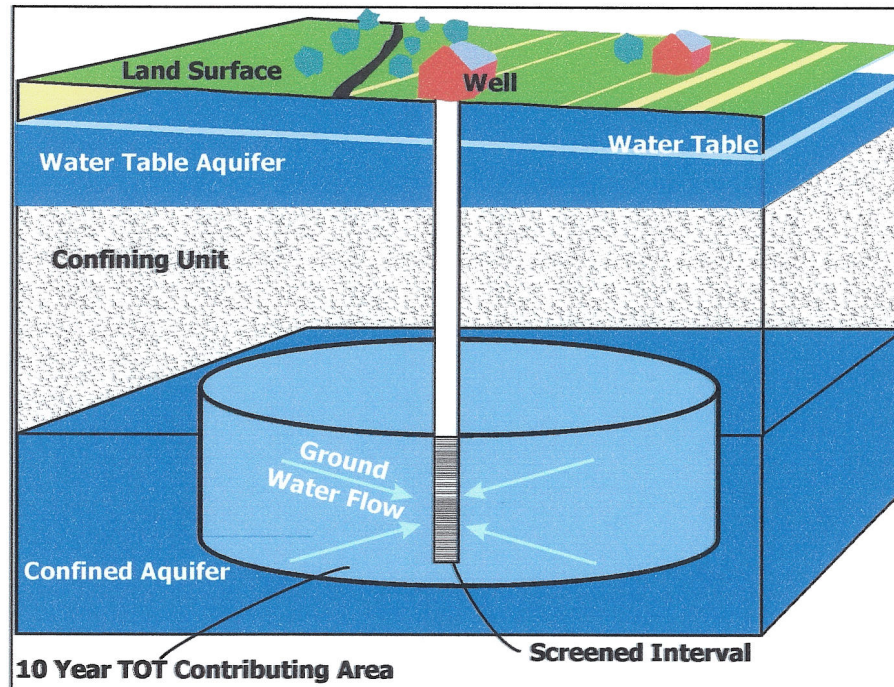


SOURCE WATER ASSESSMENT
FOR VELSICOL CHEMICAL CORPORATION
KENT COUNTY, MD



Prepared By
Water Management Administration
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October 2005



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SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for Velsicol Chemical Corporation. 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 Velsicol Chemical Corporation's water supply is a confined Coastal Plain aquifer known as the Monmouth Formation. The system currently uses four wells to obtain its drinking water. The Source Water Assessment Area was delineated by the Water Supply Program 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, and database reviews. Well information and water quality data were also reviewed. A figure potential contaminant sources within the Source Water Assessment Area and an aerial photograph of the well locations are enclosed at the end of the report.

The susceptibility analysis for the Velsicol Chemical Corporation 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 Velsicol Chemical Corporation's water supply is not susceptible contaminants originating at the land surface due to the protected nature of confined aquifer. It is susceptible to naturally occurring iron for which it is being treated.

INTRODUCTION

The Water Supply Program has conducted a source water assessment for the Velsicol Chemical Corporation water supply in Kent County (figure 1). Velsicol Chemical Corporation is a manufacturer of plasticizers and synthetic lubricants and has undergone several ownership changes in its history (see appendix). The Velsicol Chemical Corporation water supply is considered a nontransient noncommunity (NTNC) water system, which is defined as a public water system that regularly serves at least 25 of the same individuals over six months per year. The facility owns and operates its water supply system and serves water to 44 employees.

