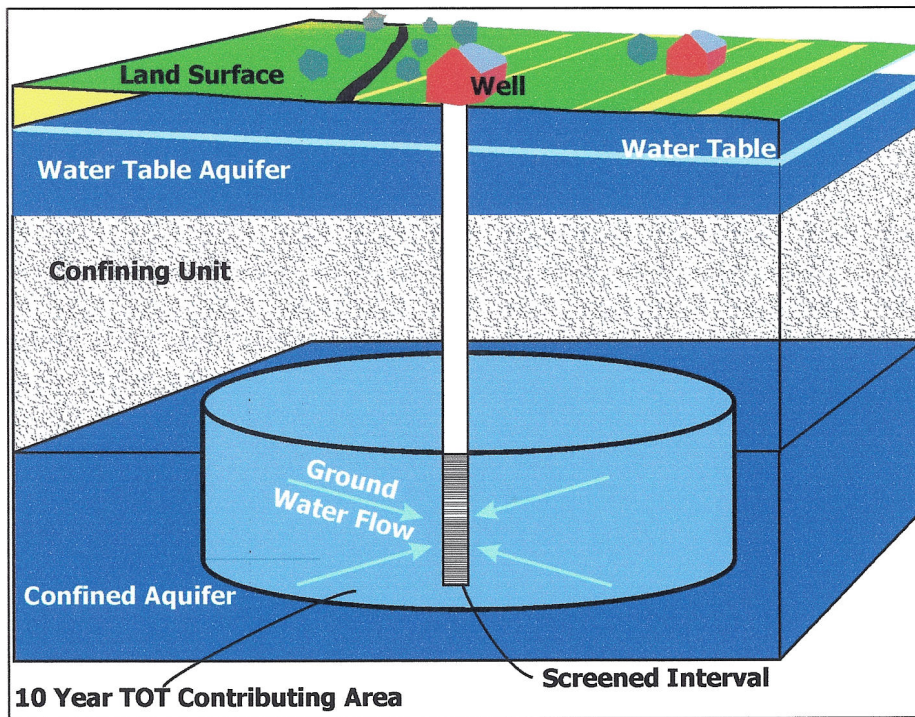


**SOURCE WATER ASSESSMENT  
FOR THE KENNEDYVILLE WATER SYSTEM  
KENT COUNTY, MD**



**Prepared By  
Maryland Department of the Environment  
Water Management Administration  
Water Supply Program  
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## SUMMARY

The Maryland Department of the Environment's (MDE) Water Supply Program has conducted a Source Water Assessment for the Kennedyville Water System. The major 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 management of the assessment area conclude this report.

The source of the Kennedyville's water supply is a naturally protected confined aquifer in the Coastal Plain. Two wells are currently being used to withdraw water out of the aquifer. 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 MDE site visits, database review 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 Area and an aerial photograph of the well location are enclosed at the end of the report.

The susceptibility analysis for the Kennedyville water supply is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that the Kennedyville water supply is not susceptible to inorganic compounds, volatile organic, compounds, synthetic organic compounds, radiological compounds or microbiological contaminants.

## INTRODUCTION

The Kennedyville Water System serves the community of Kennedyville located approximately 7 miles northeast of Chestertown in Kent County (figure1). The Kennedyville Water System is owned and operated by the Kent County Department of Water and Wastewater and serves a population of 300 through 90 connections. The water is supplied by two wells (Nos. 1 and 2), which are pumped on alternate months. Well No. 1 is near the fire station and No. 2 is by the water treatment plant (figure 1). An older well that was located near the fire station was abandoned several years ago.

## WELL INFORMATION

A review of the well data and sanitary surveys of the system indicates that the Well No. 1 was drilled in April 1967 prior to the implementation of the State's current well construction standards, which were implemented in 1973. Well No. 2 was drilled in January 1996 in accordance with the State's well construction standards. Well No. 2 is located in a low-lying area that may be prone to flooding. Wells 1 and 2 have rated yields of 100 and 80 gallons per minute (gpm) respectively. Table 1 contains a summary of the well construction data.

