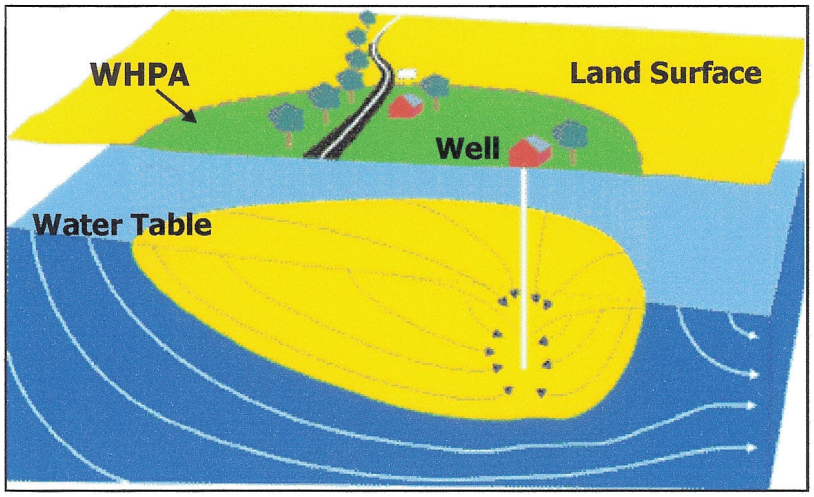
SOURCE WATER ASSESSMENT

FOR THE CITY OF SALISBURY

WICOMICO COUNTY, MD



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SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted an assessment of the vulnerability of the City of Salisbury's water supply sources to contamination. The required components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are: 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Salisbury's water supply is an unconfined Coastal Plain aquifer, known as the Quaternary System. The City currently uses 11 wells from two Plants to obtain their drinking water. The two northernmost wells draw water from the deeper and highly productive paleochannel sediments within the Quaternary System. These two wells are referred to as the Paleo wells. The other 9 wells are located along the banks of the South Prong of the Wicomico River (Beaverdam Creek). These wells are referred to as the Park wells. The Source Water Assessment Areas were delineated by the Maryland Geological Survey using U.S. EPA approved methods specifically designed for each source.

Potential sources of contamination within the assessment area were identified based on site visits, database reviews and land use maps. Well information and water quality data were also reviewed. Figures showing land uses and potential contaminant sources within the Source Water Assessment Areas and an aerial photograph of the well locations are enclosed at the end of the report.

The susceptibility analysis for Salisbury's 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 all of Salisbury's wells are susceptible to contamination by volatile organic compounds, and synthetic organic compounds. In addition, Salisbury's Park well field is susceptible to contamination by nitrate. The water supply is not susceptible to other regulated inorganic compounds, and radiological or microbiological contaminants.

INTRODUCTION

The City of Salisbury is located in central Wicomico County, and is the commercial hub of the lower Delmarva Peninsula (Figure 1). The City is within the drainage basin of the Upper Wicomico River that includes the North Prong Wicomico River and Beaverdam Creek tributaries respectively (Figure 2). The City owns and operates its water supply system that serves a population of 25,000 and has 6300 connections. Two well fields supply the water, each with its own water treatment plant. The Park well field has eight active production wells and one standby well all located in a city park along a dammed section of the South Prong Wicomico River (Figure 1). The Paleochannel well field is located to the North of Salisbury along Naylor Mill Road. It consists of two production wells completed in the highly productive paleochannel sediments of the Salisbury aquifer (Figure 1).

WELL INFORMATION

Well information was obtained from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports and published reports. A review of well data and sanitary surveys of Salisbury's water system indicates that all of the wells from both the Park and Paleo well fields meet current well construction standards for grouting and casing. The production wells in both well fields are located in enclosed and locked structures. Many of the original Park wells have been replaced by new wells that were drilled adjacent to the original well locations. The replacement wells were given the same numbering system as the original well followed by subsequent letters a, b, etc. According to the City of Salisbury's Department of Public Works, Park Wells 1-14, 16, and 7a have all been abandoned. Table 1 contains a summary of the supply wells construction data.

PLANT ID	SOURCE NAME	PERMIT NO.	TOTAL DEPTH (ft.)	CASING DEPTH (ft.)	YEAR DRILLED
01	PARK WELL 2A	WI730382	54	38	1973
01	PARK WELL 6A (standby)	WI810603	61	41	1983
01	PARK WELL 7B	WI812385	68	N/a	1986
01	PARK WELL 8A	WI810602	66	44	1983
01	PARK WELL 10A	WI737219	60	34	1982
01	PARK WELL 14A	WI732356	72	52	1976
01	PARK WELL 16A	WI812575	62	42	1986
01	PARK WELL 17A	WI930107	90	40	1994
01	PARK WELL 18	WI930106	92	42	1994
02	PALEO WELL 1	WI670195	210	81	1967
02	PALEO WELL 2	WI880251	195	105	1989

Table 1. City of Salisbury Well Information

The yields of the current Park supply wells range from 418 to 1280 gallons per minute (gpm). Paleochannel Wells 1 and 2 yield 3400 and 2520 gpm respectively.

Water Appropriation Permit No.WI1973-G001 allows the City to use an average of 7,600,000 gallons per day (gpd) and 10,000,000 gpd in the month of maximum use. Based on reported pumpage from January thru July 2002, the City used an average of 5,510,768 gpd and 6,216,581 gpd in July, which was the month of maximum use. The Park Water Treatment Plant averaged 2,231,926 gpd whereas the Paleo Plant averaged 3,278,842 gpd during the same timeframe.

HYDROGEOLOGY

The Salisbury area lies within the unconsolidated sediments of the Atlantic Coastal Plain Physiographic Province. The sediments were deposited in a southeasterly thickening wedge extending from the Fall Line to the Continental Shelf (Banks, Klohe, & Battigelli, 2001). The Coastal Plain sediments consist of unconsolidated beds of clay, silt, sand, gravel, and shells. The sediments consist of non-marine to marginal-marine deposits of Cretaceous age, overlain by marine, estuarine, and fluvial sediments of Tertiary to Quaternary age (Andreasen & Smith, 1997). All of the Salisbury municipal wells are completed in the shallow, unconfined Quaternary System (also referred to as the Salisbury aquifer). The Salisbury aquifer consists of course sand and gravel with transmissivity values ranging from 22,000 feet squared per day in the Park well field, to as much as 53,500 feet squared per day in the Paleochannel well field (Andreasen & Fewster, 2001). The geologic formations that comprise the Salisbury aquifer are the Beaverdam Sand and Pensauken Formation respectively. The Salisbury aquifer is separated from the Manokin aquifer by a 25 to 65 feet low permeability, bluish-gray clay confining layer (Andreasen & Fewster, 2001).

Low topographic relief characterizes the Salisbury area. As a result, drainage ditch networks for irrigation purposes are common throughout the area. Water-table depths range from 15 to 20 feet above sea level in the Paleochannel well field, and less than 10 feet above sea level at the Park well field (Andreasen & Smith, 1997). In general, the shallow Salisbury aquifer may therefore be prone to contamination from land use activities at the ground surface.

The most distinctive subsurface feature in the Salisbury area is an unusually thick (>200 ft.) paleochannel deposit cut into the eroded confining layer and the Manokin aquifer (Andreasen & Smith, 1997). The course sand and gravel channel is between 0.6 to 1.8 miles wide, and from about 90 to 200 feet below sea level (Andreasen & Smith, 1997). The channel extends from the northwestern corner of Wicomico County to just north of Salisbury (Weigle, 1972). The paleochannel is a major water resource for the City of Salisbury's municipal water supply.

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment area for the system. In 1993, the Maryland Geological Survey (MGS) conducted a ground water flow modeling study

in cooperation with the City of Salisbury Department of Public Works, and the U.S. Geological Survey to determine the areas contributing recharge to the city's well fields under current and future pumping conditions. In 1997, MGS in cooperation with MDE and the City expanded this study to include Park Wells 17a, 18, and other public supply wells in the Upper Wicomico River Basin. MGS used the three-dimensional numerical ground water flow model (MODFLOW), and a semi-analytical particle-tracking program (MODPATH) to delineate the WHPAs for each of the Salisbury well fields. Specific details regarding the ground water flow modeling, study area, and delineation methods can be found in the MGS Report of Investigations No. 65 (Andreasen & Smith, 1997).

Contributing areas were determined based on time-of travel (TOT) criterion of between 1, 10, 20, and 50 years respectively. The WHPAs delineated using a maximum of 1-year, 10-year, 20-year, and 50-year TOT criterion are referred to as Zones 1, 2, 3, and 4 respectively (Figure 2). MGS used a range of travel times when describing each Zone. For example, the Zone 1 TOT range is up to 1 year, the Zone 2 TOT range is between 1 to 10 years, Zone 3 is between 10 to 20 years, and Zone 4 is between 20 to 50 years respectively (Andreasen & Smith, 1997). A 1-year time-of-travel is generally used for source water assessments based on the maximum survival time of microbial organisms in ground water. A contaminant that is present within a Zone 2 WHPA, for example, would take between 1 to 10 years to reach the well (if it moves at the same rate as the ground water), using the permitted quantity. This will provide adequate time for facilities to address chemical contamination before it reaches the wells. Note that the contributing areas for Zones 2, 3, and 4 form relatively narrow elongated shapes ranging from 0.76 to 3.3 miles in length, and occurring at distances up to 1.1 miles from the wells (Figures 2).

The total area of the combined Paleochannel WHPAs is 3,105 acres. The combined Park WHPAs total area is 1,877 acres. Note that there are two separate contributing areas for Park Wells 2a, 6a, and 8a respectively. The primary ground water capture zones are from the east, whereas the secondary capture zones are from the southeast, in the general direction of Snow Hill Road (Figure 2).

POTENTIAL SOURCES OF CONTAMINATION

Potential sources of contamination are classified as either point or non-point sources. Examples of point sources of contamination are leaking underground storage tanks, landfills, ground water discharge permits, large scale feeding operations and ground water contamination sites. These sites are generally associated with commercial or industrial facilities that use chemical substances that may, if inappropriately handled, contaminate ground water via a discrete point location. Non-point sources of contamination are associated with certain types of land use practices such as the use of pesticides, application of fertilizers, animal wastes, or septic systems that may lead to ground water contamination over a larger area. The WSP conducted a field survey of the WHPAs in September 2002 and met

with Salisbury Water Plant Operators to discuss water quality issues, to observe well integrity and to verify the locations of the supply wells.

Point Sources

A review of MDE contaminant databases as well as the field survey revealed several potential point sources of contamination in and adjacent to the Salisbury WHPAs. Figure 2 identifies underground storage tanks (USTs), leaking underground storage tanks (LUSTs), above ground storage tanks (ASTs), ground water discharge (GWD) sites, controlled hazardous substance generators (CHS), ground water contamination (GWC) sites, and sanitary landfill (SLF) sites. In addition, facilities such as auto body and repair shops (MISC) that handle and use chemicals are also shown on Figure 2. Table 2 lists the facilities identified and their potential types of contaminants. The contaminants are based on generalized categories and often the potential contaminant depends on the specific chemicals and processes being used or which had been used at the facility. The potential contaminants are not limited to those listed. Potential contaminants are grouped as Volatile Organic Compounds (VOC), Synthetic Organic Compounds (SOC), Inorganic Compounds (IOC), Heavy Metals (HM), Nitrate/Nitrite (NN), and Microbiological Pathogens (MP).