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. Velsicol currently uses 4 wells (Well Nos. 3, 4, 5, and 6) for water supply (sanitary and industrial processing) Well Nos. 3 and 6 are the main production wells with 4 and 5 being used as standby wells. A review of well data and sanitary surveys of the Velsicol Chemical Corporation water system indicates that three out of the four wells were drilled after 1973, when the State's well construction regulations went into effect. A review of the well completion report for Well No. 4 (drilled prior to current regulations) indicated that it was grouted with cement down to 60 feet and appears to meet current well construction standards. All of the supply wells appear to meet proper well construction standards. There are several monitoring wells on site that are required by a discharge permit as well as past and ongoing ground water remediation efforts. The water supply well information is shown in Table 1 below.

| WELL NAME | USE CODE | PERMIT NO | TOTAL DEPTH (ft) | CASING DEPTH (ft) | YEAR DRILLED |
|-------------------------|-------------|--------------|------------------------|-------------------------|-----------------|
| Velsicol Potable Well 3 | P | KE880798 | 178 | 158 | 1994 |
| Velsicol Potable Well 4 | S | KE710067 | 175 | 110 | 1971 |
| Velsicol Potable Well 5 | S | KE811361 | 178 | 158 | 1989 |
| Velsicol Potable Well 6 | P | KE0880494 | 180 | 160 | 1992 |

Table 1. Velsicol Chemical Corporation Well Information.

Velsicol Chemical Corporation has a Water Appropriation Permit that allows it to use an average of 100,000 gallons per day (gpd) and 120,000 gpd in the month of maximum use. Most of the water is for industrial use and the facility uses bottled water for drinking. Based on past 3 years pumpage reports submitted to MDE, the facility used an average of 73,961 gpd and 104,394 gpd in the month of maximum use.

HYDROGEOLOGY

Ground water flows through pores between gravel, sand and silt grains in unconsolidated sedimentary rock aquifers such as the one used by Velsicol Chemical Corporation. An aquifer is any formation that is capable of yielding a significant amount of water. Transmissivity is a measure of the amount of water an aquifer is capable of producing and is related to the hydraulic conductivity and the thickness of the aquifer. A confining layer is generally composed of fine material such as clay and silt, which transmits relatively very little water. Confined aquifers are those formations that are overlain by a confining unit. Confined aquifers are recharged from the water stored in the confining unit above and from precipitation that infiltrates into the formation where it is exposed at the surface.

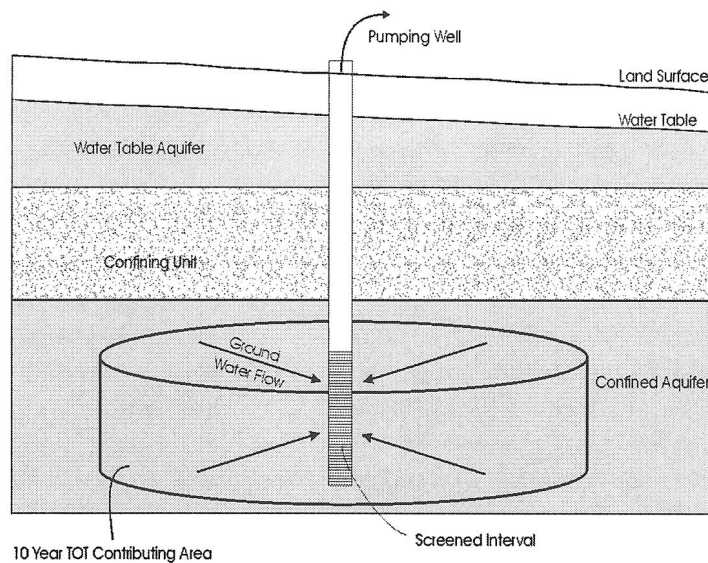
The Velsicol Chemical Corporation site lies within the Atlantic Coastal Plain physiographic province. This province, which in Maryland includes roughly the area east of Interstate 95, is underlain by unconsolidated clastic sediments of Lower Cretaceous to recent age, which thicken to the southeast so that they appear wedge-shaped. These sediments crop out in a concentric band that lies parallel to the Fall Line, which marks the western boundary of the Coastal Plain. The Velsicol Chemical Corporation wells pump water from the Monmouth Formation. At this location, the Monmouth is a confined aquifer with the top of the aquifer about 30 feet below sea level and bottom about 105 feet below sea level. The Monmouth aquifer is fine- to medium-grained glauconitic quartz sand with clayey layers and calcareous beds. The sandy intervals are light olive-gray, and the clayey layers are medium- to dark-greenish gray (Drummond, 1998).