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH	CASING DEPTH	AQUIFER
01	KENNEDYVILLE 1	KE670132	191'	164'	MONMOUTH FORMATION
02	KENNEDYVILLE 2	KE920136	181'	144'	MONMOUTH FORMATION

Table 1. Kennedyville Well Information.

## HYDROGEOLOGY

Kennedyville's wells draw water from a confined aquifer in the Coastal Plan known as the Monmouth aquifer. 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 clayey layers are medium- to dark-greenish gray (Drummond, 1998). The Severn confining unit, which is a green silty clay, overlies the Monmouth aquifer. In the Kennedyville area the upper confining unit occurs between depths of about 86 to 140 feet and the Monmouth aquifer occurs between depths of 140 to 185 feet.

A site-specific aquifer test was conducted after the completion of a test well indicated that the transmissivity of the aquifer is 1,590 gallons per day per feet and the storage coefficient is 0.0000920.

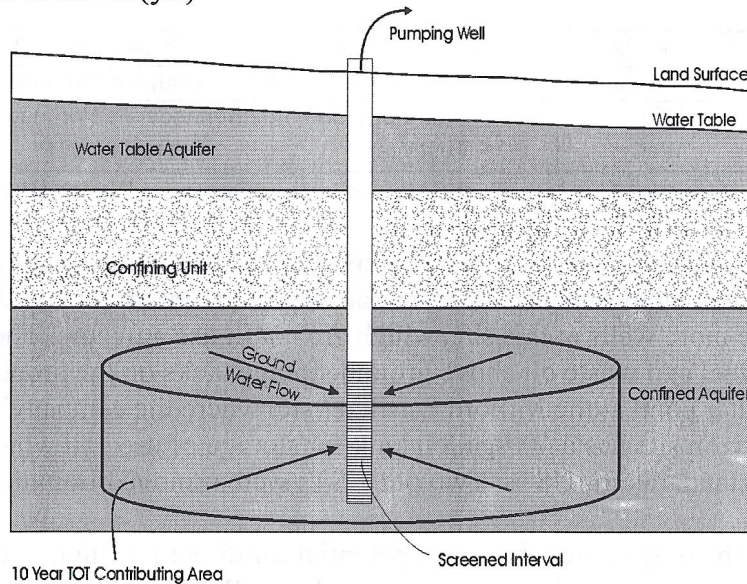
## SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment area for the system. The WHPA was delineated using the methodology described in Maryland's Source Water Assessment Plan (MDE, 1999). For

systems using an average of >10,000 gallons per day, the WHPA is a 10 year time of travel (TOT) zone of transport (figure 1b) determined by using a volumetric equation (Florida Method):

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

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



**Figure 1b. Conceptual illustration of a zone of transport for a confined aquifer**

The pumpage used for determining the WHPA was 21,000 gallons per day (1,024,733 ft<sup>3</sup>/yr), which is the permitted daily average quantity. Based on the lithology of the aquifer, a porosity of 25% was assumed for it. The following parameters were used for the above-mentioned equation:

Q = 1,024,733 ft<sup>3</sup>/yr; n = 0.25; H = 20 ft (for No. 1) and 32 ft (No. 2) t = 10 yrs.  
 The calculated fixed radius for a ten year travel time resulted in r = 808 ft for Well No. 1 and 639 feet for Well No. 2, respectively. The two circles were merged to create one larger WHPA (see figure 2). This WHPA has an area of 51.4 acres.

## POTENTIAL SOURCES OF CONTAMINATION

For this assessment, MDE Waste and Water Management databases were reviewed and a field inspection conducted to identify potential for any direct injection of contaminants into the aquifer in and around the Kennedyville WHPA. Commercial facilities in the WHPA were inspected by MDE Ground Water Permits Division staff to

determine whether there were any unpermitted discharges into ground water. Three facilities in the WHPA were inspected for discharges into ground water. No discharges into ground water were found in any of these facilities.

Potential sources of contamination that were identified are pesticide dealers and an unused well (figure 2). Also listed is an underground storage tank (UST) located just outside the WHPA. Table 2 lists the facilities identified and their potential sources of contaminants. Potential contaminants are grouped as Volatile Organic Compounds (VOC), Synthetic Organic Compounds (SOCs), and Microbiological Pathogens (MP).