Several facilities that have underground storage tanks located within or near the Salisbury WHPAs have had their tanks replaced with newer ones due to leaks or non-compliance with current State tank regulations. Other facilities had their USTs permanently removed due to leaks or non-compliance issues. Newer tanks are less likely to leak due to current construction standards, however, leaks may be possible in underground piping or by overfilling. The facilities within the WHPAs that have had their tanks permanently removed are not shown in Figure 2 unless there was a subsurface leak or spill that may have impacted the ground water supply. A summary of the MDE Oil Control Program cases within the Salisbury WHPAs that had or still have known petroleum contamination can be found in Appendix A. The location of the open LUST case is mapped on Figure 2. The Oil Control Program has since closed the remaining cases within the WHPAs after it was determined that the levels of VOC contamination were no longer a threat to public health. The reader may contact the Oil Control Program for additional information regarding any of the Cases described in this report.

ID	Type[1]	Site Name	Address	Potential Contaminant[1]
1	SLF	West Rd. Rubble Landfill	West Rd.	VOC, HM, SOC, NN, MP
2	MISC	BioGro	West Rd.	MP, NN, HM
3	AST	Bennett Airport	Near Bennett Park Dr.	VOC, HM
4	MISC	Sam's Club	2700 N. Salisbury Blvd.	VOC, MP
5	MISC	Wal-Mart	2702 N. Salisbury Blvd.	VOC, SOC
6	MISC	Home Depot	N. Salisbury Blvd.	VOC,HM, SOC
7	MISC	Target	N. Salisbury Blvd.	VOC
8	MISC	Evans Builders	706 Naylor Mill Rd.	VOC,HM
9	UST	Penske Truck Rental / Pep-Up Gas	702 Naylor Mill Rd.	VOC,HM
10	MISC	Air Products	630 Naylor Mill Rd.	VOC,HM
11	MISC	National Vault Co.	626 Naylor Mill Rd.	VOC,HM
12	MISC	Precision Tube Coaxitube Div.	620 Naylor Mill Rd.	VOC,HM, SOC
13	MISC	Hill's Marine Service	602 Naylor Mill Rd.	VOC,HM
14	MISC	Sealy Upholstery	510 Naylor Mill Rd.	VOC,HM
15	GWD	First State Packaging	511 Naylor Mill Rd.	VOC,HM
16	UST	Wicomico Co. Detention Center	411 Naylor Mill Rd.	VOC
17	CHS	K&L Microwave	2300 Northwood Dr.	VOC,HM, SOC
18	CHS	Maxum Marine	2305 Northwood Dr.	VOC,HM, SOC
19	LUST	Conectiv (formerly Delmarva Power)	2530 N. Salisbury Blvd.	VOC, HM
20	MISC	Lowe's	2606 N. Salisbury Blvd.	VOC,HM, SOC
21	GWD	Courtesy Chevrolet	2531 N. Salisbury Blvd.	VOC, HM
22	UST	Shell Gas Station	N. Salisbury Blvd.	VOC
23	MISC	Vernon's Transmissions	312 Priscilla St.	VOC,HM
24	UST	Tiny Tot Inc.	1101 Robert St.	VOC
25	UST	East Salisbury Thirsty's	1102 E. Church St.	VOC
26	MISC	SOS Auto Service	1208 Old Ocean City Rd.	VOC, HM
27	UST	MSC / Mailmovers	112 Moss Hill Ln.	VOC
28	UST	Royal Farm / Enroy Gas	1300 Old Ocean City Rd.	VOC
29	UST	Chevron Gas	Old Ocean City Rd.	VOC
30	UST	Salisbury Ward Meetinghouse	106 Greenlawn Ln.	VOC
31	CHS	Perdue Inc.	Old Ocean City Rd.	VOC,HM,SOC,MP,NN
32	UST	Hobbs Road Amoco	31373 Old Ocean City Rd.	VOC, HM
33	UST	Winterplace Market / Texaco	6731 Hobbs Rd.	VOC
34	MISC	Ted Lansing	6701 Hobbs Rd.	VOC, HM
35	GWC, CHS	Sharp Energy (formerly Salisbury Town Gas)	520 Commerce St.	VOC,HM, SOC
36	CHS	Peninsula Orthopaedic Assoc.	111 Davis St.	VOC,HM, SOC
37	UST	Bob White Office Bldg.	800 East Main St.	VOC
38	UST	High's Store # 34	834 E. Main St.	VOC
39	UST	Parkway Exxon	818 E. Main St.	VOC, HM

Table 2. Potential Contaminant Point Sources within or near Salisbury's Wellhead Protection Areas (See Figure 2 for locations)

ID	Type[1]	Site Name	Address	Potential Contaminant[1]
40	UST	Grant's Texaco	111 Truitt St.	VOC, HM
41	UST	Salisbury Mall	351 Civic Ave.	VOC
42	UST	Exxon Tiger Express	1801 Autumn Grove Ct.	VOC
43	MISC	Wicomico Co. (Perdue) Baseball Stadium	Hobbs Rd. & MD Rt. 50	NN,MP, SOC
44	MISC	Holt Paper & Chemical Co.	31375 John Deere Dr.	VOC,HM, SOC
45	CHS	Tyndalls, Inc.	31415 John Deere Dr.	VOC,HM,SOC
46	MISC	Atlantic & Hastings Printers	31545 Winterplace Pkwy.	VOC,HM, SOC
47	MISC	Winterplace Animal Hospital	31611 Winterplace Pkwy.	VOC,HM, SOC
48	CHS	Harvard Custom Manufacturing	600 Glen Ave.	VOC,HM,SOC
49	UST	Pepsi Cola Bottling Co. of Salisbury	330 Snow Hill Rd.	VOC, HM
50	UST	Discount Carpet	358 Snow Hill Rd.	VOC
51	CHS	Expert Collision & Repair	420 Snow Hill Rd.	VOC,HM, SOC
52	UST	Hastings Brothers Printers	421 Snow Hill Rd.	VOC,HM,SOC
53	GWD	Johnson-McKee Animal Hospital	404 Snow Hill Rd.	VOC,HM, SOC
54	UST	Exxon	Snow Hill Rd.	VOC,HM
55	UST	Southeast Beverage, Inc.	444 Snow Hill Rd.	VOC, HM
56	UST	Prince Street Elementary School	400 Prince St.	VOC
57	MISC	Advantage Rent-A-Car	610 Snow Hill Rd.	VOC, HM
58	UST	Super Soda Center	610 Snow Hill Rd.	VOC
59	MISC	Potteiger Raintree Roofing & Sheet Metal	Shiloh St.	VOC, HM
60	MISC	D& M Lawn & Garden / Duron Paint	703 Snow Hill Rd.	VOC,HM, SOC
61	MISC	Printery Catalogue Direct	800 Snow Hill Rd.	VOC,HM, SOC
62	MISC	Chesapeake Surgery Center	804 Snow Hill Rd.	VOC,HM, SOC
63	MISC	Delmarva Flooring	810 Snow Hill Rd.	VOC, HM
64	MISC	Budweiser	Snow Hill Rd.	VOC
65	MISC	Gunners Auto Sales	Snow Hill Rd.	VOC, HM
66	UST	Texaco	Snow Hill Rd. & Lincoln Ave.	VOC, HM
67	UST	Shell Gas	East College Ave.	VOC, HM
68	UST	Royal Farm / Enroy Gas	800 East College Ave.	VOC
69	UST	Express Lane Exxon	4912 Snow Hill Rd.	VOC

Table 2 (cont.). Potential Contaminant Point Sources within or near Salisbury's Wellhead Protection Areas (see Figure 2 for locations)

[1] UST = underground storage tanks, LUST = leaking underground storage tanks, AST = above ground storage tanks
CHS = controlled hazardous substance generators, GWD = ground water discharge sites
GWC = ground water contamination sites, SLF = sanitary landfills, MISC = miscellaneous sites
VOC = volatile organic compounds, SOC = synthetic organic compounds
MP = microbiological pathogens, HM = Heavy Metals, NN = nitrate/nitrite

Several inspections of facilities located within and near the WHPAs were conducted by MDE staff to determine the potential of any unpermitted ground water discharges (e.g. open floor drains) to the shallow Salisbury aquifer. One such facility received a notice of violation (NOV). The details of this inspection are discussed in Appendix B. Reports of additional sites that were inspected are available from MDE.

Ground water discharge permits were issued to two facilities located within the Salisbury Wellhead Protection Areas. The facilities are shown on Figure 2 and listed in the preceding table. Summary reports and fact sheets discussing the general permit details and requirements are found in Appendix C.

The West Road Rubble Landfill (also known as Roland Dashiell & Sons) is located within the Paleochannel WHPA Zone 4 (Figure 2). Recent information from the MDE Solid Waste Program revealed that the facility has stopped accepting waste until certain legal issues are resolved. Appendix D provides a brief site overview of this facility.

Based on a MDE Waste Management Administration database review, the only site in the vicinity of the Salisbury wellhead protection areas to have historical ground water contamination concerns is the former Salisbury Town Gas Light (now Sharp Energy) facility (Figure 2, ID #35). According to a 1997 MGS study by Andreasen & Smith, the ground water flow direction determined from forward particle tracking from this facility is toward the South Prong Wicomico River, and therefore should not present a water quality threat to the Park supply wells. Appendix E provides general site information and fact sheet for this facility. The reader may contact the specific programs within the MDE Waste Management Administration for additional information on any of the potential contaminant sites described in this report.

The storage of heating oil in underground tanks, and spills during the transportation of chemical products within the WHPAs, are also potential sources of contaminants that could reach the water supply. Major transportation corridors include MD Routes 12, 13, 50, 346, 350, and the railroad line that runs through the Paleochannel WHPA Zone 2 (Figure 2).

Non-Point Sources

The Maryland Office of Planning's 2000 digital land use map for Wicomico County was used to determine the predominant types of land use in the Salisbury WHPAs (Figure 3). The land use categories were calculated separately for the Park and Paleochannel WHPAs respectively. The breakdown of land use types for each WHPA is shown on Tables 3a, and 3b. Note that cropland followed by forest make-up the largest portion of land use in the Paleochannel WHPAs, whereas the land use in the Park WHPAs is primarily residential and commercial (Tables 3a & 3b).