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. The WHPA for Velsicol Chemical Corporation's wells was delineated using the methodology described in Maryland's Source Water Assessment Plan (1999) for confined aquifers in the Coastal Plain, often referred to as the "Florida Method". The area is a radial zone of transport within the aquifer and is based on a 10 year time of travel (TOT), pumping rate and the screened interval(s) of the well or wells included in the WHPA, and the porosity of the aquifer (see illustration below for conceptual model). The Florida Method is a modification of Darcy's Law for radial flow to a well and the WHPA was calculated using the following volumetric equation:

$$r = \sqrt{\frac{Qt}{\pi nH}}$$

where r = calculated fixed radius (ft)
 Q = pumping rate of well (ft^3/yr)
 n = aquifer porosity (dimensionless)
 H = length of well screen (ft)
 t = time of travel (yr.)



Velsicol Chemical Corporation has a water appropriation permit for 100,000 gallons per day (gpd). Since only two wells are being used at a time the pumping rate (Q) used for each well is 50,000 gpd. A conservative estimate of porosity (n) of 25% was used for the aquifer based on published reports. Since the lengths of the well screen (H) for the wells were much smaller than the saturated thickness of the aquifer was used. The saturated thickness of the aquifer is 75 ft. Using these parameters a radius of 643 feet (rounded off to 700 ft) was calculated for each well for the WHPA delineation using the above equation. The circles for each well were merged to form one larger WHPA as shown in Figure 2. The circle represents the aquifer zone of transport in the subsurface as illustrated above.

POTENTIAL SOURCES OF CONTAMINATION

In confined aquifer settings, sources of contamination at the land surface are generally not a threat unless there is a pathway for direct injection into the deeper aquifer such as unused wells or along well casing that are not intact or have no grout seal. Wells that are not being used or maintained will eventually corrode and provide a pathway for contaminants present in the shallow aquifers at higher-pressure heads to migrate to the deeper aquifers.

Potential sources of contamination identified at the land surface have the potential to impact the shallow water table aquifer. Based on the MDE databases and site inspections several potential sources of contamination were identified on the Velsicol Chemical Corporation WHPA. This facility (D) is identified as a CERCLA (Superfund) site for potential hazardous wastes, with an EPA designation of No Further Remedial Action Planned (NFRAP) for it. In 1989 high levels of organic compounds (especially phthalates) were detected in the unconfined aquifer near a

wastewater impoundment (site B). MDE requested the facility to submit a Closure Plan for the impoundment which included a remediation goal of 770 ppb for the phthalate concentration in the ground water. The remediation of the site has been completed. In 2004, the shallow ground water aquifer in the area around the Fire Pond (Site A) was found to high levels of benzene, toluene and phthalates. Velsicol submitted a ground water remedial action plan for this site. MDE has reviewed and approved this plan which is being currently implemented. Velsicol also has a discharge permit which allows it to discharge treated wastewater into an unnamed tributary to Morgan Creek which flows by along the northeast portion of the property. The permit allows the facility to land apply biological sludge on drying beds (site C) hill downgradient of all the potential contaminants sources. These sites are shown in figure 2.

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 may be the cause of the elevated contaminant level. All data reported is from the finished (treated) water unless otherwise noted. The current treatment for the Velsicol Chemical Corporation water system is oxidation and filtration for removal of iron

A review of the monitoring data since 1993 for the Velsicol Chemical Corporation water supply indicates that it meets the current drinking water standards. The water quality sampling results are summarized in Table 4.

| PLANT NO | IOCs | | SOCs | | VOCs | | Radionuclides* | |
|----------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | No. of Samples Collected | No. of samples > 50% MCL | No. of Samples Collected | No. of samples > 50% MCL | No. of Samples Collected | No. of samples > 50% MCL | No. of Samples Collected | No. of samples > 50% MCL |
| 01 | 68 | 0 | 2 | 0 | 10 | 0 | 0 | 0 |

Table 2. Summary of Water Quality Samples for the Velsicol Chemical Corporation Water Supply.