ID	TYPE	SITE NAME	ADDRESS	POTENTIAL CONTAMINANT
1	Pesticide Dealer	Southern States	1st Street and Rte 213	SOC, VOC
2	Pesticide Dealer	Milford Fertilizer	Kennedyville Morgnec Rd	SOC, VOC
3	UST	Verizon (formerly C& P)	Kennedyville Morgnec Rd	VOC
3	Well	Test Well	Next to WTP	SOC, VOC, MP

**Table 2. Potential Contaminant Sources in the Kennedyville WHPA**

Southern States has its own supply well in the Monmouth aquifer and another well for its operational use. A basic data report (Tomkins, et al, 1994) indicates that there are three more wells at this site, which are not in use anymore. There are also three above ground fuel and waste oil above ground storage tanks on the property. There is a stormwater pond at the Milford Fertilizer site where the company's trucks are parked. The Verizon site has a 600-gallon tank for storage of used oil which meets the State's current standards for USTs. Two old USTs were removed from this site in 1997.

The only source that has a potential for direct injection of contaminants into the Monmouth aquifer is the test well located near Well No.2. The well was drilled in 1993 and grouted to 140 feet. Both these wells are in a low-lying area that maybe prone to flooding. In addition these wells are adjacent to and also downgradient of a railroad track and may be vulnerable to chemical contamination due to accidents and improper sealing of well caps. All the other potential contaminant sources could impact the shallow Aquia aquifer and not the deeper confined Monmouth aquifer that supplies water to Kennedyville

Three land use categories based on the Maryland Office of Planning 1997 Land Use Map were identified in the WHPA (table 2). Figure 3 shows the land use in and around the Kennedyville WHPA.

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Medium Density Residential	18.36	35.7
Commercial	14.02	27.3
Cropland	19.02	37.0

**Table 2. Land Use Summary for the Kennedyville WHPA.**

A review of the 1995 Kent County Sewer Map shows that 79 % of the WHPA has sewer service with no planned service for the rest of the area (figure 4).

Non-point sources of contamination are usually associated with land use activities in the area. Since Kennedyville's source of water supply is a confined aquifer, the existing land use activities should not have an impact on its water quality.

## **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 data described is for finished (treated) water unless otherwise noted. The treatment currently used at Kennedyville is gaseous chlorination for disinfection, addition of polyphosphate for corrosion control, aeration and filtration for iron removal, and addition of orthophosphate for calcium removal.

MDE personnel discussed water quality issues and concerns with Mr. Robert Sipes who Mr. Sipes indicated that the only water quality concerns that he had was the presence high levels of calcium in the raw water. A review of the monitoring or data since 1993 for Kennedyville's finished water indicates that the system's water supply currently meets the drinking water standards.

### ***Inorganic Compounds (IOCs)***

No IOCs above 50% of the MCL have been detected in the Kennedyville water supply in twenty-one samples that have been collected since 1993 for IOC analysis. Table 3 lists the IOCs that have been detected in the water supply since 1993. MCLs have not been established for sodium and sulfate. The secondary standard for sulfate is 250 ppm. Secondary standards are levels established to indicate when taste, odor or color of the water may be offensive. As can be noted from table 3 the detected levels of the regulated IOCs were well below 50% of the MCLs.

CONTAMINANT ID	CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT (ppm)
1040	NITRATE	10	19-Feb-93	1.9
1040	NITRATE	10	25-Jan-94	1.41
1010	BARIUM	2	15-Aug-94	0.107
1055	SULFATE	none	15-Aug-94	21
1010	BARIUM	2	15-Nov-95	0.4
1041	NITRITE	1	15-Nov-95	0.002
1055	SULFATE	none	15-Nov-95	6.1
1010	BARIUM	2	6-Jul-98	0.41
1025	FLUORIDE	4	6-Jul-98	0.11
1055	SULFATE	none	6-Jul-98	8.7
1052	SODIUM	none	6-Jul-98	2.7
1040	NITRATE	10	19-Nov-98	1.8
1040	NITRATE	10	25-Mar-00	0.4
1052	SODIUM	none	28-Mar-00	90.8

