, drought condition recharge value of 400 gallons per day (gpd) per acre (or approximately 5.4 inches per year) was used to estimate the total ground-water contribution area required to supply the wells.

For Cecil Woods MHP, the current Water Appropriation Permit issued by the MDE Water Rights Division is for an average of 30,200 gpd for the total of the two wells. To determine the total ground-water contribution area during a drought, the following equation was used:

Recharge Area (acre) = Average Use (gpd)/Drought Condition Recharge (gpd/acre)

From the equation above, the total ground-water contributing area during a drought is approximately 76 acres. The delineated SWPA is approximately 154 acres (Figure 2), and is therefore adequate to meet the average daily ground-water usage during a drought.

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 the Comprehensive Environmental Response, Compensation, and Liability Act Information System (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 Hazardous 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

Approximately nine pole-mounted electrical transformers were identified at the adjacent Town & Country MHP to the east. Prior to 1977, many transformers contained polychlorinated biphenyls (PCB) as an insulator. It is possible that the transformers may contain PCB. If the transformer leaks, the PCB oil may eventually leach through the soil overburden into the ground-water aquifer.

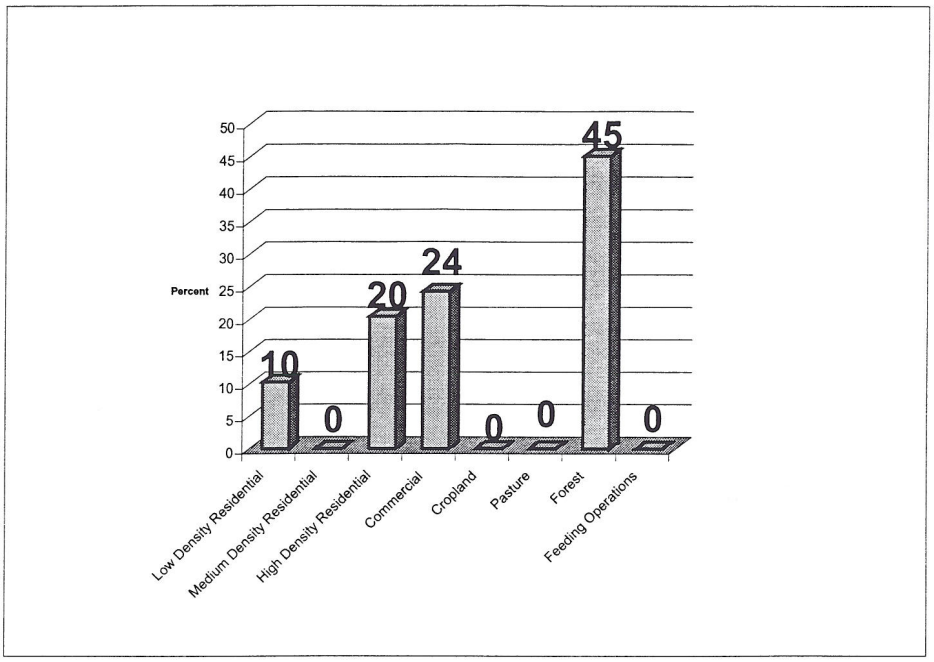
Septic system drain fields were observed onsite. Septic system discharge could contain contaminants if there is insufficient treatment of biological contaminants such as coliforms and inorganic compounds such as nitrogen. Septic system discharge could also contain contaminants that the systems were not designed to treat, such as solvents and fuels.

Two automobile repair facilities, E. Sprague Champion Service Auto Repair and Cecil County Auto Body, were observed within the SWPA. The use of solvents and fuels are common at these facilities. Six additional automobile repair, automobile sales, or gasoline stations are present within one-half mile of the supply wells along Pulaski Highway (Route 40).

