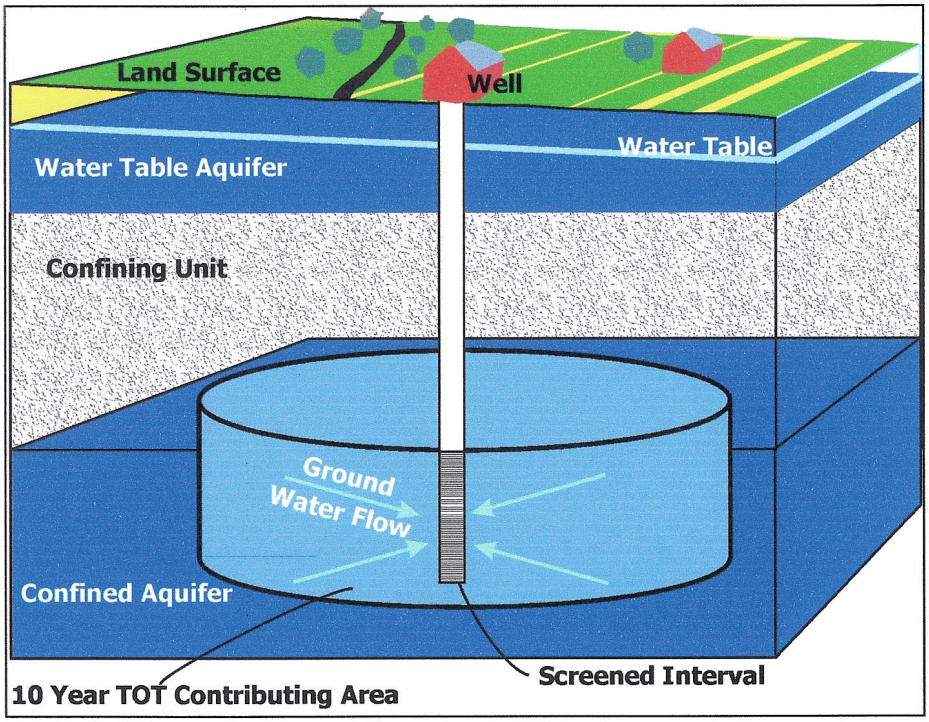
SOURCE WATER ASSESSMENT

FOR THE TOWN OF GALENA

KENT COUNTY, MD



Prepared By
Maryland Department of the Environment
Water Management Administration
Water Supply Program
July 2001

MDE

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SUMMARY

The Maryland Department of the Environment's (MDE) Water Supply Program has conducted a Source Water Assessment for the Town of Galena. 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) an inventory of potential sources of contamination, and 3) determining the susceptibility of the water supply to contamination. Recommendations for management of the assessment area conclude this report.

The source of the Galena's water supply is a naturally protected confined aquifer in the Coastal Plain. Two wells are currently being used to pump the 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 sewer service areas 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 Galena'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 the Galena water supply is not susceptible to inorganic compounds, volatile organic, compounds, synthetic organic compounds, radiological compounds or microbiological contaminants.

INTRODUCTION

The Town of Galena is located about 14 miles northeast of Chestertown in Kent County. The Town owns and operates its water supply system that serves a population of 354 and has 200 connections. Currently, the water is supplied by two wells (Nos. 3 and 4) and their locations are shown in figure 1.

WELL INFORMATION

A review of the well data and sanitary surveys of the system indicates that Well No. 3 was drilled in 1972, which was prior to the implementation of the State's current well construction standards in 1973. Well No. 4 was drilled in 1990 in accordance with the current well construction standards. Both these wells pump between 250 to 270 gallons per minutes (gpm). An older shallower well (No. 1) has been abandoned. Well No.1 was abandoned some years ago and Well No. 2 is unused and not connected to the system. Table 1 contains a summary of the well construction data for the Town's active wells.

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH	CASING DEPTH	AQUIFER
03	GALENA 3	KE720100	477'	447'	PATAPSCO FORMATION
05	GALENA 4	KE880493	500'	432'	PATAPSCO FORMATION

Table 1. Galena Well Information.