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	285.38	15.20
Medium Density Residential	433.14	23.07
High Density Residential	45.12	2.41
Commercial	395.17	21.05
Industrial	18.20	0.97
Open Urban Land	28.26	1.51
Cropland	359.96	19.18
Pasture	43.80	2.33
Forest	242.06	12.89
Feeding Operations	26.16	1.39
Total Area	1877.24	100.00

Table 3a. Land Use Summary of the Salisbury Park WHPA (See Figure 3)

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	292.76	9.43
Medium Density Residential	76.33	2.46
Commercial	230.93	7.44
Industrial	17.09	0.55
Extractive	45.36	1.46
Open Urban Land	24.68	0.79
Cropland	1669.43	53.76
Pasture	16.35	0.53
Forest	622.07	20.03
Feeding Operations	110.27	3.55
Total Area	3105.27	100.00

Table 3b. Land Use Summary of the Salisbury Paleochannel WHPA (See Figure 3)

Agricultural land (cropland, pasture and feeding operations) is commonly associated with nitrate loading of ground water. Cropland also represents a potential source of SOCs depending on the use of pesticides. Historical pesticide use may be as significant or more significant than current usage, as previous usage rates were not protective of ground water resources. In addition, pasture and feeding operations may be potential sources of microbiological pathogens due to animal wastes. Chicken manure used as a fertilizer is another common source of nitrate in Wicomico County. Sludge application is a potential non-point source of nitrate, microbiological pathogens, and heavy metals. Figure 2 indicates a sludge application site within the Paleo Well 1 WHPA Zone 2. It must be noted, however, that regulations governing sludge application rates and pre-treatment methods are designed to protect ground water resources from heavy metals, excessive nutrients, and pathogens. The use of private septic systems and lawn maintenance and landscaping activities in residential areas are potential non-point sources of nitrates and SOCs to ground water. Commercial

areas are associated with facilities that may have point sources of contamination as described in the previous section.

The Maryland Office of Planning's 1995 Wicomico County Sewer Map was used to break down the sewerage coverages within the Salisbury WHPAs (Figure 4). The sewer service categories were calculated separately for the Park and Paleochannel WHPAs respectively. Tables' 4a and 4b summarize the breakdown of sewer service for each of the WHPAs. It must be noted that the categories showing future service now most likely have service, since the map is based on 1995 data. The tables demonstrate that sewer service is not planned for the majority of the wellhead protection areas.

SEWER SERVICE AREA CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
No Planned Service	1342.31	71.50
Existing Service Area	460.63	24.54
Final Planning Area	73.09	3.89
Service Within 3 to 5 Years	1.23	0.07
Total Area	1877.26	100.00

Table 4a. Sewer Service Area Summary of the Salisbury Park WHPA (see Figure 4)

SEWER SERVICE AREA CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
No Planned Service	2691.46	86.67
Existing Service Area	373.86	12.04
Final Planning Area	39.95	1.29
Total Area	3105.27	100.00

Table 4b. Sewer Service Area Summary of the Salisbury Paleochannel WHPA (see Figure 4)

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database and system files for Safe Drinking Water Act contaminants. The State's SWAP defines a threshold for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is at or greater than 50% of a MCL, this assessment will describe the sources of such a contaminant and, if possible, locate the specific sources which are the cause of the elevated contaminant level. All data reported is from the finished (treated) water unless otherwise noted. The Salisbury water system has 2 plants or points of entry with differing methods of treatment. The Park and Paleo Plants both use post gaseous chlorination for disinfection, polyphosphate inhibitors for corrosion control, and fluoridation for the strengthening of teeth. The Park Plant also utilizes post pH adjustment for corrosion control, and slat tray aeration for carbon dioxide, and volatiles removal. The Paleo Plant also incorporates pre-gaseous chlorination, pressure sand filtration, permanganate, and pH adustment for the purpose of iron removal.

A review of the monitoring data since 1991for Salisbury's water indicates that the water supply meets the current drinking water standards. The water quality sampling results are summarized on Table 5.

PLANT NAME	Nitrate		SOCs		VOCs		IOCs (except nitrate)		Radionuclides	
	No. of Samples	No. of samples > 50% MCL	No. of Samples	No. of samples > 50% MCL	No. of Samples	No. of samples > 50% MCL	No. of Samples	No. of samples > 50% MCL	No. of Samples	No. of samples > 50% MCL
Park	19	13	9	2	48	2	10	0	4	0
Paleo	13	0	6	2	29	1	11	0	3	0

Table 5. Summary of Water Quality Samples for Salisbury's Water Supply

Inorganic Compounds (IOCs)

IOCs were detected above 50% of the MCL at the Park Water Treatment Plant only (Table 5). The only IOC detected above 50% of the MCL was nitrate. The MCL for nitrate is 10 parts per million (ppm). The nitrate detections above 50% of the MCL for Salisbury's Park water supply are shown on Table 6. The average nitrate detects at the Paleo Plant since 1993 is 3.2 ppm.

PLANT NAME	CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT (ppm)
Park	NITRATE	10	6-Apr-94	5.7
Park	NITRATE	10	30-Mar-95	5.4
Park	NITRATE	10	16-Jan-96	5.6
Park	NITRATE	10	21-Feb-96	5.8
Park	NITRATE	10	27-Jan-97	5.8
Park	NITRATE	10	13-May-97	6.4
Park	NITRATE	10	31-Aug-98	6.6
Park	NITRATE	10	31-Aug-98	5.8
Park	NITRATE	10	2-Sep-98	6.9
Park	NITRATE	10	17-Nov-99	6.1
Park	NITRATE	10	19-Oct-00	5.1
Park	NITRATE	10	2-Nov-01	5.4
Park	NITRATE	10	23-Jul-02	5.3

Table 6. IOC Results Above 50% of the MCL for the Salisbury Wells Since 1993

Volatile Organic Compounds (VOCs)

In the past decade, the only VOC detected above 50% of the MCL in finished water was tetrachloroethylene (PCE). The MCL for PCE is 5 parts per billion (ppb). The PCE detections above 50% of the MCL in Salisbury's water supply are shown on Table 7. PCE was detected periodically in the Salisbury water supply from 1988 to 1994 and has not been detected since that time. Note that the PCE detects in bold above the respective MCL is from raw water testing of Park Wells 2, 5, 7, 8, 10, & 16. These wells have since been abandoned and replaced by Park Wells 2a, 7b, 8a, 10a, and 16a.

PLANT NAME	CONTAMINANT NAME	MCL (ppb)	SAMPLE DATE	RESULT (ppb)	REMARKS
Park	TETRACHLOROETHYLENE	5	2-Jul-91	4	Finished water
Park	**TETRACHLOROETHYLENE**	**5**	**19-Nov-91**	**10**	**Raw water (composite for Park Wells 5, 8, 10, & 16)**
Park	**TETRACHLOROETHYLENE**	**5**	**18-Dec-91**	**17**	**Raw water (Park Well 7)**
Park	**TETRACHLOROETHYLENE**	**5**	**18-Dec-91**	**7**	**Raw water (Park Well 5)**
Park	**TETRACHLOROETHYLENE**	**5**	**18-Dec-91**	**9**	**Raw water (Park Well 8)**
Park	**TETRACHLOROETHYLENE**	**5**	**18-Dec-91**	**6**	**Raw water (Park Well 2)**
Park	BENZENE	5	15-Mar-93	3.1	Raw water (Park Well 7b)
Park	**BENZENE**	**5**	**13-Apr-93**	**8.6**	**Raw water (Park Well 6a)**

Table 7. VOC Results above 50% of the MCL for Salisbury's Water Supply

The most widely detected VOC in Salisbury's water supply from 1988 thru 1993 was benzene. The average finished water detection level of benzene from both plants was 0.5 ppb. The MCL for benzene is 5 ppb. Raw water sampling of Wells 7b and 6a in 1993 showed benzene levels at 3.1, and 8.6 ppb respectively (Table 7). Since 1990, 1,2–dichloropropane has been detected periodically in sampling results primarily at the Park Water Treatment Plant. The average detection level was 1.1 ppb, and the MCL is 5 ppb. The VOC 1,1,1-trichloroethane was detected once at the Paleo Plant in 1990 at 0.8 ppb, and once at the Park Plant in 1999 at 0.5 ppb. The MCL for this contaminant is 200 ppb.

Four sets of sampling results at the Park Plant from October 2001 to July 2002 indicate detects of methyl-tert-butyl-ether (MTBE) at levels that range from 0.6 ppb to 3.7 ppb. MTBE does not currently have a MCL but has a taste and odor threshold of 20 ppb. MDE currently investigates areas for potential VOC sources when MTBE levels exceed 10 ppb.

Disinfecton byproducts known as trihalomethanes (THMs) were detected at both Plants at low levels since 1990. The total of the THM levels from each set of sampling data since 1990 ranged from 0.3 to 29 ppb. The current MCL for regulated systems is 80 ppb for the total of all the THMs. Disinfection byproducts are the result of a reaction between chlorine used for disinfection and organic material in the water supply.

Synthetic Organic Compounds (SOCs)

The only SOC that was detected at or above 50% of the MCL was 1,2-dibromo-3-chloropropane. Table 8 shows the levels of this SOC and its respective MCL. A sample in April of 2000 from the Paleo well field was found to be at the maximum allowable level. Repeat samples collected at both plants were also positive for this contaminant, as shown. Di(2-ethylhexyl phthalate) was detected once at 1.1 ppb on 4/4/00 at the Park Plant. The MCL for this SOC is 6 ppb. Low levels of phthalate are often found in the laboratory blanks and therefore these results are not interpreted to represent actual water quality.

PLANT NAME	CONTAMINANT NAME	MCL (ppb)	SAMPLE DATE	RESULT (ppb)
Park	1,2-DIBROMO-3-CHLOROPROPANE	0.2	4-Apr-00	0.1
Park	1,2-DIBROMO-3-CHLOROPROPANE	0.2	19-Jun-00	0.1
Paleo	**1,2-DIBROMO-3-CHLOROPROPANE**	**0.2**	**25-Apr-00**	**0.2**
Paleo	1,2-DIBROMO-3-CHLOROPROPANE	0.2	19-Jun-00	0.1

Table 8. SOC Results Above 50% of the MCL for Salisbury's Water Supply

Radionuclides

Gross alpha and gross beta were both detected at 2 picoCuries/Liter (pCi/L) on 2/4/99 at the Paleo Plant. Gross beta was also detected at 2 pCi/L on the same day at the Park Plant. The MCLs for gross alpha and gross beta are 15 (pCi/L) and 50 pCi/L respectively. Radon-222 was detected at 20 pCi/L at the Park Plant and 140 pCi/L at the Paleo Plant on 8/3/99. At present, there is no MCL for radon-222, however EPA has proposed an MCL of 300 pCi/L and an alternate MCL of 4000 pCi/L for community water systems if the State has a program to address the more significant risk from radon in indoor air.

Microbiological Contaminants

Raw water samples were collected and tested for bacteria for all of the supply wells to determine whether these sources are ground water under the influence of surface water (GWUDI). All of the Salisbury wells were initially classified as moderate risk to surface water influence and required one raw water sample to be collected as soon as possible after a minimum of 0.5 inches of rainfall in 24 hours had occurred. As shown in Table 9, all results were negative for the presence of total and fecal coliform bacteria.