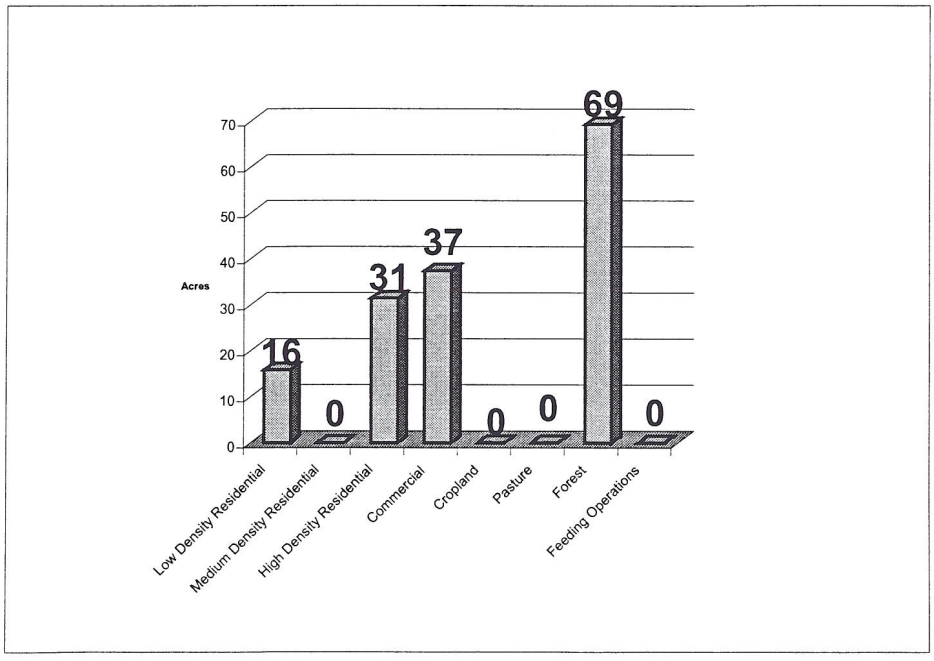
3.2 NON-POINT SOURCES

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 (Figure 3). A summary of the percent and acreage of each type of land use is presented in the graphs below:

PERCENTAGE OF EACH LAND USE TYPE



ACREAGE OF EACH LAND USE TYPE



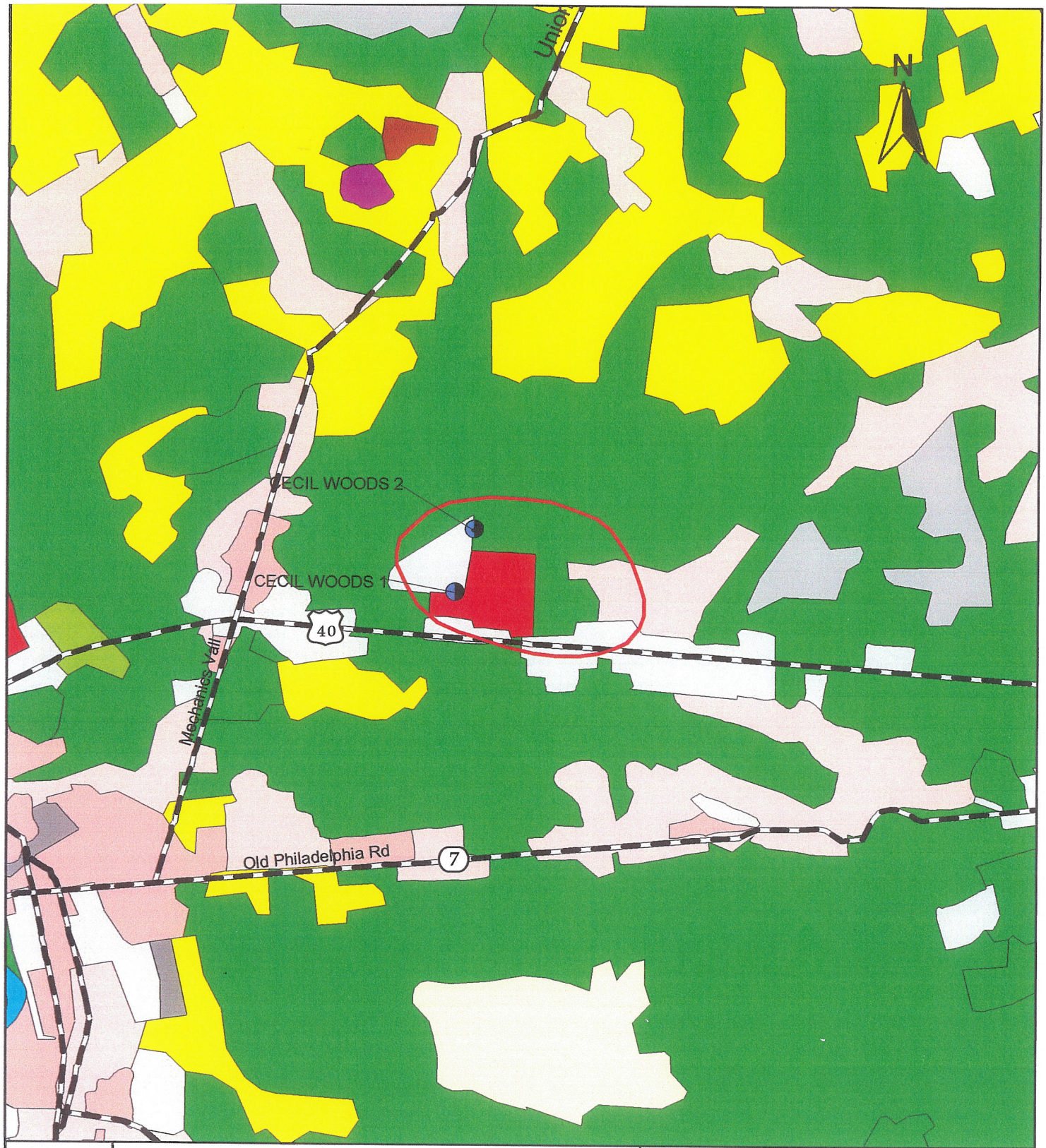


Figure 3. Cecil Woods MHP Land Use Map of the Source Water Protection Area

Source Water Assessment Program
2003

Scale: 1000 0 1000 2000 Feet

Source: Maryland Office of Planning, 2000.

Legend:

- MHP Wells
- SWPA Boundary
- Major Roads

Land Use

- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial
- Industrial
- Extractive
- Open Urban Land
- Cropland
- Pasture
- Orchards
- Forest
- Feeding Operations
- Barren Land
- Water

From an interpretation of the figures above, forest (69 acres) and residential areas (47 acres) accounts for a majority of the SWPA (154 acres). The only non-point source of pollution generally associated with forests is from logging activities. Overuse of fertilizers, pesticides, and herbicides on residential areas can be a non-point source of SOC. Therefore, there is some potential for the migration of potential contaminants into the ground water.

Using the 1995 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 over the sewerage coverage layer in ArcView GIS, it was determined that approximately 71 percent of the SWPA does not have public sewer service while 29 percent is either on public sewer service or is under construction.