HYDROGEOLOGY

The Galena wells pump water from the sediments of the Patapasco Formation of the Coastal Plain. In a recent hydrogeologic report (Drummond, 1998) this aquifer is also referred to as the Upper Patapsco aquifer. The aquifer is confined due to clay beds in the overlying Magothy and Matawan Formations which occur in the Galena area between 250 and 420 feet below ground surface. Thick clay beds below the Upper Patapsco aquifer create a tight confining unit and probably prevent significant flow to or from sands deeper in the formation. The Upper Patapsco aquifer is a light-colored quartz sand, with some feldspar, lignite, and associated pyrite. The color of the sand ranges from white to light pinkish gray and brownish gray. The sand layers are generally 2 to 35 feet thick and are interlayered with variegated silty clay layers (Drummond, 1998). In the Galena area the top of the aquifer occurs between 400 to 420 feet.

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 determined by using a volumetric equation (Florida Method):

$$r = \sqrt{\frac{Qt}{\pi n H}}$$

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.)

Figure 1b is a conceptual illustration of the zone of transport for a confined aquifer.

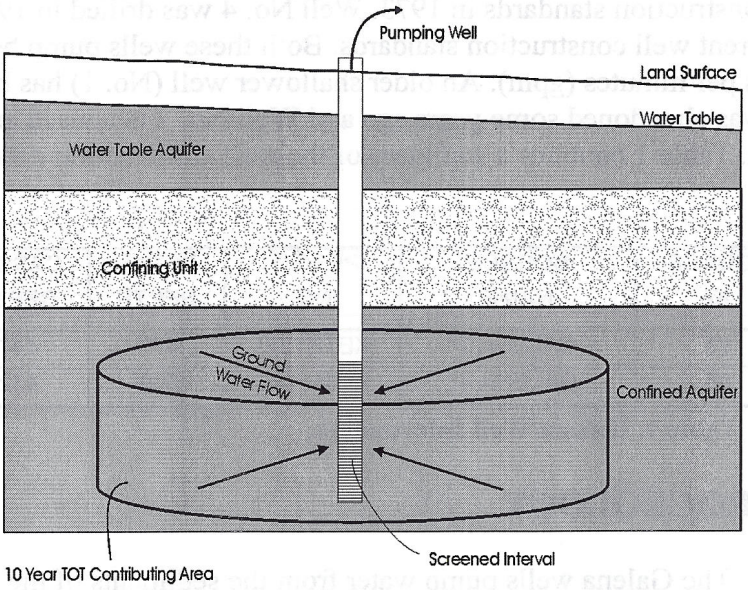

Figure 1b. Conceptual illustration of a zone of transport for a confined aquifer

The pumpage used for determining the WHPA was 90,000 gallons per day (4,391,711 ft^3/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 = 4,391,711 ft^3/yr; n = 0.25; H = 32 ft; t = 10 yrs. The calculated fixed radius for a ten year travel time resulted in r = 1366 ft.

WHPAs for both Well Nos. 3 and 4 were delineated using the above parameters. It must be noted the entire daily average pumpage was assigned to each well for the delineation, this was done to provide for situations when only one well would be pumping all the water for the Town. The WHPA from each well were merged to form one larger WHPA for the system (figure 2). This WHPA has an area of 113.54 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 Galena 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. One facility (see figure 2) was issued a notice of violation for unpermitted discharge to ground water through an open floor drain. The owner was notified to close up the drain and to connect to the Town's sewer and stop the discharge into ground water.

The potential sources of contamination identified were underground storage tanks, a ground water discharge site and unused wells (figure 2). 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), Inorganic Compounds (IOC), Heavy Metals (HM), and Microbiological Pathogens (MP).

ID	TYPE	SITE NAME	ADDRESS	POTENTIAL CONTAMINANT
1	UST	St. Dennis Catholic Civic Ctr	153 N Main St	VOC
2	UST	Harry Rudnick & Sons	N Main St	VOC
3	UST	Grumpy's Mart	101N Main St	VOC
4	UST	Bell Atlantic	103 S Main St	VOC
5	UST	Galena Middle School	114 S Main St	VOC
6	UST	Firehouse Antiques Ctr	100 E Cross St	VOC
7	UST	Galena VFD	Route 290	VOC
8	GWD	Power King Automotive	Route 290	VOC
9	WELL	Galena Well No.2	Jarman & Cross St	VOC, SOC, MP
10	WELL	Galena Well No.4T	Off Boxwood La	VOC, SOC, MP

Table 2. Potential Contaminant Sources in the Galena WHPA

The only source that may be a potential for direct injection of contaminants into the Upper Patapsco aquifer is Well 4T which is around 471 ft. deep. The Galena Well No. 1 is 150 ft. deep and terminates in the shallow Aquia aquifer. All the other potential contaminant sources could impact the shallow aquifer and not the deeper confined aquifer that supplies water to Galena.