**Table 3. IOC results for the Kenndyville water supply.**

***Volatile Organic Compounds (VOCs)***

No regulated VOCS have been detected above 50% of the MCL in the Kennedyville water supply in twelve samples collected since 1993 for VOC analysis. Unregulated VOCs known as trihalomethanes (THMs) have been detected in samples taken in August 1994 and March 2000. THMs – bromodichloromethane, bromoform, chloroform, and dibromochloromethane, are disinfection by-products which are the result of a reaction between chlorine used for disinfection and organic material in the water supply. THMs are currently regulated only for systems serving a population of over 10,000. The current MCL for regulated systems is 100 ppb for the total of the four above-mentioned VOCs. The total concentrations of the four THMs in the Kennedyville water supply were 9.6 ppb and 1.2 ppb.

***Synthetic Organic Compounds (SOCs)***

No SOC's have been detected in the Kennedyville water supply in four samples collected since 1993 for SOC analysis. Atrazine, which has an MCL of 3 ppb was detected in a sample taken in 1992 at 0.23 ppb. Subsequent sampling have shown no detects of this SOC.

***Radionuclides***

No radionuclides above 50% of the MCL have been detected in the Kennedyville water supply since 1993. Gross beta was detected on 8/2/93 at 1.4 picoCuries per liter (pCi/L) and radon-222 at 60 pCi/L on 3/28/00. Gross beta has an MCL of 15 pCi/L. Currently there is no MCL for radon-222, however EPA has proposed an MCL of 300 picoCuries per liter (pCi/L) or an alternate of 4000 pCi/L if the State has a program to address the more significant risk form radon in indoor air.



### ***Microbiological Contaminants***

No total or fecal coliform has been detected in Kennedyville's water supply in 49 samples collected since 1997. A raw water sample collected from Well No. 1 in February 10, 2000 to determine whether the well is under the influence of surface water showed no detections of total or fecal coliform. No raw water quality data was available for Well No 2.

## **SUSCEPTIBILITY ANALYSIS**

The aquifer that supplies Kennedyville's drinking water is confined and based on the well data a confining bed about 50 feet thick overlies it. The confining layer would prevent the flow of any surface contamination into the aquifer supplying Kennedyville. Only direct injection into the aquifer from point sources within the WHPA like underground injection wells or improperly abandoned wells could cause a potential contamination threat to the supply. 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.

### ***Inorganic Compound (IOCs)***

No IOCs above 50% of the MCL have been detected in the Kennedyville water supply. Nitrate was detected four times (table 3) and may represent background levels found in the aquifer or since three of these detections were over 1 ppm, may have been from past farming activities in the area. Barium, sulfate, and fluoride are naturally occurring minerals in the aquifer material. The sodium may have been the result of the treatment process (ph adjustment).

Based on the above analysis, the Kennedyville water supply is **not** susceptible to IOC contamination.

### ***Volatile Organic Compounds (VOCs)***

No VOCs have been detected in the Kennedyville water supply since 1993. There are no sources of VOC contamination in the WHPA that could impact the confined aquifer.

Based on the above analysis, the Kennedyville water supply is **not** susceptible to VOC contamination.

### ***Synthetic Organic Compounds (SOCs)***

No SOCs have been detected in the Kennedyville water supply since 1993. There are no sources of SOC contamination in the WHPA that could impact the confined aquifer.

Hence the Kennedyville water supply is **not** susceptible to SOC contamination.

### ***Radionuclides***

Gross beta radiation and radon-222 have each been detected once at levels well below the MCL or proposed MCL in the Kennedyville water supply since 1993. The presence of these contaminants is attributed to decay of naturally occurring minerals like uranium in the aquifer sediments.

Based on the above analysis the Kennedyville water supply is **not** susceptible to radionuclides.

### ***Microbiological Contaminants***

Based on coliform sampling data and the aquifer characteristics, the Kennedyville water supply is **not** susceptible to microbiological contaminants.