SOURCE NAME	RAIN DATE	RAIN AMOUNT (inches)	REMARK	SAMPLE DATE	TEMP. (^{0}C)	pH	TURBIDITY (NTU)	TOTAL COLIFORM (col/100ml)	FECAL COLIFORM (col/100 ml)
Park 2a	9-Dec-98	1.22	WET	11-Dec-98	17.4	6.04	44.5	-1.1	-1.1
Park 6a	9-Dec-98	1.22	WET	11-Dec-98	15.1	5.78	8.3	-1.1	-1.1
Park 7b	11-Dec-98	1.22	WET	11-Dec-98	16.7	5.72	0.0	-1.1	-1.1
Park 8a	13-Dec-98	1.42	WET	14-Dec-98	16.0	5.83	2.0	-1.1	-1.1
Park 10a	9-Dec-98	1.22	WET	11-Dec-98	16.1	5.73	0.2	-1.1	-1.1
Park 14a	9-Dec-98	1.22	WET	11-Dec-98	17.7	5.47	0.1	-1.1	-1.1
Park 16a	13-Dec-98	1.42	WET	14-Dec-98	17.1	5.92	0.0	-1.1	-1.1
Park 17a	13-Dec-98	1.42	WET	14-Dec-98	16.6	5.48	7.3	-1.1	-1.1
Park 18	13-Dec-98	1.42	WET	14-Dec-98	17.0	5.82	21.5	-1.1	-1.1
Park 18		0	DRY	15-Jan-99	15.2	6.04	0.3	-1.1	-1.1
Park 18		0	DRY	17-Jan-99	15.3	6.24	1.8	-1.1	-1.1
Paleo 1	9-Dec-98	1.22	WET	10-Dec-98	16.3	6.10	0.3	-1.1	-1.1
Paleo 2	9-Dec-98	1.22	WET	10-Dec-98	16.2	6.53	0.4	-1.1	-1.1

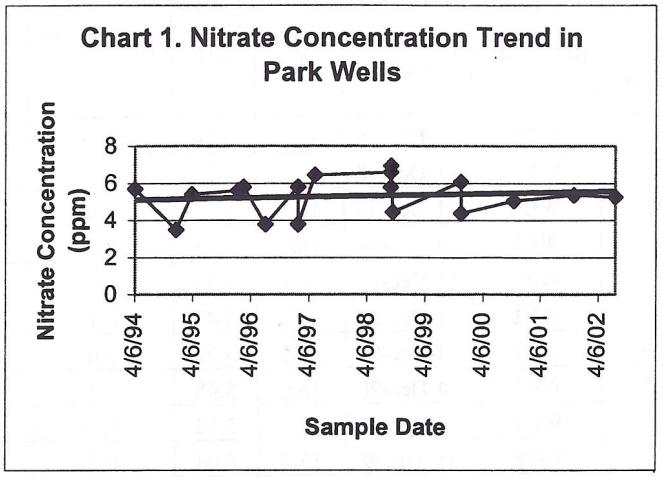
Table 9. Raw Water GWUDI Test Results for Salisbury's Supply Wells

SUSCEPTIBILITY ANALYSIS

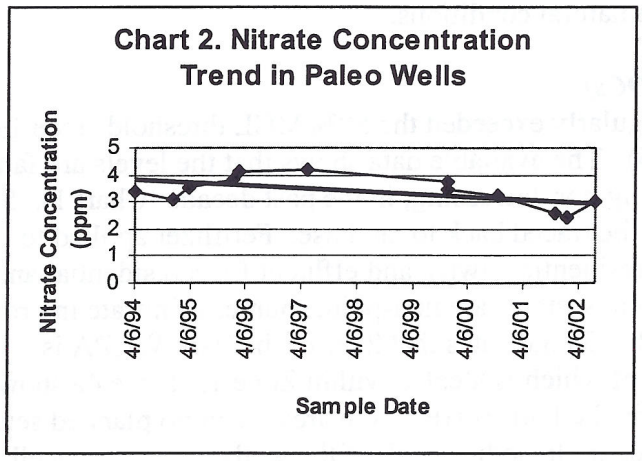
Salisbury's wells obtain water from a shallow unconfined Coastal Plain aquifer. Wells in unconfined aquifers are generally vulnerable to any activity on the land surface that occurs within the WHPA. Therefore, managing this area to minimize the risk to the aquifer and continued routine monitoring of contaminants is essential in assuring a safe drinking water supply. The susceptibility of the wells to contamination is determined for each group of contaminants based on the following criteria: (1) available water quality data, (2) presence of potential contaminant sources in the WHPA, (3) aquifer characteristics, (4) well integrity, and (5) the likelihood of change to the natural conditions.

Inorganic Compounds (IOCs)

Nitrate levels have regularly exceeded the 50% MCL threshold since 1994 at the Park Plant (Table 6). The available data shows that the levels are fairly steady, neither increasing nor decreasing, in the past decade (Chart 1). Sources of nitrate can generally be traced back to land use. Fertilizer applied to agricultural fields and residential lawns, and effluent from residential and commercial on-site septic systems are non-point sources of nitrate in ground water. A review of Table 3a indicates that 23% of the Park WHPA is agricultural land, none of which is located within Zone 1. Table 4a shows that 71.5% of the land within the Park WHPA is in areas with no planned sewer service based on 1995 data. In addition, all of the wells in the Park well field are completed in a shallow unconfined aquifer at depths of 92 feet or less (Table 1). Therefore, based on the presence of potential non-point sources of nitrate within the Park WHPA coupled with the available water quality data, and shallow well depths, the Park well field is susceptible to nitrate contamination.



In contrast, no IOC detects above 50% of the MCL have been reported over the past nine years of sampling data at the Paleo Water Treatment Plant. The available data shows a slightly decreasing trend of nitrate levels in the past decade (Chart 2). The average nitrate level since 1993 is 3.2 ppm, well below the MCL of 10 ppm, even though several non-point sources of nitrate exist within the Paleo WHPA. A review of Table 3b indicates that 58% of the Paleo WHPA is agricultural land. However, very little of this land is located within the WHPA Zone 1, as this area is predominantly forest and open urban land (see Figure 3). Table 4b and Figure 4 indicate that 87% of the Paleo WHPA is in areas with no planned sewer service based on 1995 data. Additionally, a sludge application site is present within the WHPA Zone 2 as shown in Figure 2. However, as noted earlier in the report, sludge application rates are regulated to prevent ground water contamination from nitrogen and heavy metals.



The wells are completed in the deeper Paleochannel sediments, where the confining bed at the base of the Salisbury aquifer is breached, resulting in a hydraulic interconnection with the underlying confined Manokin aquifer (Andreasen & Smith, 1997). Typically, nitrate levels are low in ground water

originating from confined aquifers. Therefore, the water withdrawn from the Paleochannel sediments is a mixture of Manokin aquifer water generally low in nitrates with the shallower Salisbury aquifer that may be higher in nitrates. The resulting "blended" water that is withdrawn by the Paleo wells may therefore be lower in nitrates, as is indicated in the sampling results. MGS determined that the estimated age of the water withdrawn from the paleochannel wells dates from 1954-1961, or from 1975-present (Andreasen & Smith, 1997). It is therefore presumed that the ground water is a mixture of older Manokin aquifer water and younger Salisbury aquifer water. Based on the available water quality data, and the hydrogeologic characteristics of the paleochannel sediments, the Paleo well field is **not** susceptible to nitrates.

Additionally, Salisbury's water supply is **not** susceptible to other regulated inorganic compounds other than nitrate, based on available water quality data.

Volatile Organic Compounds (VOCs)

Tetrachloroethylene (PCE), and benzene are the only VOCs that were detected in Salisbury's water supply above 50% of their respective MCLs of 5 ppb (Table 7). PCE is an industrial and commercial solvent used in factories and dry cleaning. Benzene is a component of gasoline that may be leached from underground storage tanks, and landfills, or discharged from factories. Benzene has been detected in past sampling results at both plants. MTBE has been detected in four sets of sampling results at the Park Plant since October 2001. MTBE is used as an additive to gasoline for cleaner burning. Low levels of 1,2-dichloropropane have also been detected in sampling results since 1990. This VOC solvent is used in industrial chemical factories, and as a soil fumigant. The compound, 1,1,1-trichloroethane was detected once at both plants from available sampling results. This VOC is used in industry as a metal degreaser, and is a compound in adhesives, aerosols, textiles, paints, and inks.

There are numerous VOC sources within the Salisbury WHPAs that may contribute to the contamination of the City's wells (Figure 2 & Table 2). Salisbury's Park wells are located in the heart of the City's commercial district, and both well fields have commercial, industrial, and residential land use within their respective Zone 2 WHPAs (Figure 3). Table 3a shows that 41% of the Park WHPA is residential property. Leaking home heating fuel tanks located within the WHPAs may also have the potential to contaminate ground water. Additionally, the major transportation lines (including railroads) are a concern in the event of a petroleum or chemical spill that occurs within the WHPAs.

Many sites have undertaken ground water cleanup under the direction of MDE; others are monitoring, and have not found contamination. Still other sites need further investigation to determine if they are a potential risk.

Potential sources of VOCs are present in both of the Salisbury WHPAs. The wells draw water from a shallow, unconfined aquifer in the Coastal Plain. Available water quality data indicate several VOC detects from both plants, even

though the concentrations in finished water have not exceeded allowable drinking water standards. The likelihood of change in land use activities for this area is unlikely. Therefore, based on this analysis, Salisbury's water supply **is** susceptible to VOC contamination.

Synthetic Organic Compounds (SOCs)

The SOC 1,2-dibromo-3-chloropropane (DBCP) was detected twice at both plants at the 50% MCL threshold, and at the MCL once at the Paleo Plant in the year 2000. DBCP is a soil fumigant that was used on fruits, vegetables, orchards, and grasses. A study conducted by the Wicomico County Health Department discussed the past usage of DBCP on strawberry fields, and was detected in various shallow wells tested in the Salisbury area (Pinto, 1980). DBCP usage has been banned in the continental USA since 1979, and therefore, any contamination present in aquifer material is most likely from historical applications. No other SOCs relating to water quality have been detected from 7 previous sets of SOC data collected at both plants dating back to 1994.

The current land use indicates that non-point sources exist in both WHPAs that could potentially contaminate the water supply with SOCs. Cropland makes up19% and 54% of the Park and Paleo WHPAs respectively (Tables 3a & 3b). Residential areas account for 41% of the Park WHPAs based on 2000 Land Use (Table 3a). The improper application of pesticides for crop production or residential and commercial landscaping activities can be a potential source of SOC contamination. There are also a number of potential point sources of SOCs within both WHPAs as shown on Table 2.

The Salisbury wells draw water from a shallow, unconfined Coastal Plain aquifer. Due to this, coupled with the potential point and non-point sources present within both WHPAs, and recent SOC sampling results, Salisbury's water supply **is** susceptible to SOC contamination.

Radionuclides

Gross alpha and gross beta radiation were detected at low levels in finished water samples at Salisbury. The results are less than 50% of the 15 pCi/L and 50 pCi/L MCLs respectively. Radon-222 was detected at 20 pCi/L at the Park Plant, and 140 pCi/L at the Paleo Plant both in August 1999. However, these results are less than 50% of the more conservative MCL of 300 pCi/L currently under consideration by EPA. The source of radon in ground water can be traced back to the natural occurrence of uranium in rocks. Based on limited available sampling data, Salisbury's water supply is **not** susceptible to radiological contaminants.

Microbiological Contaminants

Based on raw water bacteriological data (Table 9) Salisbury's supply wells were determined not to be under the direct influence of surface water. Hence the Salisbury wells are **not** susceptible to any microbiological contaminant present at the surface including *Giardia and Cryptosporidium*.