Based on the Maryland Office of Planning 1997 Land Use Map, six land use categories were identified in the WHPA (table 2). Figure 3 shows the land use in and around the Galena WHPA. It must be noted that a field inspection of the WHPA indicated that the cropland area in the northwest portion is now has a residential subdivision resulting in the current acreage for medium density residential being higher and cropland being lower than indicated in table 2.

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	43.71	23.1
Medium Density Residential	24.28	12.8
High Density Residential	3.89	2.0
Commercial/Institutional	29.14	15.3
Cropland	81.47	43.0
Forest	7.28	3.8

Table 3. Land Use Summary for the Galena WHPA.

A review of the 1995 Kent County Sewer Map shows that 82 % 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 Galena's source of water supply is a confined aquifer, the current 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 only treatment currently used at Galena is gaseous chlorination for disinfection.

MDE personnel discussed water quality issues and concerns with Mr. Palmer Councell, Superintendent for the Galena Water System. Mr. Palmer indicated that he had no specific water quality concerns but was interested in measures to protect the water supply from contamination. A review of the monitoring or data since 1993 for Galena'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 Galena water supply since 1993. Table 3 lists the IOCs that have been detected in the water supply since 1993.

PLANT NO	CONTAMINANT ID	CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT (ppm)
1	1010	BARIUM	2	26-Dec-95	0.055
1	1025	FLUORIDE	4	26-Dec-95	1.41
1	1025	FLUORIDE	4	13-Mar-97	0.34
1	1052	SODIUM	none	13-Mar-97	63.5
1	1055	SULFATE	none	13-Mar-97	6
1	1041	NITRITE	1	13-Mar-97	0.002
1	1025	FLUORIDE	4	28-Mar-00	0.34
1	1040	NITRATE	10	28-Mar-00	0.8
1	1052	SODIUM	none	28-Mar-00	56
1	1028	IRON	none	28-Mar-00	0.11
2	1025	FLUORIDE	4	23-Sep-92	0.47
2	1041	NITRITE	1	23-Sep-92	0.04
2	1040	NITRATE	10	23-Sep-92	0.05
2	1010	BARIUM	2	7-Feb-95	0.059
2	1020	CHROMIUM	0.1	7-Feb-95	0.003
2	1010	BARIUM	2	26-Dec-95	0.056
2	1055	SULFATE	none	13-Mar-97	7.8
2	1052	SODIUM	none	13-Mar-97	63.4
2	1041	NITRITE	1	13-Mar-97	0.002
2	1025	FLUORIDE	4	13-Mar-97	0.35
2	1025	FLUORIDE	4	6-Jul-98	0.35
2	1052	SODIUM	none	6-Jul-98	67.4
2	1055	SULFATE	none	6-Jul-98	10.1
2	1040	NITRATE	10	6-Jul-98	0.2
2	1025	FLUORIDE	4	28-Mar-00	0.34
2	1052	SODIUM	none	28-Mar-00	58.1
2	1040	NITRATE	10	28-Mar-00	0.6

Table 4. IOC results for the Galena water supply.

MCLS have not been established for sodium, iron or sulfate. The secondary standards for iron and sulfate are 0.3 ppm and 250 ppm, respectively. Secondary standards are levels established to indicate when taste, odor or color of the water may be offensive.

Volatile Organic Compounds (VOCs)

Thirteen samples have been collected since 1993 for VOC analysis. None of the samples contained VOC above 50% of the MCL. Two compounds were detected at low levels in two isolated samples and their presence in not believed to be related to the quality of the source water. Toluene was detected at Plant 1 (Well No.3) at 0.8 ppb on 6-7-98. The MCL for toluene is 1000 ppb. Xylenes were detected at Plant 1 (Well No. 3) at 5.5 ppb and 2.3 ppb on 6-7-98 and 10-21-98 respectively. The MCL for total xylenes is 10,000 ppb. These VOCs have not been detected in subsequent samples.