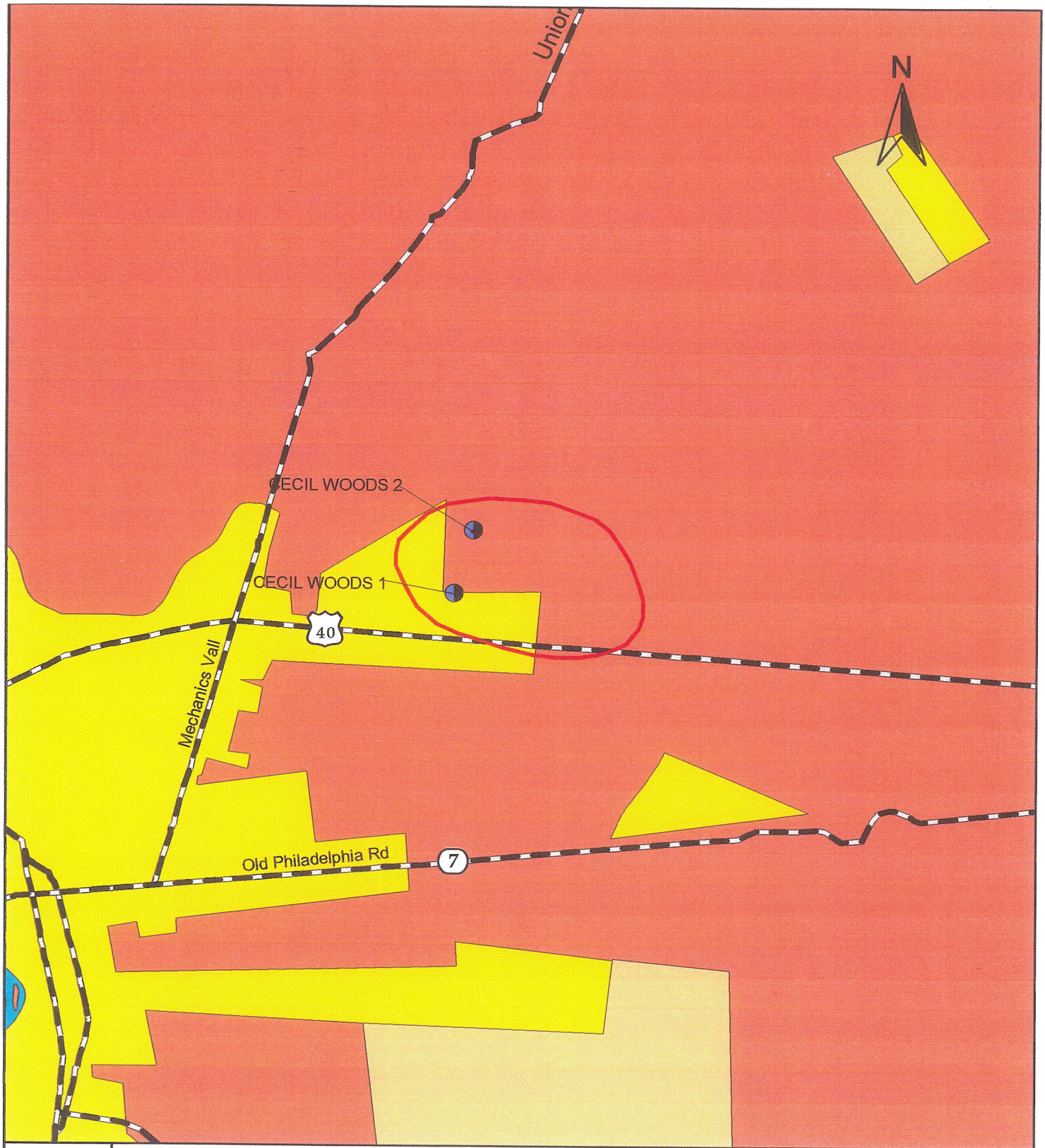


Figure 4. Cecil Woods MHP Sewer Service Map of the Source Water Protection Area

Source Water Assessment Program
2003

Legend:

- MHP Wells
- SWPA Boundary
- 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

Scale: 1000 0 1000 2000 Feet

Source: Maryland Office of Planning, 1993.

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 1989 to 2002 has been performed for Cecil Woods 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

No general water quality parameters were reported in the ground-water samples above 50 percent of the USEPA MCL. The pH of the ground-water samples was reported to range from 6.9 to 7.7 standard units.

4.2 VOLATILE ORGANIC COMPOUNDS

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

Gasoline constituents such as ethylbenzene, toluene, and xylenes were reported in the water samples collected in 1996 and 1997. However, no concentrations of these compounds have been reported since July 1997 in the annual water samples submitted for VOC analysis.

The disinfection by-products bromodichloromethane, chloroform, and dibromochloromethane (commonly known as trihalomethanes) were also reported in the water samples in January and April 1997 and ranged in concentration from 0.6 to 1.2 µg/L. The current MCL for total trihalomethanes is 100 µg/L. However, effective 1 January 2004, the MCL for total trihalomethanes will be 80 µg/L.

4.3 SYNTHETIC ORGANIC COMPOUNDS

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

collected with the exception of low-level concentrations (less than 1.5 µg/L) of di(2-ethylhexyl)phthalate. Di(2- ethylhexyl)phthalate is a common laboratory cross-contaminant and has an MCL of 6 µg/L.