MANAGEMENT OF THE WHPA

Form a Local Planning Team

- In 1997, the City and County made a commitment to wellhead protection by requesting MDE funding of the expanded public water supply delineation project (Andreasen & Fewster, 2001). Appropriate local agencies and interest groups should review the results of that study and this report. City Public Works and Planning Departments, Wicomico County Planning and Health Departments, and representatives of developers, residents, farmers, and local businesses within the WHPAs, should work to reach a consensus on how to protect the water supply. There is a need to coordinate and bring consistency to protection efforts of the City of Salisbury and Wicomico County to ensure adequate protection of this vital resource.

Public Awareness and Outreach

- The Consumer Confidence Report should include a summary of this report and information that this report is available to the general public through their county library, or by contacting the City or MDE.
- Conduct educational outreach to facilities that may present potential contaminant sources. Important topics include: (a) compliance with MDE and federal guidelines for USTs, (b) best management practices, (c) proper chemical storage practices, (d) reporting chemical and petroleum spills, and (e) proper use and application of fertilizers and pesticides.
- Placing signs at the WHPA boundaries is a good way to make the public aware of protecting their source of water supply.

Cooperative Efforts with Other Agencies

- The City should develop a plan with Salisbury's Fire Department and other emergency response personnel regarding proper spill response to protect ground water, particularly along MD Routes 12, 13, 50, 346, and 350, and the railroad line that runs through the Paleochannel WHPA Zone 2.

- The farmers can participate in the New Conservation Reserve Program (CREP) applicable to the cropland located within the WHPAs. Government funding is available to qualified farmers equal to the cost and financial benefit of farming the area. The Natural Resources Conservation Service is responsible for determining the relative environmental benefits of each acre offered for participation.

Planning/New Development

- The City should consider if the Zoning Ordinance Article XXVII established for the Paleochannel District is adequate, and should be updated if necessary.
- Salisbury should continue to work closely with the Wicomico County Planning Department to conduct site review of new developments in the Park WHPAs prior to approval of the developments to ensure water supply source protection.
- Examine the appropriateness of adopting an ordinance that improves performance standards at the facilities within the Park WHPAs. The State of Maryland Wellhead Protection Ordinance may be used as a template.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE. Also, the City should monitor quarterly for DBCP at both plants until it is reliably and consistently below the MCL.
- The City should stay in contact with MDE's Oil Control Program for updates on existing and new LUST cases. Comparison of specific well sampling results with monitoring at the facilities could help determine the ultimate effectiveness of clean-up measures being taken.
- Requiring the installation of monitoring wells at key UST sites not regulated by MDE may also be considered.
- Annual raw water bacteriological testing is a good check on well integrity.

Land Acquisition/Easements

- Loans are available for the purchase of property or easements for the protection of the water supply. Eligible property must lie within the designated WHPAs. Loans are currently being offered at zero percent interest and zero points. The Water Supply Program at MDE can be contacted at (410) 537-3714 for more information.

Contingency Plan

- COMAR 26.04.01.22 regulations require all community water systems to have a plan for providing a safe and adequate drinking water supply under emergency conditions. The City's current plan should be reviewed, and the information updated as necessary.

Changes in Use

- Any increase in pumpage or addition of new wells to the system may require revision of the WHPAs. The system is required to contact the Water Supply

Program when an increase in pumpage is applied for and when new wells are being considered.

Contaminant Source Inventory/Well Inspection

- The City should review the potential sources of contaminants within the WHPAs and update them if necessary, including a consideration of historical uses.
- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.
- Wells 4a, 5a, and 15 should be repaired and put back into service, or properly abandoned and sealed according to current State well construction standards. Unused wells may provide a direct route for ground water contamination to an aquifer.

REFERENCES

Andreasen, David C., and Fewster, Brandon T., 2001, Estimation of Areas Contributing Recharge to Selected Public-Supply Wells in Designated Metro Core Areas of Upper Wicomico River and Rockawalking Creek Basins, Maryland: Maryland Geological Survey Open-File Report No. 2001-02-14, 54 p.

Andreasen, David C., and Smith, Barry S., 1997, Hydrogeology and Simulation of Ground-Water Flow in the Upper Wicomico River Basin and Estimation of Contributing Areas of the City of Salisbury Well Fields, Wicomico County, Maryland: Maryland Geological Survey Report of Investigations No.65, 87p.

Banks, William S.L., Klohe, Cheryl A., and Battigelli, David A., Occurrence and Distribution of Enteric Viruses in Shallow Ground Water and Factors Affecting Well Vulnerability to Microbiological Contamination in Worcester and Wicomico Counties, Maryland: U.S. Geological Survey Water-Resources Investigations Report 01-4147, 23 p.

Hamilton, P.A., Denver, J.M., Phillips, P.J., and Shedlock, R.J., 1993, Water Quality Assessment of the Delmarva Peninsula, Delaware, Maryland, and Virginia – Effects of agricultural activities on, and distribution of, nitrate and other inorganic constituents in the surficial aquifer: U.S. Geological Survey Open-File Report 93 – 40, 87 p.

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

Pinto, Edward, 1980: Report of Groundwater Contamination Study in Wicomico County, Maryland; Wicomico County Health Department, 9 p.

Rasmussen, William C., and Slaughter, Turbit H., 1955, The Water Resources of Somerset, Wicomico, and Worcester Counties: Department of Geology, Mines, and Water Resources Bulletin 16, 533 p.

Shedlock, Robert J., Denver, Judith M, Hayes, Martha A., Hamilton, Pixie A., Koterba, Michael T., Bachman, Joseph L., Phillips, Patrick J., and Banks, William S.L., 1999, Water-Quality Assessment of the Delmarva Peninsula, Delaware, Maryland, and Virginia: Results of Investigations, 1987-91: U.S. Geological Survey Water-Supply Paper 2355-A, 41 p.

Weigle, J.M., 1972, Part 2: Exploration and mapping of Salisbury Paleochannel, Wicomico County, Maryland: Maryland Geological Survey Bulletin 31, p. 61-124.

OTHER SOURCES OF DATA

Water Appropriation and Use Permit:WI1973G001
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle® Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles: Delmar SW & SE, Salisbury NW & NE 4/14/89 & 4/17/89
USGS Topographic 7.5 Minute Quadrangles-Delmar, Salisbury, Hebron, & Eden
Maryland Office of Planning 2000 Wicomico County Land Use Map
Maryland Office of Planning 1995 Wicomico County Sewerage Coverage Map

FIGURES

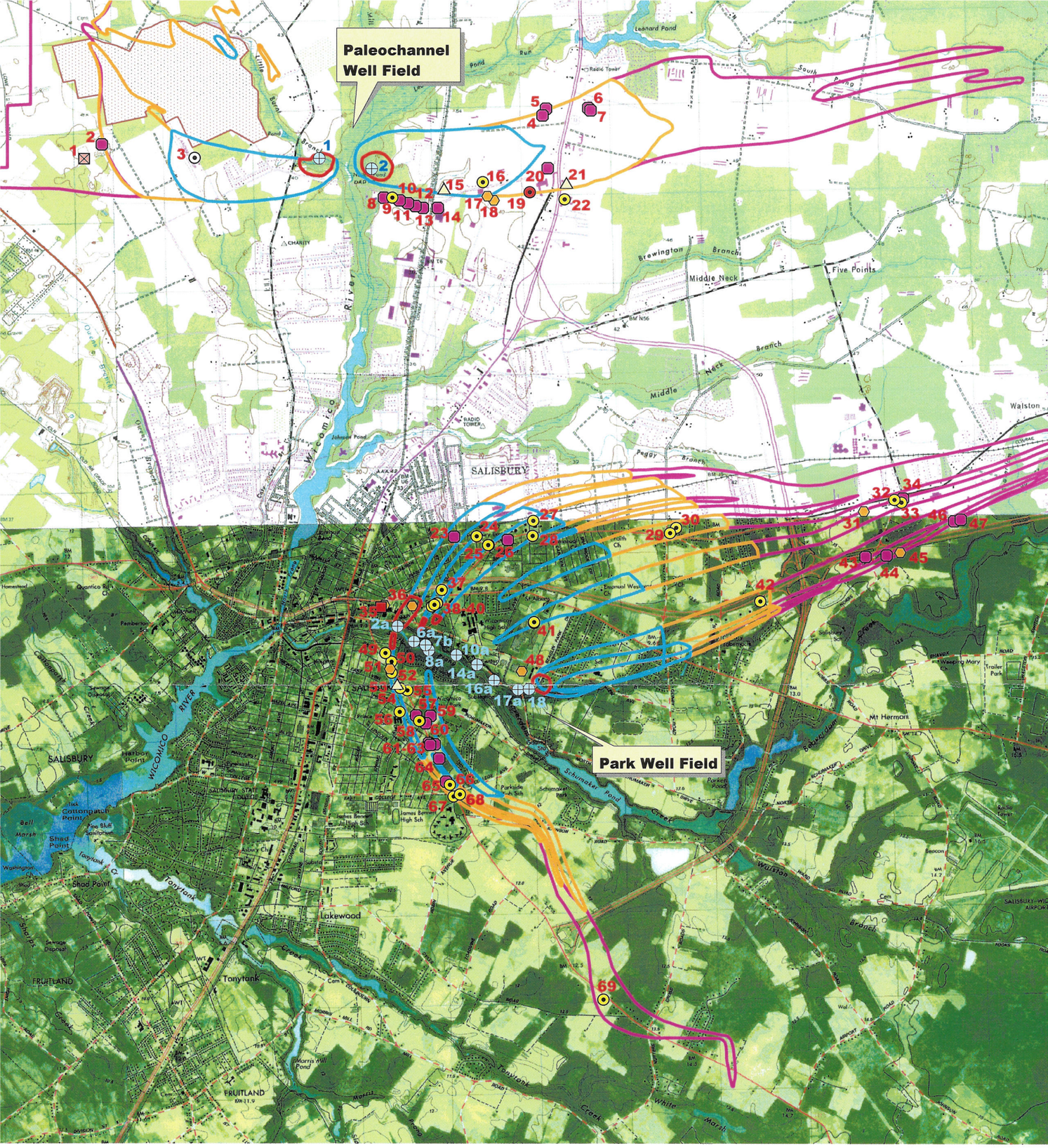


FIgure 2. City of Salisbury Wellhead Protection Areas with Potential Sources of Contamination

LEGEND

- Supply Wells
- Underground Storage Tanks (USTs)
- Leaking USTs
- Above Ground Storage Tanks
- Ground Water Contamination Sites
- Sanitary Landfills
- Controlled Hazardous Substance Generators
- Ground Water Discharge Sites
- Miscellaneous Sites
- Sludge Application Sites

Wellhead Protection Areas

- Zone 1
- Zone 2
- Zone 3
- Zone 4

N

4500 0 4500 Feet

Base Map: USGS Topographic 7.5 Minute Quadrangles - Delmar, Salisbury, Hebron, & Eden