Also detected in two samples taken in July and October 1998 were disinfection by-products know as trihalomethanes – bromodichloromethane, bromoform,

chloroform, and dibromochloromethane. Trihalomethanes 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 trihalomethanes in the Galena water supply were 1.6 ppb to 5.0 ppb. Disinfection by-products are the result of a reaction between chlorine used for disinfection and organic material in the water supply.

Synthetic Organic Compounds (SOCs)

No SOCs have been detected in the Galena water supply since 1993.

Radionuclides

No radionuclides above 50% of the MCL have been detected in the Galena water supply since 1993. Table 4 lists the radionuclides that have been detected at levels below 50% of the MCL. 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.

PLANT ID	CONTAMINANT ID	CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT (ppm)
1	4004	RADON-222	300/4000*	11-Apr-94	120
1	4100	GROSS BETA	50	13-Mar-97	3
1	4004	RADON-222	300/4000*	5-Jun-97	55
1	40AS	GROSS ALPHA (SHORT TERM)	15	22-Sep-98	5.16
1	41BS	GROSS BETA (SHORT TERM)	50	22-Sep-98	6.89
1	4100	GROSS BETA	50	22-Sep-98	5.31
1	4000	GROSS ALPHA	15	22-Sep-98	3.81
1	4000	GROSS ALPHA	15	26-Feb-01	3
1	4100	GROSS BETA	50	26-Feb-01	7
2	4004	RADON-222	300/4000*	11-Apr-94	160
2	4000	GROSS ALPHA	15	13-Mar-97	3
2	4100	GROSS BETA	50	13-Mar-97	4
2	4004	RADON-222	300/4000*	5-Jun-97	60
2	4000	GROSS ALPHA	15	26-Feb-01	2
2	4100	GROSS BETA	50	26-Feb-01	4

*proposed

Table 5. Radionuclide results for the Galena water supply.

Microbiological Contaminants

No total or fecal coliform has been detected in Galena's raw or finished water since 1993.

SUSCEPTIBILITY ANALYSIS

The aquifer that supplies Galena's drinking water is confined and based on the well completion reports several confining beds overlie it. These confining layers would prevent the flow of any surface contamination into the aquifer supplying Galena. 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 criteria 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 Galena water supply. Nitrate/nitrite levels detected are probably background levels found in the aquifer. Barium, chromium, sodium, fluoride, sulfate and iron are naturally occurring minerals in the aquifer material.

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

Volatile Organic Compounds (VOCs)

Toluene was detected once and xylenes were detected twice in Galena's water supply. These were detected at very low levels and have not been detected since 1998. These may have been the result of paints used for maintenance of the water system. Several sources of VOCs have been identified in the WHPA. Due to the confined nature of the aquifer VOCs will not be able to be directly injected into the aquifer, except through a well in the same aquifer. Well No. 4T is in a secure area near a treatment plant and has a sealed well cap.

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

Synthetic Organic Compounds (SOCs)

No SOCs have been detected in the Galena water supply since 1993. There are no sources of SOC contamination in the WHPA that could impact the confined aquifer. Hence the Galena water supply is **not** susceptible to SOC contamination.

Radionuclides

Gross alpha and gross beta radiation have been detected below 50% of the MCL. Of the four radon-222 detections, one may be above 50% of the one of the proposed MCLs for it of 300 pCi/L. 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 Galena water supply is **not** susceptible to radionuclides.

Microbiological Contaminants

Based on coliform sampling data and the aquifer characteristics, the Galena 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 Town's Water and Wastewater operations, 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.

Public Awareness and Outreach

- Pamphlets, flyers or bill stuffers sent to local residents, businesses, and farmers will help educate the general public about Wellhead Protection. Emphasis should be on properly 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.

Monitoring

- Continue sampling as required by the Safe Drinking Water Act.
- Annual bacteriological sampling is a good check on well integrity.

Planning/New Development

- 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 sewered, and that there are no discharges into the deep aquifer.

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.