## **MANAGEMENT OF THE WHPA**

### ***Form a Local Planning Team***

- The team should represent all the interests in the community. The County Department of Water and Wastewater, the County Health Department, local planning agencies, local businesses, residents, developers and farmers within and near the WHPA should work to reach a consensus on how to protect the water supply.

### ***Increase Public Awareness***

- Pamphlets, flyers or bill stuffers sent to local residents, businesses, and farmers will help educate the general public about Wellhead Protection. Emphasis should be placed on sealing unused wells.
- Placing signs at the WHPA boundaries is a good way to make the public aware of protecting their source of water supply.

### ***Conduct Monitoring***

- Continue sampling as required by the Safe Drinking Water Act.
- Annual bacteriological sampling is a good check on well integrity.
- Raw water bacteriological sampling for Well No. 2 should be considered.

### ***Plan and Zone to Protect the Water Sources***

- Continue to stress the importance of a Comprehensive Water and Sewer Plan to ensure that new development (residential and commercial) adjacent to the WHPA is sewerered, and that there are no discharges into the deeper aquifer.
- The County Department of Water and Wastewater should work with the County Planning Department to consider countywide wellhead protection implementation. Grants are available from MDE for wellhead protection projects.

### ***Prepare Contingency Plan***

- Comar 26.04.01.22 regulations require all community water systems to prepare and submit for approval a plan for providing a safe and adequate drinking water supply under emergency conditions.

### ***Changes in Uses***

- Any increase in pumpage or the addition of new wells to the system will require revision of the WHPA since it is affected by pumpage. It is recommended the system contact the MDE Water Supply Program when an increase in pumpage is applied for or when new proposed wells are being considered.

### ***Manage Potential Contaminant Sources and Wells***

- Conduct a detailed survey to ensure that there are no other potential sources of contamination within the WHPA. Updated records of new development within the WHPA should be maintained.
- Work with the County Health Department to ensure that there are no unused wells within the WHPA. An improperly abandoned well can be a potential source of contamination to the aquifer.
- Consider abandoning the test well if it is not being used for monitoring water levels.
- Water operation personnel should have a regular inspection and maintenance program for the wells to ensure their integrity and to protect the aquifer from surficial contamination.