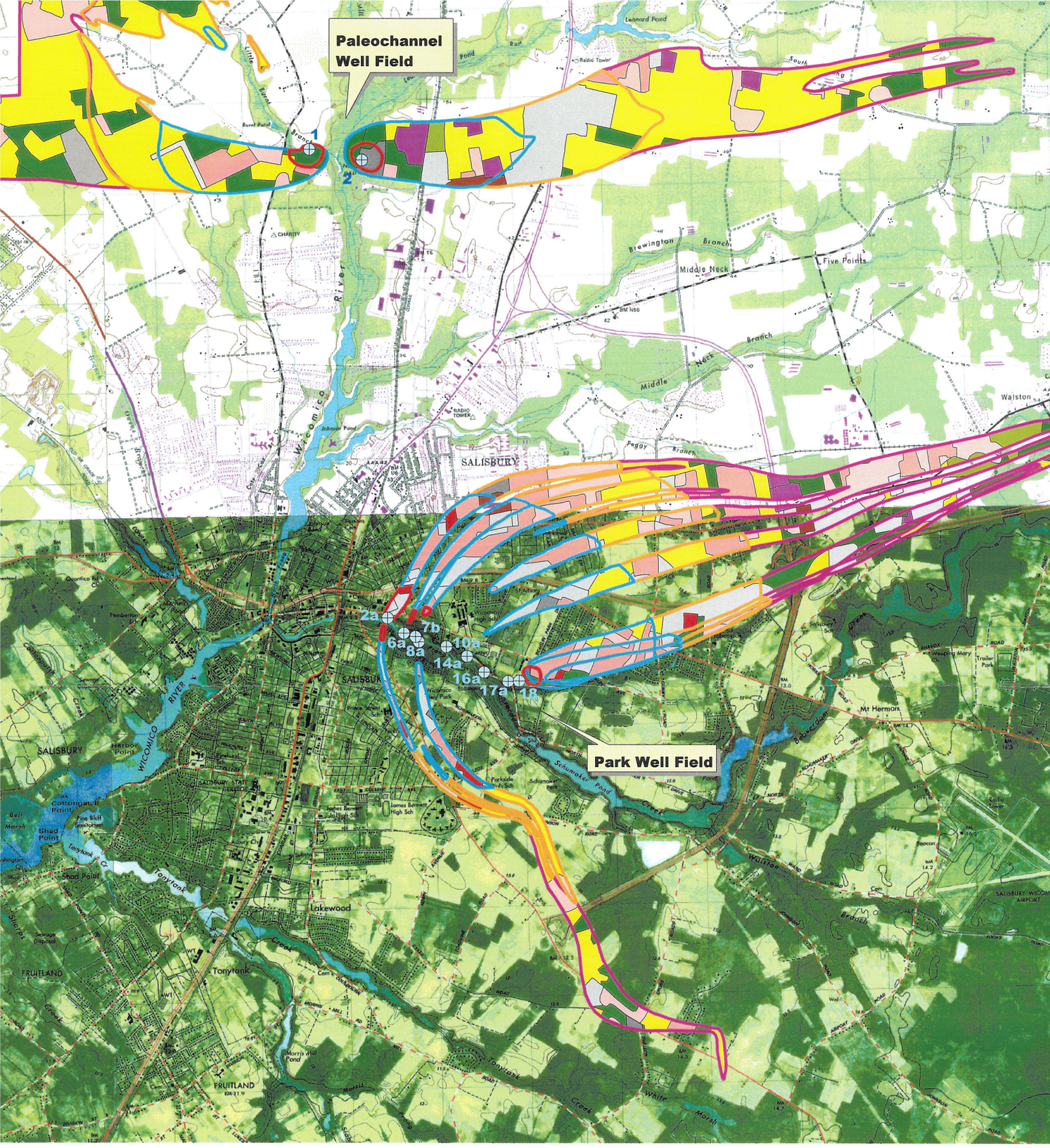


Figure 3. Land Use Map of the Salisbury Wellhead Protection Areas

LEGEND

Supply Wells

Wellhead Protection Areas
- Zone 1
- Zone 2
- Zone 3
- Zone 4

Land Use Categories
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial
- Industrial
- Extractive
- Open Urban Land
- Cropland
- Pasture
- Forest
- Feeding Operations

N

4500 0 45

Base Maps: MD Office of Planning 2000 Land Use Map for Wicomico County, and USGS Topographic 7.5 Minute Quadrangles - Delmar, Salisbury, Hebron, & Eden

Figure 3a. Land Use Map of the Salisbury Park Wellhead Protection Areas

LEGEND

Park Supply Wells

Wellhead Protection Areas
- Zone 1
- Zone 2
- Zone 3
- Zone 4

Land Use Categories
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial
- Industrial
- Extractive
- Open Urban Land
- Cropland
- Pasture
- Forest
- Feeding Operations

N

2750 0 27

Base Maps: MD Office of Planning 2000 Land Use Map for Wicomico County, and USGS Topographic 7.5 Minute Quadrangles - Delmar, Salisbury, Hebron & Eden

Figure 4. Sewer Service Area Map of the Salisbury Wellhead Protection Areas

LEGEND

⊕ Supply Wells

Wellhead Protection Areas

- Zone 1
- Zone 2
- Zone 3
- Zone 4

Sewer Service Area Categories

- No Planned Service
- Existing Service Area
- Final Planning Area
- Service Within 3 to 5 Years

N

4500 0 4500 Feet

Base Maps: MD Office of Planning 1995 Sewerage Coverage Map for Wicomico County, and USGS Topographic 7.5 Minute Quadrangles - Delmar, Salisbury, Hebron, & Eden

Figure 4a. Sewer Service Area Map of Salisbury Park Wellhead Protection Areas

LEGEND

Park Supply Wells

Wellhead Protection Areas

- Zone 1
- Zone 2
- Zone 3
- Zone 4

Sewer Service Area Categories

- No Planned Service
- Existing Service
- Final Planning Area
- Service Within 3 to 5 Years

N

2750 0 2750 Feet

Base Maps: MD Office of Planning 1995 Sewerage Coverage Map for Wicomico County, and USGS Topographic 7.5 Minute Quadrangles - Delmar, Salisbury, Hebron, & Eden

APPENDICES

APPENDIX A

Report of cases within the Salisbury WHPAs from MDE Oil Control Program

CASE NO.	NAME	LOCATION	STATUS AS OF OCTOBER 2002
91-1454WI	Conectiv (formerly Delmarva Power)	2530 North Salisbury Blvd.	High Levels of dissolved phase hydrocarbons (VOCs) continue to be detected in monitoring well sampling results. The Oil Control Program is requiring additional remediation work to be performed on-site.
93-2682WI	7-Eleven	608 Snow Hill Rd.	Site was remediated this past year. Drinking water wells in the immediate vicinity were tested for contaminants and found to be non-detect and therefore, the Oil Control Program closed the case.
02-0718WI	North Park Apartments	304 Glen Ave.	Underground tank(s) were removed. Site was remediated. Sampling results showed no detects. Case was closed by the Oil Control Program

MDE Oil Control Program Cases within the City of Salisbury Wellhead Protection Areas

APPENDIX B

Report of underground injection control inspections with notice of violations (NOVs)
from MDE Ground Water Permits Program

MARYLAND DEPARTMENT OF THE ENVIRONMENT
2500 Broening Highway □ Baltimore, Maryland 21224
410-631-3000 □ 1-800-633-6101 □ http://www.mde.state.md.us

Parris N. Glendening
Governor

Merrylin Zaw-Mon
Acting Secretary

April 26, 2002

Mr. Michael Flynn
First State Packaging, Inc.
P.O. Box 3037
Salisbury, MD 21802-3037

Dear Mr. Flynn:

This letter is a follow-up to my site inspection on April 24, 2002, of First State Packaging, Inc. located at 511 Naylor Mill Road, Salisbury, MD. During this inspection, it was found that vehicle washwater is discharged to a stormwater pond. The discharge of vehicle washwater to the ground via a stormwater pond or to surface waters typically requires a state discharge permit. A permit has operational and maintenance requirements, as well as wastewater testing requirements deemed necessary to protect ground and surface waters.

We agree that choosing to wash vehicles offsite at the Penske location is a practical solution to managing the discharge of your vehicle washwater. With this plan, a permit will not be required for your Naylor Mill Road operations. It is important for you to verify that the washwater at the Penske location is either discharged to the public sanitary sewer system, or that the Penske facility has a discharge permit for washwater discharge.

Please contact the Department in the future if you would like to wash vehicles onsite, or learn more about the permitting process. Thank you very much for your cooperation in these matters and agreeing to stop washing the three truck cabs at your site. If you have any questions, please feel free to contact Michael Eisner, at 410-631-3771, or me at (410) 631-3101.

Sincerely,

Susan M. Allen

Susan M. Allen
Environmental Specialist II

APPENDIX C

General information of ground water discharge permits within Salisbury WHPAs

STATE OF MARYLAND
DEPARTMENT OF THE ENVIRONMENT
WATER MANAGEMENT ADMINISTRATION

NOTICE OF TENTATIVE DETERMINATION

Wicomico County

Application for State Discharge Permit 97-DP-1888:

Johnson McKee Animal Hospital, 404 Snow Hill Road Salisbury, Maryland 21804, applied for renewal of the permit to discharge non-contact heating and cooling water from a veterinary hospital, located at the same address, to ground water via an injection well.

A tentative determination has been made by the Department to reissue the permit prohibiting the introduction of treatment chemicals into the system and with other operational requirements.

A public hearing on the tentative determination will be scheduled if a written request is received by December 27, 1996. The request should be sent to the Maryland Department of the Environment, Water Management Administration, 2500 Broening Highway, Baltimore, Maryland 21224, Attn: Dr. Ching-Tzone Tien and must include the name, address and telephone number (home and work) of the person making the request, the name of any other party whom the person making the request may represent, and the name of the facility and permit number. Failure to request a hearing by December 27, 1996 will constitute a waiver of the right to a public hearing on the tentative determination. Written comments concerning the tentative determination will be considered in the preparation of a final determination if submitted to the Department, to the attention of Dr. Tien at the above address, on or before January 7, 1997. Any hearing impaired person who requests a hearing may also request an interpreter at the hearing by contacting Mark Jacobs at (410) 631-3595 or by written request to the above address at least ten working days prior to the scheduled hearing date.

Information supporting the tentative determination, including the draft permit and fact sheet, may be reviewed by contacting Mr. Jacobs at the above telephone number to make an appointment or by written request to Mr. Jacobs at the above address. Copies of documents may be obtained at a cost of $0.22 per page.

Publication Dates: **Please publish on December 6 and 13, 1996**

WICOMICO COUNTY

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Industrial Discharge Program

Groundwater Permits and Oil Control Division

Summary Report and Fact Sheet

Type: Industrial/ Groundwater/ Renewal

State Application No.: ~~97-DP-1888~~ **UIC No:**

Facility Name: Johnson McKee Animal Hospital

Address: 404 Snow Hill Road

Salisbury, Maryland.

County: Wicomico County

Contact (name,title): June Burgund, Office Manager

Phone: (410)-749-9422

SIC Code: 9999

Applicant is engaged in operating a veterinary hospital

Legal Name of Applicant: Same as above

Address: same as above

Basin Code: 02.13.03.01

Receiving Water Name (Class): Pleistocene Deposits (Type I).