Contaminant Source Inventory Updates/ Well Inspections

- 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.
- Abandon Well Nos. 2 and 4T according to the State construction standards to protect the aquifer from contamination
- 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

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 1971G003
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: Galena NE and Millington NW 3-25-95
USGS Topographic 7.5Minute Quadrangle – Galena
Maryland Office of Planning 1997 Kent County Land Use Map
Maryland Office of Planning 1995 Kent County Sewer Map

FIGURES

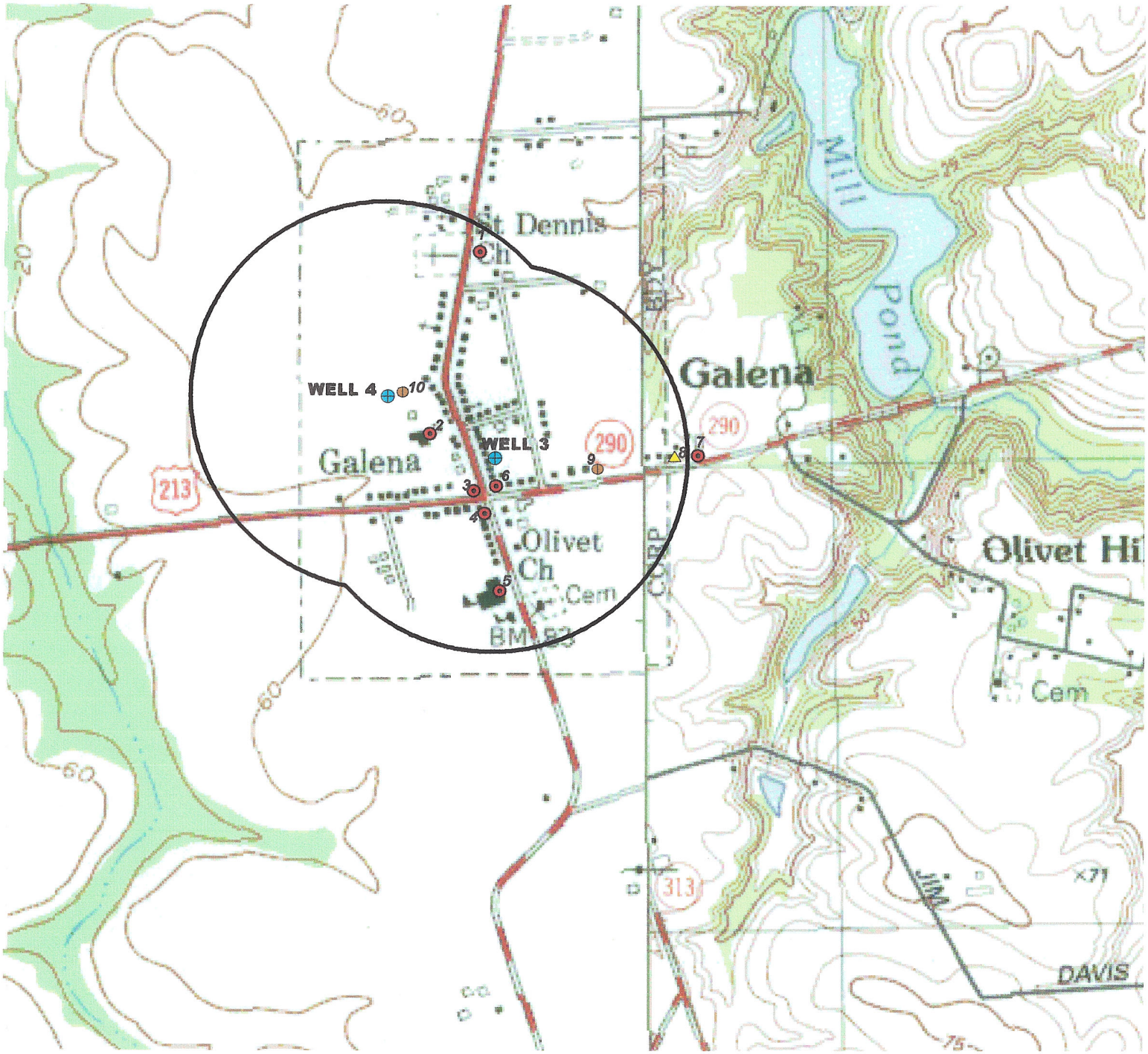

Figure 2. Galena Wellhead Protection Area with Potential Contaminant Sites

LEGEND

- Underground Storage Tank
- Supply Well
- Ground Water Discharge
- Wellhead Protection Area
- Unused Well