4.4 INORGANIC COMPOUNDS

Two concentrations of iron were reported greater than the SDWR (0.30 mg/L) in the two water samples collected on 13 December 1989. Two concentrations of manganese were reported greater than the SDWR (0.05 mg/L) in the two water samples collected on 13 December 1989. A summary of inorganic water quality analysis is presented in Table 2. No other water samples have been submitted for the analysis of iron or manganese since 1989.

TABLE 2. SUMMARY OF INORGANIC WATER QUALITY ANALYSIS

Plant ID	Contaminant	Sample Date	Result	Unit
1	Iron	12/13/89	**3.3**	mg/L
1	Iron	12/13/89	**9.54**	mg/L
1	Manganese	12/13/89	**0.19**	mg/L
1	Manganese	12/13/89	**0.46**	mg/L

ND = Not Detected.
Shaded values are greater than 50 percent of the SDWR.

The SDWR parameters are non-enforceable federal guidelines regarding cosmetic effects, such as tooth or skin discoloration, or aesthetic effects, such as taste, odor, or color.

4.5 MICROBIOLOGICAL CONTAMINANTS

No total or fecal coliforms have been detected in ground-water samples of the water system's finished or raw 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 through major fractures in rock 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 Cecil Woods MHP is not under the direct influence of surface water.

4.6 RADIONUCLIDES

Radon 222 was reported above 50 percent of the more conservative proposed MCL of 300 picocuries per liter (pCi/L) in the only water sample collected and analyzed with a concentration of 210 pCi/L as shown in Table 4 below:

TABLE 3. SUMMARY OF RADON-222 ANALYSIS

Plant ID	Sample Date	Contaminant	Result	Unit
01	28-Aug-2000	Radon-222	**210**	pCi/L

ND = Not Detected.
Shaded values are greater than 50 percent of the more conservative proposed MCL.

The MCL used for comparing detections of Radon-222 was 300 pCi/L. This MCL is a proposed MCL established by USEPA since there is no current MCL for this contaminant (USEPA 1999). However, if a state has a program to address the more significant risk from radon in indoor air, than 4,000 pCi/L can be used as an alternate MCL. For the purpose of this investigation, the more conservative number was utilized.

Gross alpha (1 pCi/L) and beta particles (4 pCi/L) were also reported in water samples collected. However, the reported concentrations were below 50 percent of the respective MCLs of 15 and 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 Cecil Woods 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

Trihalomethanes and the gasoline constituents toluene, ethylbenzene, and xylenes, were reported in the water samples. Each reported concentration was reported below 50 percent of the MCL or the USEPA advisory level.

The trihalomethanes reported are most likely the result of the disinfection process using sodium hypochlorite (bleach).

Gasoline constituents were reported in water samples prior to 1997. The reported concentrations may have been the result of a gasoline release or spill from sources along Route 40. However, the only gasoline constituent that has been reported in the ground-water samples since 1997 is MTBE. This may be the result of cleanup efforts performed at the potential sites or to the natural attenuation of the contaminants over time.

Based on the water quality data reviewed and the observed facilities within and adjacent to the SWPA that may cause VOC contamination in the SWPA, the water supply at Cecil Woods MHP is moderately susceptible to VOCs.

5.2 SYNTHETIC ORGANIC COMPOUNDS

Potential PCB oil-containing transformers were observed within the SWPA and may be a source of SOCs if a leak or release were to occur. However, no synthetic organic compounds were reported in the water samples with the exception of the laboratory cross-contaminant di(2-ethylhexyl)phthalate. Most SOCs, including PCB, have a high affinity to sorb to soil particles and are not likely to infiltrate into the ground-water aquifer. From the well construction information, the soil overburden above the bedrock aquifer is approximately 60 to 80 ft thick.

Based on the water quality review, the relatively thick soil overburden, and the lack of significant non-point sources, it does not appear that the potential sources observed are impacting the ground water with SOCs. Therefore, the water supply at Cecil Woods MHP has a low susceptibility to SOCs.