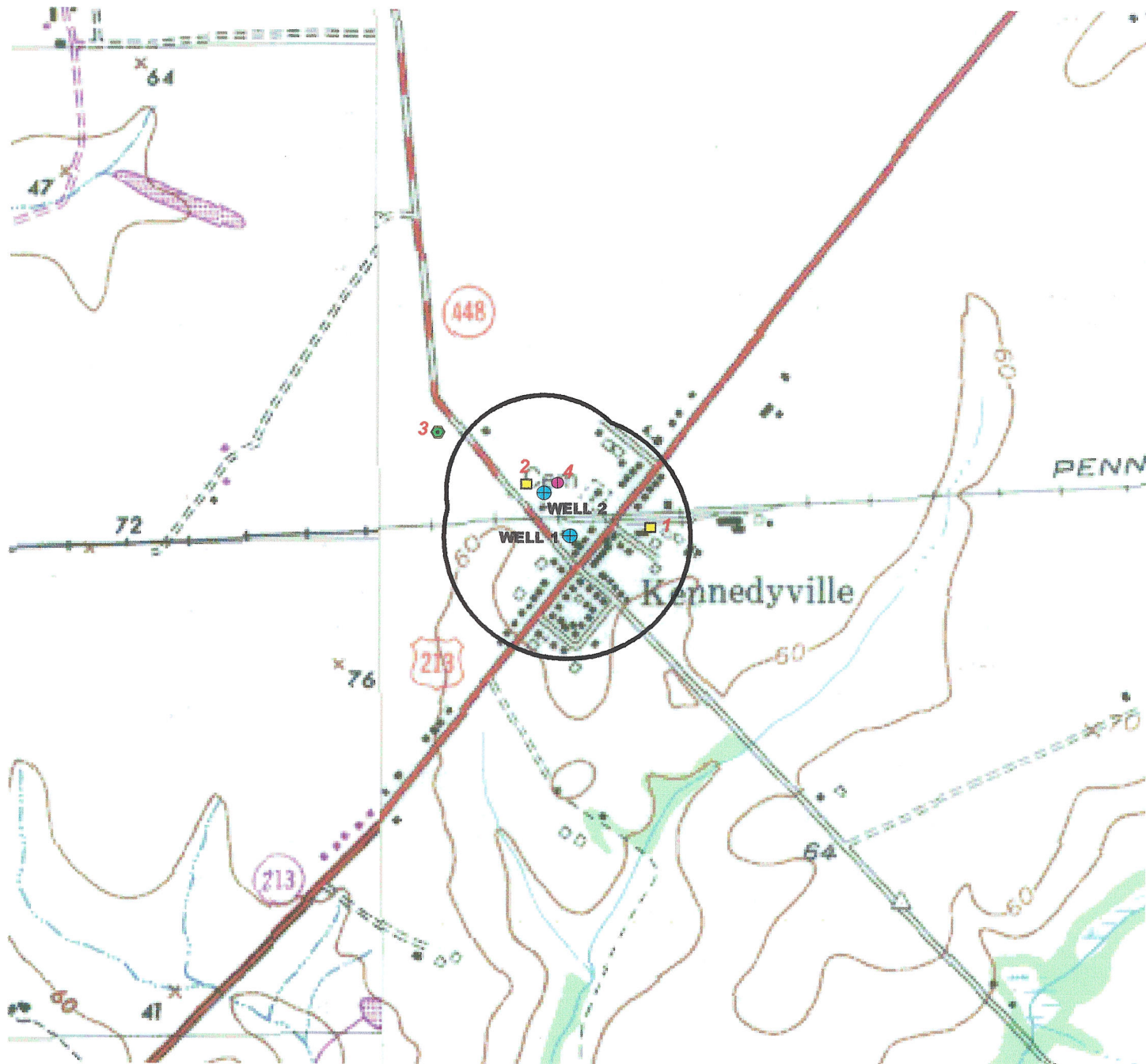
## REFERENCES

- Andrews, Miller & Assoc., Inc. 1994, Contract Documents and Specifications for Contract II Water System Improvements for Kent County Sanitary District, Inc. Kennedyville Water System, 2<sup>nd</sup> Election District, Kent County, Maryland.
- Drummond, D. 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, 76 p.
- 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: Maryland Geological Survey Basic Data Report No. 20, 155 p.
- United States Environmental Protection Agency, Office of Ground-Water Protection, 1987, Guidelines for Delineation of Wellhead Protection Areas.

## SOURCES OF DATA






Water Appropriation and Use Permit No. KE 1967G008  
Public Water Supply Inspection Reports  
Monthly Operating Reports  
Monitoring Reports  
MDE Water Supply Program Oracle Database  
MDE Waste Management Sites Database  
Department of Natural Resources Digital Orthophoto Quarter Quads Rock Hall NW and SW 3/25/95  
USGS Topographic 7.5 Minute Quadrangle – Galena  
Maryland Office of Planning 1997 Kent County Land Use Map  
Maryland Office of Planning 1995 Kent County Sewer Map