N

1000 0 1000 Feet

Base Map: USGS Topographic 7.5 Minute Quadrangle - Galena, MD

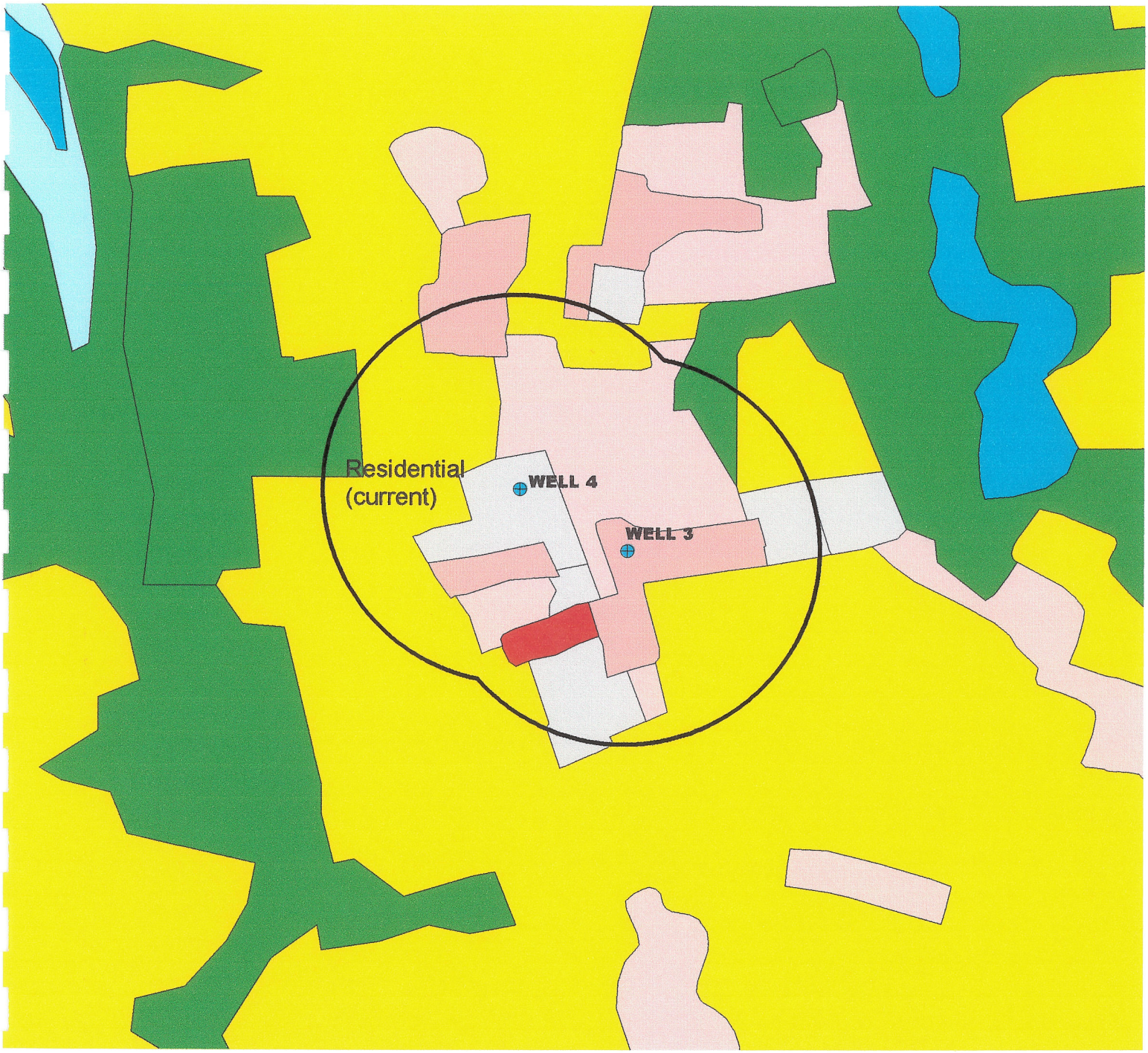

Figure 3. Land Use Map of the Galena Wellhead Protection Area

LEGEND

Land Use Categories

- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial
- Cropland
- Forest
- Water
- Wetlands
- Wellhead Protection Area
- Supply Well