5.3 INORGANIC COMPOUNDS

No inorganic compounds (IOCs) were reported above 50 percent of the MCL. However, concentrations of iron and manganese were reported above 50 percent of the SDWR in two water samples collected in 1989. SDWR parameters are non-enforceable federal guidelines regarding cosmetic effects, such as tooth and skin discoloration, or aesthetic effects, such as taste, odor, or color.

Nitrate, a common contaminant in septic system discharge, has not been reported in any of the water samples and is the likely result of proper septic system construction and the relative thickness of the soil overburden.

Based on the water quality data reviewed and the absence of known facilities and significant non-point sources of IOC contamination within the SWPA, the water supply at Cecil Woods MHP has a low susceptibility to IOCs.

5.4 RADIONUCLIDES

Only radon-222 was reported above 50 percent of the MCL in the water samples collected. Gross alpha and beta particles were reported well below their respective MCLs of 15 and 50 pCi/L.

Radon-222 was reported at a concentration of 210 µg/L, which is greater than 50 percent of the more conservative proposed MCL of 300 pCi/L.

The presence of radon-222 is generally attributed to decay of naturally occurring minerals like uranium in the metamorphic rock aquifer (Bolton 1996). However, the concentrations of radon-222 were reported above 50 percent of the more conservative MCL. Therefore, the water supply at Cecil Woods MHP is moderately susceptible to radon-222 and has a low susceptibility to other radionuclides.

5.5 MICROBIOLOGICAL CONTAMINANTS

No coliform bacteria have been detected in the water samples based on a review of available data since 1997. From an assessment of GWUDI ground-water results by MDE, the ground-water supply for Cecil Woods 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 Cecil Woods MHP has a low susceptibility to microbiological contaminants.

6. RECOMMENDATIONS FOR PROTECTING THE WATER SUPPLY

With the information contained in this report, Cecil Woods MHP has a basis for better understanding of the risks to the 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 onsite 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, 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 MDE.

6.3 PLANNING/NEW DEVELOPMENT

The management of the mobile home park should also inform the Cecil County Health and Planning Departments of any concerns about future development or zoning changes for 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.

Additional sampling for radiological contaminants (specifically radon-222) should be performed to monitor and document levels until USEPA determines how to regulate the radionuclides in public water supplies.

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.

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. 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.

3. 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.

4. Maryland Department of the Environment (MDE), Water Supply Program. 1999. Maryland's Source Water Assessment Plan, 36. p.

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

6. 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.

7. United States Environmental Protection Agency (USEPA). 1999. *Proposed Radon in Drinking Water Rule.* Office of Water. EPA 815-F-99-006. October.

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 Bay View, Maryland Quad
USGS Topographic 7.5 minute Quadrangle Map – 1992 North East, Maryland Quad