## **FIGURES**

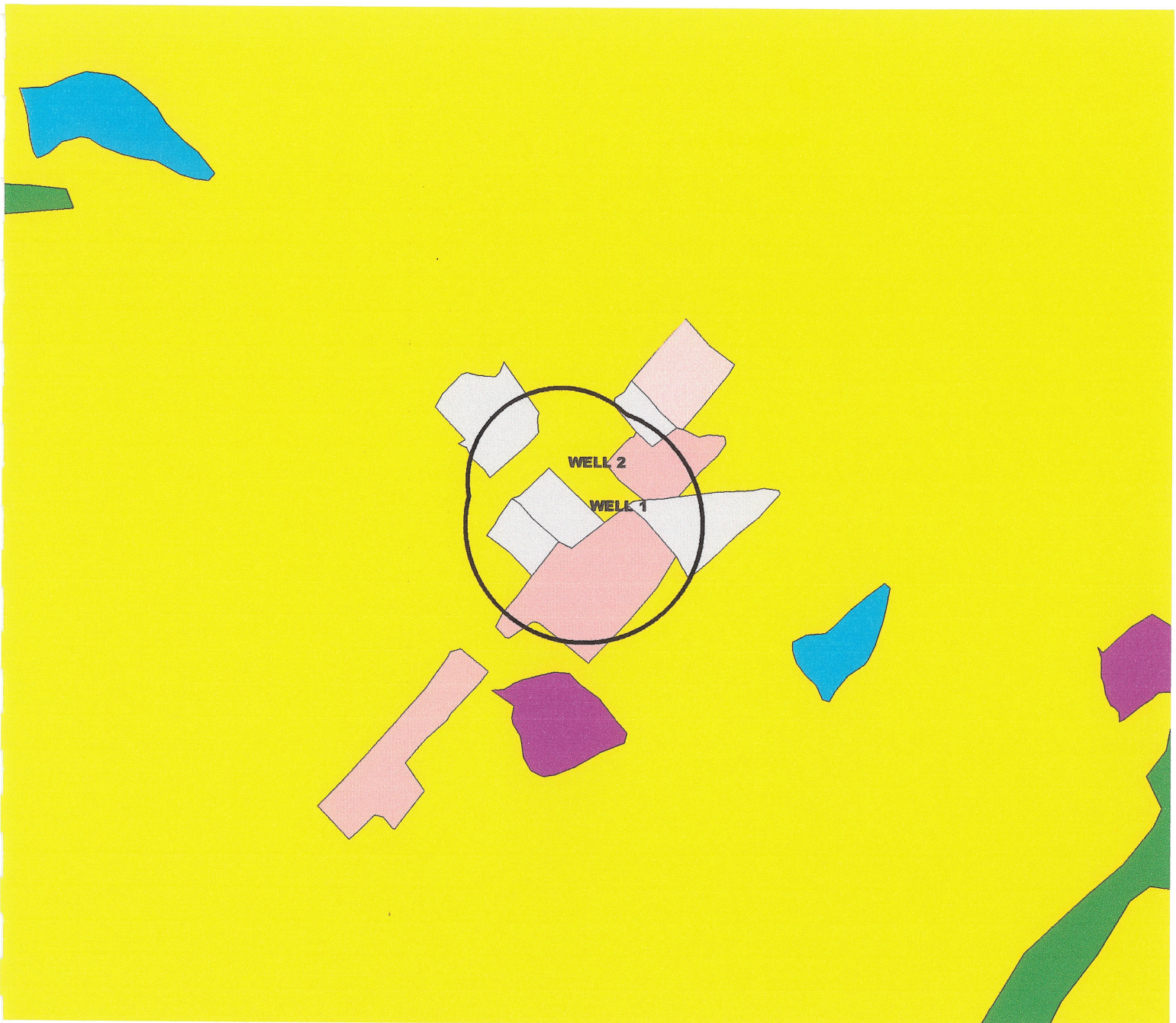


**Figure 2. Kennedyville Wellhead Protection Area with Potential Contaminant Sites**

**LEGEND**

	Pesticide dealer		Supply Well
	Unused well		Wellhead Protection Area
	Underground Storage Tank		