Inorganic Compounds (IOCs)

No IOCs above 50% of the MCL have been detected in Velsicol Chemical Corporation's water supply. Naturally occurring iron is present in the raw water supply and removed through oxidation and filtration. Iron does not have an MCL but has a secondary standard of 0.3 ppm based on taste and color.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of the MCL have been detected in Velsicol Chemical Corporation's water supply. Very low levels of xylenes, toluene and p-dichlorobenzene have been detected in the water supply (table 3).

| CONTAMINANT ID | CONTAMINANT NAME | MCL (ppb) | SAMPLE DATE | RESULT (ppb) |
|----------------|-------------------|-----------|-------------|--------------|
| 2955 | XYLENES, TOTAL | 10000 | 09-MAR-93 | 4 |
| 2991 | TOLUENE | 1000 | 07-APR-93 | 1 |
| 2955 | XYLENES, TOTAL | 10000 | 07-APR-93 | 2 |
| 2969 | p-DICHLOROBENZENE | 75 | 22-FEB-05 | .6 |

Table 3. VOC detections in Velsicol Chemical Corporation's Water Supply

Synthetic Organic Compounds (SOCs)

No SOC's have been detected in Velsicol Chemical Corporation's water supply.

Radionuclides

Nontransient noncommunity systems are currently not regulated for radionuclides. Currently no radionuclide sampling data is available for this water supply.

Microbiological Contaminants

Routine bacteriological monitoring is conducted in the finished water for each noncommunity nontransient water system on a quarterly basis and measures total coliform bacteria. Total coliform bacteria are not pathogenic, but are used as an indicator organism for other disease-causing microorganisms. A major breach of the system such as due to flooding a well, ruptured water line or back siphonage of contaminated water could cause a positive total coliform result in the distribution system, and would require follow-up total and fecal coliform analysis. Since 1996 Velsicol Chemical Corporation has conducted routine bacteriological sampling 40 times, but no samples had any detections of total coliform bacteria.

SUSCEPTIBILITY ANALYSIS

The wells serving Velsicol Chemical Corporation's water supply pump water from confined aquifers. Confined aquifers are naturally well protected from activity on the land surface due to the confining layers that provide a barrier for water movement from the surface into the aquifer below. A properly constructed well with the casing extended to the confining layer above the aquifer and with sufficient grout should be well protected from contamination at the land surface. Wells that are not being used or maintained will eventually corrode and provide a pathway for contaminants present in the shallow aquifers at higher-pressure heads to migrate to the deeper aquifers. The information that was used to conduct the susceptibility analysis is as follows: (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. The susceptibility of the

Velsicol Chemical Corporation water supply to the various contaminant groups in shown in table 4 at the end of this section.

Inorganic Compounds (IOCs)

No IOCs have been detected above 50% of the MCL in the Velsicol Chemical Corporation water supply. Due to high levels of naturally occurring iron in the aquifer, the system uses treatment for iron removal from the water supply.

Based on above analysis the Velsicol Chemical Corporation water supply is susceptible to iron but not to other inorganic compounds.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of the MCL have been detected in Velsicol Chemical Corporation's water supply since 1993. As discussed earlier, there are several potential contamination sources of VOCs in the WHPA and known ground water contamination of the shallow aquifer. Water quality data indicates that these sources have not negatively affected the water supply in part due to the confined nature of the Monmouth aquifer.

Based on the above discussion, Velsicol Chemical Corporation's water supply is **not** susceptible to VOC contamination.