C

Subject to EPA Review? No

Application Rec.: 09/13/96 **Assigned:** 10/96

Project Manager: Roger ~~Simon~~ JS **Phone:** (410) 631-3323

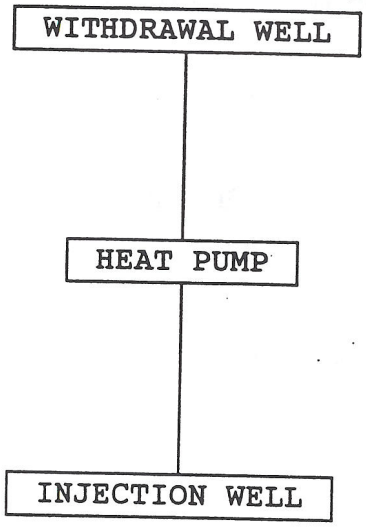
Date Completed: 10-24-96 **Reviewed by** **Date:**

Industrial Operations Which Generate Wastewater

The applicant is engaged in operating an animal hospital located at 404 Snow Hill Road, Salisbury, Maryland. The discharge consists of non-contact cooling and heating water which is discharged to ground water via an injection well. Water is appropriated from the surficial deposits (Pleistocene) via one withdrawal well, circulated through the heat pump and then discharged to groundwater via the injection well (Outfall 001). No chemicals or additives are used in the water and only a slight temperature change will occur.

Process & Wastewater Flow Diagram

NON-CONTACT HEATING/COOLING WATER



Detailed Assessment of Liquid Wastes

Type of wastewater in outfall (001): Non-contact heating/cooling water.

Discharge: Type - intermittent Period - year round

Flow: Average - 9,000 GPD Maximum - 18,000 GPD Design - N/A

pH Range: N/A

Temperature: ambient

Effluent Constituents	Concentrations(mg/l)	Loadings(lbs/d)
N/A	N/A	N/A*

* The only change in water quality will be a slight temperature change.

I. SPECIAL CONDITIONS

A. Discharge Authorization

The permittee is authorized to discharge non-contact heating/cooling water to groundwater via the injection well.

B. Other Requirements

1. There shall be no introduction of treatment chemicals to the heating/cooling water without specific written authorization from the Department.

2. Non-contact heating/cooling water shall not be discharged to surface waters of the State.

a.County Water & Sewer Plan Yes X No ___

b.208 Water Quality Mgmt. Plan Yes X No ___

Source of Water: Well.

SAP or GAP Number:

Summary of Plant Visits and Meetings:

Removed Substances Handling Practices: N/A.

Wastewater Operator Requirement: no

Sanitary Waste Handling: Sewer

Other Environmental Permits: N/A.

Recommended Enforcement Activities: Routine visits to the facility.

MDE
MARYLAND DEPARTMENT OF THE ENVIRONMENT
2500 Broening Highway • Baltimore, Maryland 21224
(410) 631-3000

Parris N. Glendening
Governor

Jane T. Nishida
Secretary

STATE DISCHARGE PERMIT NUMBER	97-DP-3231
UIC PERMIT NUMBER	UIC0455W003
EFFECTIVE DATE	October 1, 1997
EXPIRATION DATE	October 1, 2002

Pursuant to the provisions of Title 9 of the Environment Article, Annotated Code of Maryland and regulations promulgated thereunder, the Department of the Environment, hereinafter referred to as the "Department," hereby authorizes

Nordstrom Chevrolet Geo Inc.
P.O. Box 3376
Salisbury, Maryland 21802

TO DISCHARGE FROM

an automobile sales and service facility

LOCATED ON

2531 North Salisbury Blvd., Salisbury, MD 21801

VIA OUTFALL

001, as identified and described herein

TO

ground waters of the State in accordance with the following special and general conditions and map made a part hereof.

I. SPECIAL CONDITIONS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the effective period of this permit, the permittee is authorized to discharge vehicle exterior wash water to a drainfield via Outfall 001.

As specified below, such discharge shall be limited and monitored by the permittee prior to dsicharge into the drainfield.

EFFLUENT CHARACTERISTICS	EFFLUENT LIMITATIONS		MONITORING REQUIREMENTS	
	Quarterly Average	Daily Maximum	Measurement Frequency	Sample Type
Flow	(1) gpd	(1) gpd	1/Month	Estimated
Total Petroleum Hydrocarbons	N/A	15 mg/l	1/Month[2]	Grab

(1) Monitoring required without limits.

(2) After 12 months of sampling, the permittee may request a reduction in the sampling frequency.

Industrial Discharge Program

Groundwater Permits Division

Summary Report and Fact Sheet

Type: Industrial/ Groundwater/ New

State Application No.: 97-DP-3231 **UIC No:**

Facility Name: Courtesy Chevrolet, Geo

Address: 2531 N. Salisbury Blvd., Salisbury, MD 21801

County: Wicomico County

Contact (name,title): Ms. Laurie Waugh, Secretary-Treasurer-Controller

Bob Orgain - Environmental Consulting Servicves, Inc.

Phone: (410) 749-7100, Bob Orgain (410) 543-0068

SIC Codes: 5511

Applicant is engaged in automobile sales and service.

Legal Name of Applicant: Nordstrom Chevrolet Geo, Inc.

Address: P.O. Box 3376

Salisbury, MD 21802

Receiving Water Name (Class): Quaternary unconsolidated sediments

Type I aquifer

Basin Code: 02.13.03.04

Subject to EPA Review? No

Application Rec.: 4/1/97 **Assigned:**

Project Manager: Michael H. Eisner **Phone:** (410) 631-3771

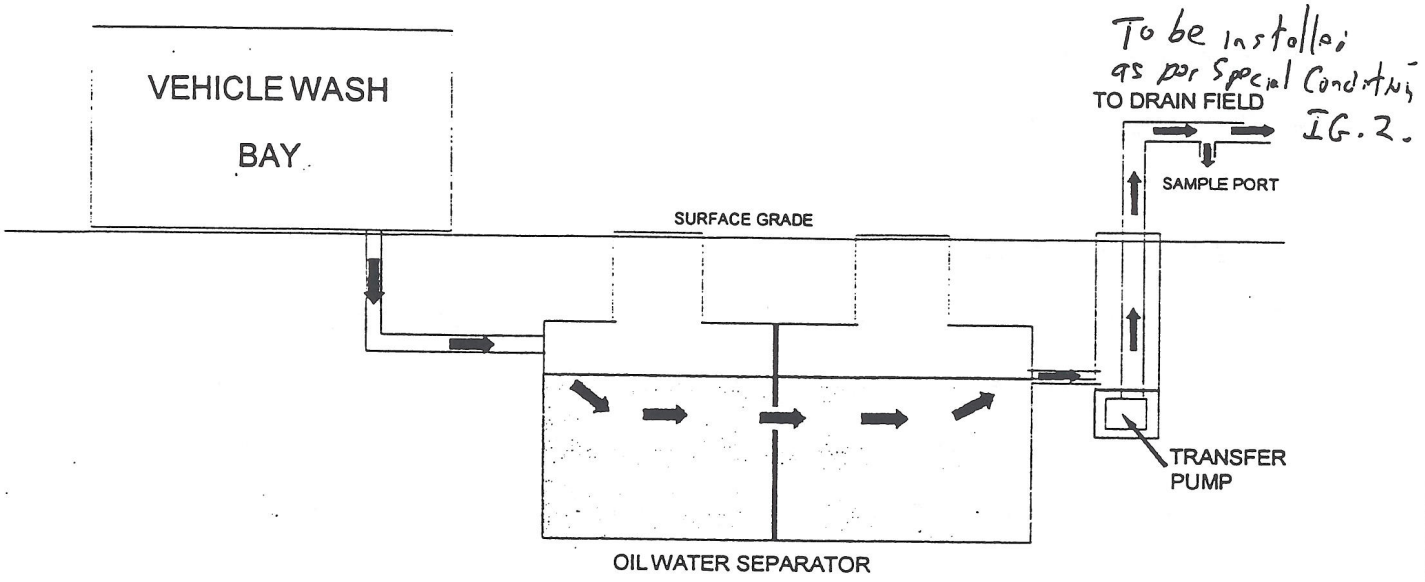
Date Completed: **Reviewed by** **Date:**

Industrial Operations Which Generate Wastewater

The applicant operates a car dealership and service center. The discharge consists of exterior vehicle wash water. Wastewater from washing vehicle exteriors flows to a floor drain then into an oil/water separator, and will then flow into a new, dedicated drainfield. They wash an average of 5 cars per day, with a maximum of 8.

ENVIRONMENTAL CONSULTING SERVICES, INC.
PO BOX 1615
SALISBURY, MD.
21802-1615

TITLE: TREATMENT EQUIPMENT CONFIGURATION DIAGRAM			
PROJECT: COURTESY CHEVROLET GEO			
LOCATION: SALISBURY, MARYLAND			
PROJECT NO. 36300197	SCALE NTS	DATE 03/05/97	DRAWING NO. 36300197B



To be installed as per Special Condition IG.2.

Detailed Assessment of Liquid Wastes

Type of wastewater in outfall 001: Wash water from exterior washing of cars.

Discharge: Type - Intermittent Period - year round

Flow: Average - 250 gpd Maximum - 400 gpd Design - N/A

Ph: N/A

Temperature: ambient

Stormwater Contribution: N/A

Wastewater Analysis

The wastewater was sampled on March 13, 1997 by Environmental Consulting Services, Inc. by Water Testing Laboratories and analyzed for volatile organic chemicals by EPA Method's 624 and Total Petroleum Hydrocarbons by EPA Method 418.1. The results of the analysis follows.

Effluent Constituents	Concentrations(ppb)	MCL'S
Total Petroleum Hydrocarbons	14 ppm	None
EPA 624		
Methylene chloride *	93 ppb	5 ppb
Tetrachloroethene	6.3 ppb	5 ppb
Toluene	5.9 ppb	1000 ppb

* Claimed to be contamination by consultant.

Constit.'s	Loadings Avg	Loadings Max	Conc.'s Avg	Conc.'s Max	Requirements Frequency	Self Monitoring Type of Sample
Flow (GPD)	N/A	N/A	*	*	1/Month	Estimated
Total Petroleum Hydrocarbons	N/A	N/A	*	15mg/L	1/Month(2)	Grab
Total Volatile Organics(3)	N/A	N/A	*	100 ppb	1/Quarter(2)	Grab
Tetrachloroethene	N/A	N/A	*	5 ppb	1/Quarter(2)	Grab

* Monitoring required without limits.

(2) After 12 months of sampling, the permittee may request a reduction in the sampling frequency.

(3) Total Volatile Organics is defined as the sum of the concentrations of the constituents present in the wastewater according to EPA Method 624. The permittee shall include in the quarterly Discharge Monitoring Report the total sum and each individual concentration of detected constituents.

Rationale:

TPH: A daily maximum of 15 mg/l is attainable as a result of gravity separation in an oil/water separator. This limit is set under a controlled flow situation and is used in similar treatment systems throughout the State. Monitoring for volatile organics is required due to the presence of solvents in the effluent analysis. Under conditions of the permit, solvents will be prohibited from being discharged into the disposal system.