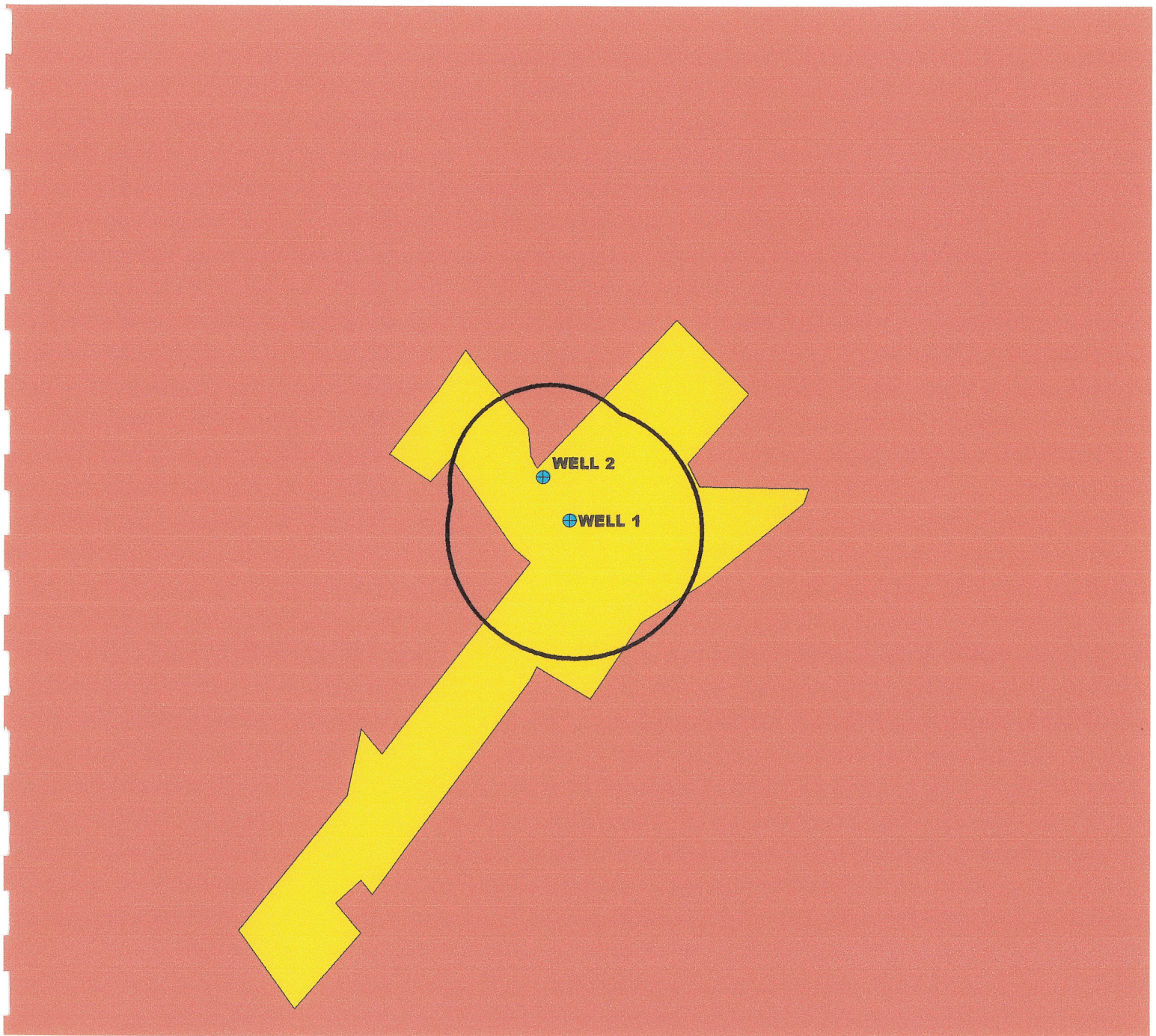




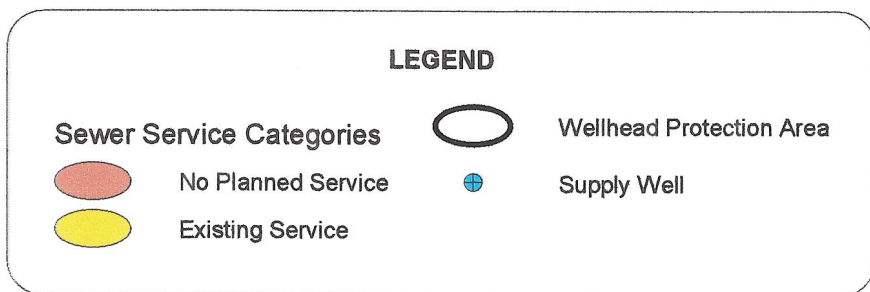
**Figure 3. Land Use Map of the Kennedyville Wellhead Protection Area**



Source: MD Office of Planning 1997 Kent Count Land Use Map



**Figure 4. Sewer Service Map of the Kennedyville Wellhead Protection Area**



Source: MD Office of Planning 1995 Kent County Sewer Map