Synthetic Organic Compounds (SOCs)

No SOC's have been detected in Velsicol Chemical Corporation's water supply. As discussed earlier, there are several potential contamination sources of SOC's (phthalates) in the WHPA and known ground water contamination of the shallow aquifer. Water quality data indicates that these sources have not had a negative impact on the water supply in part due to the confined nature of the Monmouth aquifer.

Based on the above analysis, Velsicol Chemical Corporation's water supply is **not** susceptible to SOC contamination.

Radionuclides

Nontransient noncommunity systems are currently not regulated for radionuclides. No monitoring results for radionuclides were available for this water supply. No determination about the susceptibility of Velsicol Chemical Corporation's water supply to radionuclides can be made at this time.

Microbiological Contaminants

Raw water monitoring for microbiological contaminants is not required of water systems in confined aquifers because they are considered naturally protected from sources of pathogens at the land surface. Routine bacteriological testing for these plants revealed no positive total coliform in the water supply. Therefore, Velsicol Chemical Corporation's water supply is **not** susceptible to microbiological contaminants.

| CONTAMINANT TYPE | Are Contaminant Sources present in the WHPA? | Are Contaminants detected in WQ samples at 50% of the MCL | Is Well Integrity a Factor? | Is the Aquifer Vulnerable? | Is the System Susceptible to the Contaminant |
|-----------------------------------|--|---|-----------------------------|----------------------------|--|
| Iron | YES (naturally occurring) | NO | NO | NO | YES |
| Inorganic Compounds (except iron) | NO | NO | NO | NO | NO |
| Volatile Organic Compounds | YES | NO | NO | NO | NO |
| Synthetic Organic Compounds | YES | NO | NO | NO | NO |
| Radionuclides | NO | NO WATER QUALITY DATA | NO | NO | CANNOT BE DETERMINED |
| Microbiological Contaminants | NO | NO | NO | NO | NO |

Table 4. Susceptibility Summary for Velsicol Chemical Corporation's water supply.

MANAGEMENT OF THE WHPA

The Velsicol Chemical Corporation site has had known ground water contamination in the shallow aquifer. Long term monitoring of the deeper confined aquifer has shown no indication of any contamination. Confining clay layer above this Monmouth aquifer has prevented the migration of contaminants at the surface and shallower aquifer into this aquifer. The following recommendations for protection of the water supply are listed below:

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.
- Periodically monitor the contaminants found in the shallow aquifer in the deeper confined aquifer to ensure that it is not breached.
- Conduct annual raw water bacteriological testing of the supply wells to ensure well integrity

Contaminant Source Inventory/Well Inspection

- Conduct a survey of the WHPA and inventory any potential sources of contamination, including unused wells that are drilled into the Monmouth aquifer.
- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and help protect the aquifer from contamination.

Cooperative Efforts with Other Agencies

- Work closely with Kent County Health Department to identify any unused wells in the WHPA and to ensure that they are abandoned and sealed in compliance with the State's well construction standards.

Changes in Use

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

REFERENCES

- 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, 167 p.
- Drummond, David D., 1998, Hydrogeology, Simulation of Ground-Water Flow, and Ground-Water Quality of the Upper Coastal Plain Aquifers in Kent County, Maryland: Maryland Geological Survey Report of Investigations No. 68. 76p.
- Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 p.
- Tompkins, M. D., Cooper, B. F., and Drummond, D. D., 1994, Ground-Water and Surface-Water Data for Kent County, Maryland: Basic Data Report No. 20, 155p.