Appendix A

Detected Compounds in Ground-Water Samples

SUMMARY OF DETECTED COMPOUNDS IN CECIL WOODS MOBILE HOME PARK WATER SAMPLES				
Plant ID	**Sample Date**	**Contaminant Name**	**Result**	**Unit**
Volatile Organic Compounds				
01	08-Apr-97	BROMODICHLOROMETHANE	0.6	ug/L
01	30-Jan-97	CHLOROFORM	1.2	ug/L
01	30-Jan-97	DIBROMOCHLOROMETHANE	1	ug/L
01	08-Apr-97	DIBROMOCHLOROMETHANE	0.9	ug/L
01	05-Dec-96	ETHYLBENZENE	1.8	ug/L
01	30-Jan-97	ETHYLBENZENE	2.2	ug/L
01	08-Apr-97	ETHYLBENZENE	3.3	ug/L
01	01-Jul-97	ETHYLBENZENE	1	ug/L
01	05-Dec-96	ISOPROPYLBENZENE	1.6	ug/L
01	28-Aug-00	METHYL-TERT-BUTYL-ETHER	0.5	ug/L
01	30-Jan-97	TOLUENE	1	ug/L
01	05-Dec-96	XYLENES, TOTAL	7.3	ug/L
01	30-Jan-97	XYLENES, TOTAL	10.6	ug/L
01	08-Apr-97	XYLENES, TOTAL	14.7	ug/L
01	01-Jul-97	XYLENES, TOTAL	10	ug/L
Synthetic Organic Compounds				
01	04-Mar-97	DI(2-ETHYLHEXYL) PHTHALATE	0.85	ug/L
01	04-Mar-97	DI(2-ETHYLHEXYL) PHTHALATE	1.41	ug/L
01	28-Aug-00	DI(2-ETHYLHEXYL) PHTHALATE	0.8	ug/L
Inorganic Compounds				
01	13-Dec-89	BARIUM	0.1	mg/L
01	13-Dec-89	BARIUM	0.2	mg/L
01	10-Dec-96	BARIUM	0.2	mg/L
01	06-Dec-99	BARIUM	0.17	mg/L
01	13-Dec-89	CHLORIDE	4	mg/L
01	13-Dec-89	CHLORIDE	7	mg/L
01	30-Jan-97	CHLORIDE	1	mg/L
01	08-Apr-97	CHLORIDE	0.6	mg/L
01	01-Jul-97	CHLORIDE	0.5	mg/L
01	03-Nov-97	CHLORIDE	0.3	mg/L
01	06-Dec-99	CHROMIUM	0.002	mg/L
01	13-Dec-89	FLUORIDE	0.12	mg/L
01	13-Dec-89	FLUORIDE	0.13	mg/L
01	10-Dec-96	FLUORIDE	0.13	mg/L
01	10-Dec-96	FLUORIDE	0.14	mg/L
01	06-Dec-99	FLUORIDE	0.115	mg/L
01	28-Aug-00	FLUORIDE	0.15	mg/L
01	13-Dec-89	IRON	3.3	mg/L
01	13-Dec-89	IRON	9.54	mg/L
01	13-Dec-89	MANGANESE	0.46	mg/L
01	13-Dec-89	MANGANESE	0.19	mg/L
01	10-Dec-96	NITRITE	0.006	mg/L
01	10-Dec-96	NITRITE	0.015	mg/L
01	13-Dec-89	SODIUM	6.4	mg/L

SUMMARY OF DETECTED COMPOUNDS IN CECIL WOODS MOBILE HOME PARK WATER SAMPLES				
Plant ID	**Sample Date**	**Contaminant Name**	**Result**	**Unit**
Inorganic Compounds				
01	13-Dec-89	SODIUM	7.8	mg/L
01	10-Dec-96	SODIUM	9.6	mg/L
01	10-Dec-96	SODIUM	6.1	mg/L
01	06-Dec-99	SODIUM	6	mg/L
01	28-Aug-00	SODIUM	24	mg/L
01	10-Dec-96	SULFATE	5.2	mg/L
01	10-Dec-96	SULFATE	7	mg/L
General Water Quality Parameters				
01	13-Dec-89	ALKALINITY, TOTAL	45	mg/L
01	13-Dec-89	ALKALINITY, TOTAL	57	mg/L
01	13-Dec-89	pH	7.1	s.u.
01	13-Dec-89	pH	7.2	s.u.
01	10-Dec-96	pH	7.3	s.u.
01	10-Dec-96	pH	6.9	s.u.
01	30-Jan-97	pH	6.9	s.u.
01	08-Apr-97	pH	7.3	s.u.
01	01-Jul-97	pH	7.7	s.u.
01	03-Nov-97	pH	7.5	s.u.
01	13-Dec-89	TOTAL DISSOLVED SOLIDS (TDS)	111	mg/L
01	13-Dec-89	TOTAL DISSOLVED SOLIDS (TDS)	120	mg/L
01	13-Dec-89	TURBIDITY	0.6	mg/L
01	13-Dec-89	TURBIDITY	1.2	mg/L
Radionuclides				
01	29-May-01	GROSS ALPHA	1	pCi/L
01	30-Jan-97	GROSS BETA	4	pCi/L
01	08-Apr-97	GROSS BETA	4	pCi/L
01	01-Jul-97	GROSS BETA	4	pCi/L
01	03-Nov-97	GROSS BETA	4	pCi/L
01	29-May-01	GROSS BETA	4	pCi/L
01	28-Aug-00	RADON-222	210	pCi/L

s.u. – standard units.