County Water & Sewer Plan Yes X No ___

208 Water Quality Mgmt. Plan Yes X No ___

Source of Water: Well.

SAP or GAP Number:

Summary of Plant Visits and Meetings:

Site visit by Roger Simon.

Wastewater Operator Requirement: No.

Sanitary Waste Handling: On-site septic system.

Other Environmental Permits: N/A.

Recommended Enforcement Activities: Routine visits to the facility.

APPENDIX D

General information of sanitary landfills within Salisbury WHPAs from MDE Solid Waste Program

3.0 SITE OVERVIEW

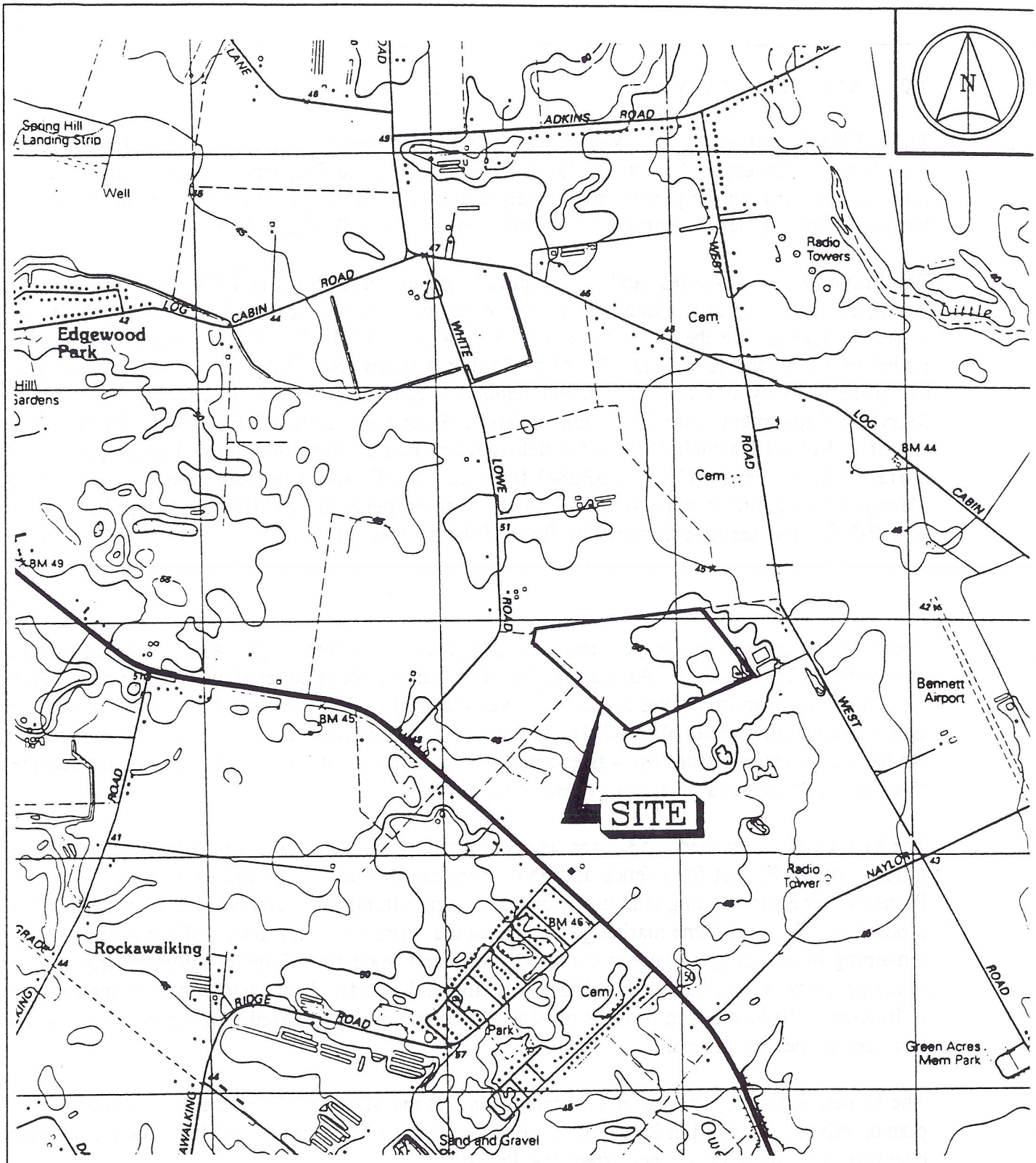
The J. Roland Dashiell & Sons West Road Rubble Fill (Property) is located in Wicomico County, Maryland, northwest of the City of Salisbury. Access to the Property is by a private road on a right-of-way through the parcel immediately east of the Property, off of West Road. Copies of location maps and aerial photos may be found in Appendix B of this document.

The Property is 70.04 acres, and was acquired by Dashiell & Sons in 1971. The area is zoned A-1 Agricultural-Rural Residential, and the Wicomico County Zoning Board of Appeals issued a special exception for the development of a borrow pit in 1971. In 1975, a special exception was issued by the Wicomico County Board of Zoning Appeals (No. WA-75127-89F) approving the use of the Property as a construction and demolition rubble fill. It was subsequently permitted by Maryland Department of the Environment (MDE)(Permit No. 1995-WRF-0348-00) for the private use of J. Roland Dashiell & Sons for debris from their construction sites. The Property has a Surface Mining Permit (No. 78-SP084) from the MDE, and a license from the MDE Water Management Administration (No. 96-SL0131). The Property has an MDE Discharge Permit (No. 96-DP-3193) for seepage through the floor of the borrow pit.

The rubble deposited on the property is disposed of in the borrow pit, which is approximately twenty eight (28) feet deep. As required by MDE, the rubble is covered every three days. Some fill dirt from construction sites is used as cover material. The rubble fill is permitted to accept asbestos containing materials (ACM). No other hazardous wastes are permitted to be accepted. No hazardous (except asbestos) wastes are stored or disposed of on site. No wastes are accepted from construction sites other than those of the owner.

The balance of the Property, 58 acres, is approximately half woodland and half farmland planted in feed crops. Except for a fence and gate, there are no buildings, utilities or structures on the Property. The surrounding land use is primarily agricultural, with animal feed crops dominating production. There is some market gardening on the farms to the northwest of the property. The remaining surrounding land use is scattered homes and woodland. Land use immediately adjacent to the Property is a mixture of farming, open land and woods. Immediately east of the Property is BioGro, a lined chicken processing waste lagoon. The processed chicken waste is used as fertilizer on nearby farmland.

The United States Department of Transportation and the Maryland Department of Transportation plan to enlarge and re-align Route 50 in the vicinity of the Property. Available State records were checked, and the plans do not affect the Property.



MAP REFERENCE:

HEBRON, MARYLAND–DELAWARE USGS QUADRANGLE
7.5 MINUTE SERIES, 1992 EDITION
DELMAR, MARYLAND–DELAWARE USGS QUADRANGLE
7.5 MINUTE SERIES, 1992 EDITION

QUADRANGLE LOCATION

GRAPHIC SCALE

(IN FEET)
1 inch = 2000 ft.

DRAWING No. 39883-00

RUST ENVIRONMENT & INFRASTRUCTURE

SITE LOCATION MAP

WEST ROAD RUBBLE LANDFILL
J. ROLAND DASHIELL REALTY COMPANY
WICOMICO COUNTY, MARYLAND

PROJECT No. 39883.000	DATE 9/11/96	DWG. No. 39883-00	SCALE AS NOTED	FIGURE No. 1

APPENDIX E

General information of sites with known ground water contamination issues within or near Salisbury WHPAs from MDE Waste Management Administration

MD-163
Wicomico County

1900-1940s - A manufactured gas plant facility operated on the 3.68-acre property.

1982 - EPA requested verification that a gas plant had operated at the site.

1984 - The site was placed on CERCLIS.

1985 - DHMH conducted a PA.

1986 - CUC conducted source removal activities.

1986-1989 - Further studies conducted by CUC indicated that groundwater had been impacted by BTEX and PAHs.

1990-1992 - Discussion of clean up goals, drafting of remediation plans.

1993-1995 - Groundwater monitoring and free-phase recovery began, and pilot testing was conducted for groundwater remediation.

1996-present - The AS/SVE system began operating.

1999 - MDE and CUC discussed when the system should be shut off.

2001 – Downgradient plume boundary is still unclear as potential downgradient/adjacent sources have not been investigated.

Salisbury Town Gas Light
Salisbury, MD

Site Location

The Salisbury Town Gas Light site is located at 520 Commerce Street in Salisbury, Maryland. A mix of commercial and industrial properties, including a former Redhead Station and Trailways Bus Terminal, surrounds the site. A branch of the Wicomico River exists approximately 500 feet south and downgradient of the site. A well field supplying the City of Salisbury exists approximately 2,000' southeast of the site.

Site History

A predecessor of Chesapeake Utilities Corporation (CUC), Citizens' Gas Corporation, formerly operated a manufactured gas plant at the site. During operation, some of the coal tar generated was stored on-site in earthen pits. CUC currently uses the site as a natural gas and propane distribution facility.

Environmental Investigations

In 1985, the Department of Health and Mental Hygiene (DHMH) conducted a Preliminary Assessment (PA), which concluded that a low priority investigation should be done at the site. About the same time, CUC began site investigation activities and discovered the soil and groundwater had been impacted primarily by benzene, toluene, ethylbenzene, and xylene (BTEX) and polyaromatic hydrocarbon (PAH) compounds.

In 1986, CUC conducted a removal action, which included the excavation and disposal of 830 tons of raw coal tar, contaminated soil, building debris, drums, tanks, pipes, brick and concrete.

In approximately 1989, free product (diesel fuel) was discovered at the site during a subsequent study, which included installation of monitoring wells. In 1993, a product recovery system was implemented by CUC.

CUC submitted a plan for groundwater remediation involving Air Sparging/Soil Vapor Extraction (AS/SVE). The AS/SVE system was started in 1996 after approval was obtained from the Maryland Department of the Environment (MDE).

The groundwater sampling data at the site showed an almost immediate decrease in the concentrations of the on-site contaminants while the system was operational. After running the system for approximately 2 ½ years, groundwater data indicated significantly

lower levels of contamination. Consequently, CUC gained MDE approval to shut the system off.

Current Status

The AS/SVE system is to remain in place in the event that levels start increasing and the system needs to be reactivated. CUC is currently conducting groundwater monitoring while the system is off to determine the effect on the groundwater contaminant concentrations.

During historic monitoring of the site groundwater, other sources which might be contributing to the contamination at the site were suspected. The consistent presence of low levels of chlorinated solvents has been documented in the downgradient wells; however, the source of the solvents is unclear. The property immediately downgradient of the former gas plant (a former gas station and currently a used car lot), has never been investigated because access was denied. This property lies between the site and the downgradient wells and should be investigated as a possible source of contamination and to differentiate chlorinated solvents which might be coming from the Salisbury Town Gas site versus other sources.

MDE has proposed additional investigation under the State Superfund Program to identify the source of the chlorinated solvents detected at the site. Future actions will depend on the outcome of these investigations.

Contact

Art O'Connell
Maryland Department of the Environment
Site and Brownfields Assessments/State Superfund Division
(410) 631-3493