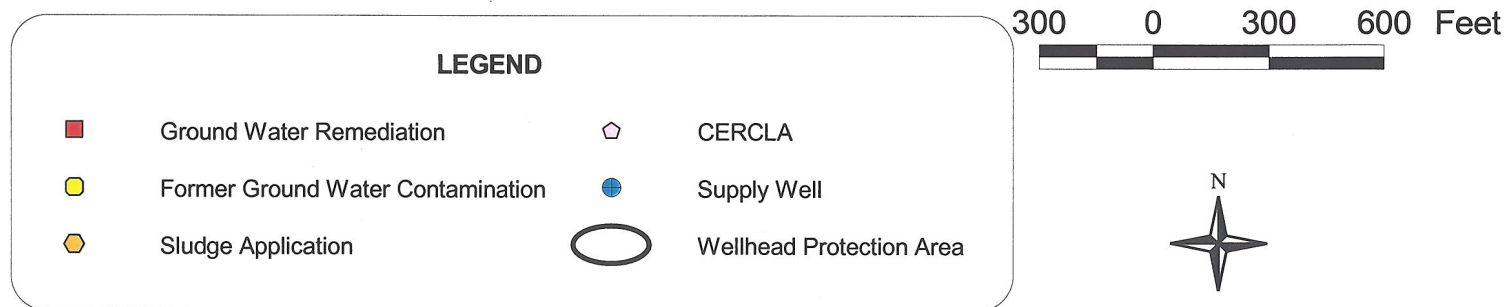
OTHER SOURCES OF DATA

Water Appropriation and Use Permit: KE1959G002
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles:
Betterton
USGS Topographic 7.5 Minute Betterton Quadrangle

FIGURES



Fig. 2. Wellhead Protection Area for Velsicol Chemical Corporation with Potential Contaminant Sites



Base Map: USGS 7.5 Minute Topographic Quadrangle - Betterton

APPENDIX

CERCLA FACT SHEET

MD-28 Kent County

- 1951 Lehigh Chemical began to manufacture plastics and polymers.
- 1957 Lehigh moved facility to location on State Rt. 297.
- 1964 Tenneco Chemical purchased Lehigh Chemical.
- 1979 Site listed in Eckhardt Report.
- 1982 Nu-Dex purchased plant.
Hazardous Waste Site Assessment Reports, Final Report completed.
- 1984 DHMH sampled soil and groundwater at the site.
- 1986 DHMH completed *Site Inspection of Tenneco Chemicals, Inc.* report.
- 1989 MDE approved a closure plan for Impoundment 314.
- 1999 MDE concluded the site does not present a risk to Kent County Sanitary District's Worton Water System.

TENNECO CHEMICALS Chestertown, Maryland

Site Location

The Tenneco Chemicals, Inc. facility (now owned by Velsicol Chemical Corporation) is located on MD Route 297, two miles north of the intersection of Maryland Routes 297 and 213 in Chestertown, Kent County, Maryland. The site size is 10 acres. A wastewater treatment plant and sludge-settling basin (lagoon) are located in the northeastern corner of the site. Production facilities and storage tanks are located in the northern portion of the site. The site is situated on the eastern shore of Maryland, in the Coastal Plain Physiographic Province. The area is generally agricultural land. An unnamed, intermittent stream that flows east toward Morgan Creek is 1/4 mile east of the site.

Site History

The Chestertown plant began manufacturing plastics and polymers in 1951. During the period 1951 through 1964, the plant was known as Lehigh Chemical Company and was located on Flatland Road in Chestertown, MD. In 1959, Lehigh moved its facility to Maryland Route 297 where the present-day plant is located. In 1964, Tenneco Chemicals bought Lehigh and the plant became known as Tenneco Chemicals, Inc. In 1982, Nu-Dex purchased the plant from Tenneco. The next owner of the plant was Huls America Company who owned the plant in 1989, although it is not known when they purchased or sold the facility. The plant owner in 1999 was Velsicol Chemical Corporation.

The wastes generated at the plant included plasticizers, polar and non-polar solvents, oil and oil sludges, esters, ethers, alcohols, and scrubber residuals. From 1951 through 1964, Tenneco (formerly Lehigh) disposed of 402,000 gallons of liquid wastes and 500 tons of solid wastes at the Kent Price Landfill located on Flatland Road in Chestertown. The Kent Price operation closed in 1964. From 1965 until 1979, Tenneco disposed of 7,245,000 gallons of liquid wastes and 9,000 tons of solid wastes at the Nicholson Landfill located west of Earl Nicholson Road and east of State Route 298 in Chestertown.