1000 0 1000 Feet

N

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

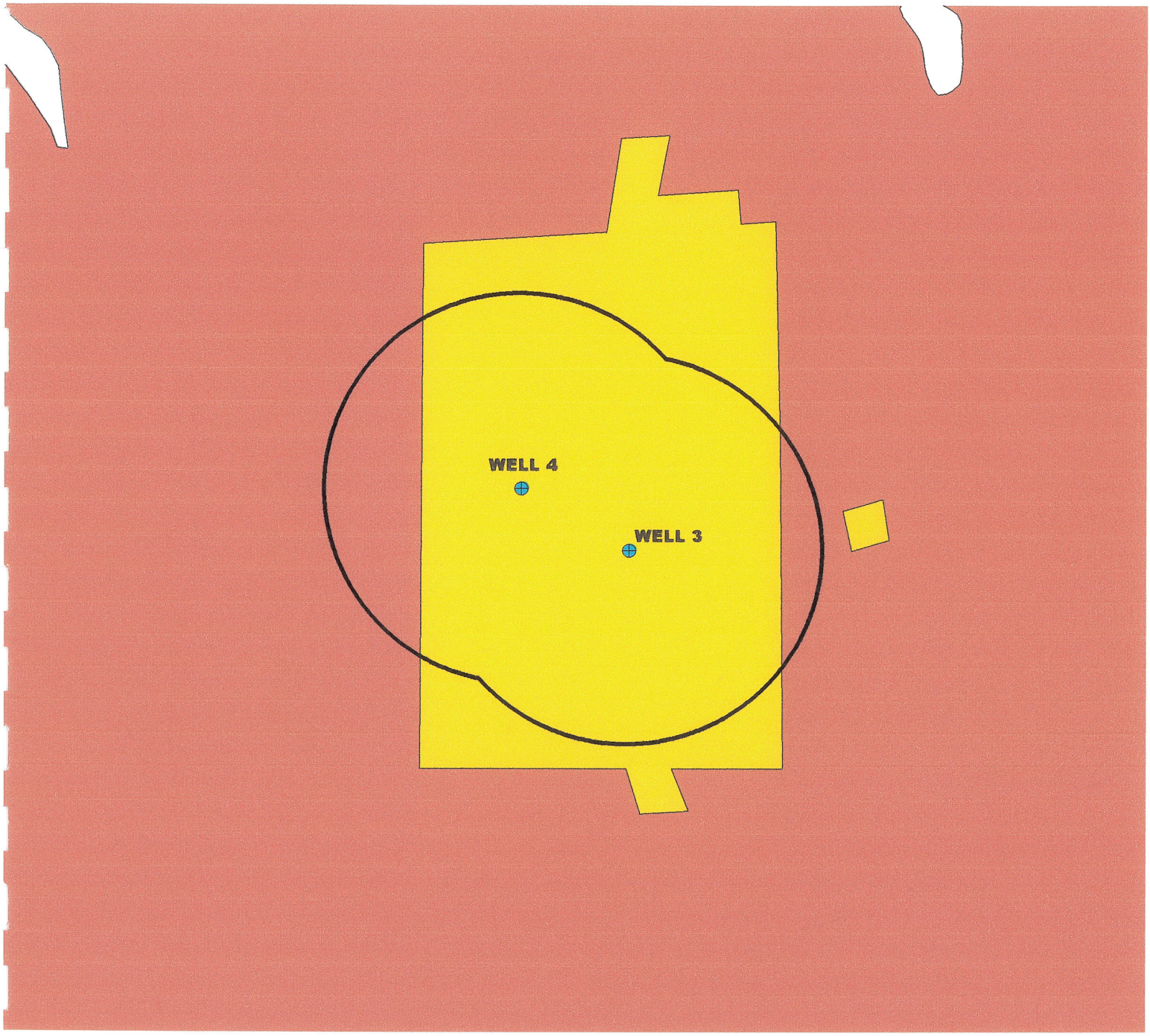

Figure 4. Sewer Service Map of the Galena Wellhead Protection Area

LEGEND

Sewer Service Categories
- No Planned Service
- Existing Service

Wellhead Protection Area

Supply Well

1000 0 1000 Feet

N

Source: MD Office of Planning 1995 Kent County Sewer Map