Tenneco officials stated in 1981 that chemical process wastes were never disposed of on-site at their Chestertown plant. The only disposal that occurred on site was of some liquid wastes, such as alcohols and plastic scraps, which were used as fuel supplements and burned in on-site plant boilers. Biosludges from wastewater ponds were incorporated into the land at the Chestertown plant using land-farming techniques. The bio-treatment process began in the late 1960s and the land-farming procedures began in 1971 or 1972. Solid wastes were always disposed of elsewhere.

Environmental Investigations

The Tenneco Chemicals site was listed in the 1979 *Waste Disposal Site Survey* prepared by The Subcommittee on Oversight and Investigations of the House Committee on Interstate and Foreign

Commerce (The Eckhardt Report). The report stated that 30,168 tons of chemical process wastes were disposed of on the Chestertown plant site between 1959 and 1979. An undated U.S. Environmental Protection Agency (EPA) computer printout reported that during the same period, 7,500 tons and 6,037,000 gallons of wastes were disposed of on-site.

A 1982, *Hazardous Waste Site Assessment Reports, Final Report* prepared for the EPA and Maryland Department of Health and Mental Hygiene (DHMH) concluded that probably no disposal other than that described by Tenneco officials (burning of liquid wastes in plant boilers and land-spreading of sludge from on-site treatment plant) had occurred on site. They reasoned that DHMH and Maryland Water Resources Administration inspectors conducting regular inspections of the Tenneco site would have noticed any disposal other than that described. The 1982 report further noted that the Tenneco statements regarding on-site waste disposal contradicted information reported in the Eckhardt Report and the EPA printout, and concluded that one possible explanation for the inconsistencies may have been that the Eckhardt Report forms were filled out incorrectly. The report recommended undertaking efforts to reconcile the inconsistencies in reported quantities and testing of the sludges that are incorporated into Tenneco's land using land-farming techniques and of the liquid wastes and plant scraps that are burned in plant boilers to determine if the substances are regulated under the Resource Conservation and Recovery Act.

In May 1984, DHMH conducted another site inspection of the facility to collect groundwater and soil samples (*Site Inspection of Tenneco Chemicals, Incorporated*, 1986). The site was owned by Nu-Dex at the time. The sample results revealed the presence of heavy metals in on-site monitoring wells. The report concluded the source(s) of contamination had not been identified.

In January 1989, a closure plan for Impoundment 314 was submitted to the Maryland Department of the Environment's (MDE) Groundwater/ Underground Injection Control Permits Division by Huls America Inc. and an addendum to the plan was submitted in April 1989. On May 2, 1989, MDE approved the plan and its addendum subject to a sludge-removal schedule, bioremediation installation schedule, and groundwater monitoring requirements. The groundwater monitoring required (1) quarterly monitoring and reporting until achievement of the remediation goal of 700 parts per billion (ppb) or less phthalates in five groundwater monitoring wells for two consecutive quarters, (2) a final report, and (3) quarterly post-closure monitoring and reporting for one year.

In February 1999, the Kent County Sanitary District asked MDE's Water Management Administration, Water Supply Program, for information on the groundwater contamination at the Velsicol property. MDE reviewed the data and concluded the site does not present a risk to the Sanitary District's Worton Water System. In March 1999, MDE noted that the level of phthalates permitted in drinking water had been reduced to 6 ppb.

Current Status

This site is on the State Master List that identifies potential hazardous waste sites in Maryland. The Master List includes sites currently identified by EPA's Comprehensive Environmental Response Compensation and Liability Information System. EPA has given the site a designation of No Further Remedial Action Planned (NFRAP). The designation of NFRAP by EPA does not mean that MDE has reached the same conclusion concerning further investigation at the site. The information contained in the fact sheet presents a summary of past investigations and site conditions currently known to MDE.

Facility Contacts

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