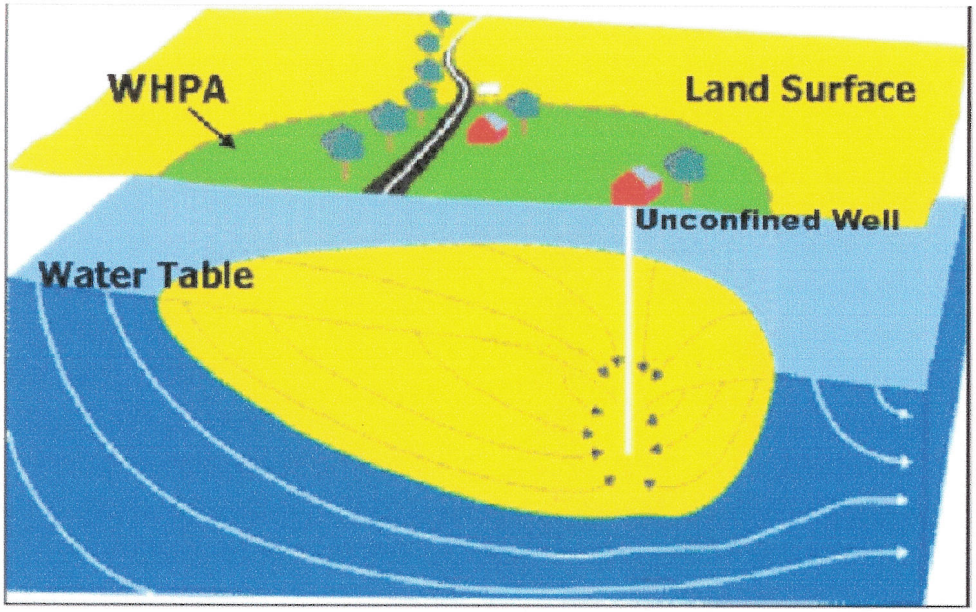
Source Water Assessment

For Transient Water System's
Kent County, Maryland



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Summary

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for 62 Transient noncommunity water systems in Kent County. The required components of this report as described in Maryland's Source Water Assessment Program (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.

Confined aquifers protect water supplies from contaminants originating on the land surface. Transient water supply systems in Kent County use both confined and unconfined aquifers. Sixty-six (66) wells supply Kent County's 62 transient systems. Nineteen (19) of these are completed in confined aquifers and 47 are completed in unconfined aquifers. The Source Water Assessment Areas for all unconfined wells were delineated by the WSP using EPA approved methods specifically designed for each source.

Potential point sources of contamination within the assessment areas were identified from field inspections and contaminant inventory databases. Common potential sources of contamination are on-site septic systems and underground storage tanks. The Maryland Office of Planning's 1997 land use map for Kent County was used to determine which land use was present in each assessment area. Open urban land and residential land uses were most commonly identified within the assessment areas. Figures showing well locations, assessment areas and potential contaminant sources overlain on aerial photographs were produced for all of the unconfined sources.

For each system, the WSP reviewed water quality results, along with the presence of potential sources of contamination in the individual assessment areas, the integrity of the system's well, and the inherent vulnerability of the aquifer. It was determined that some of the transient systems are susceptible to contamination by nitrates, volatile organic compounds, and microbiological contaminants. Sources using confined aquifers were determined not to be susceptible to these contaminants. Table 2 highlights those systems with nearby sources of volatile organic compounds, and Table 7 summarizes the susceptibility analysis for nitrates and microbiological contaminants. Most of the supply sources were not found to be susceptible to these contaminants and the evidence of proper well construction practices were observed from on-site inspections throughout the county.

INTRODUCTION

The Water Supply Program (WSP) has conducted a Source Water Assessment for 62 transient noncommunity water systems in Kent County (Figure 1). As defined in Maryland's Source Water Assessment Plan (SWAP), a transient noncommunity water system is any noncommunity water system that does not regularly serve at least 25 of the same individuals over 6 months per year. Some good examples of transient water systems include hotels, restaurants, parks, fire departments, and churches. The transient systems must sample for two contaminants. The first is coliform, which is an indicator that other microbiological contaminants could be in the water supply. Systems are required to test for coliform regularly. Additional sampling is required following positive coliform results. The second contaminate is nitrogen in the form of nitrite or nitrate. This SWAP report will focus on these two contaminants, but will address other obvious potential sources of contamination.

Kent County is located on the Upper Eastern Shore portion of the State. Kent County is part of the Coastal Plain physiographic province. The Coastal Plain, geologically the youngest province in Maryland, covers nearly half of the State and cosists entirely of unconsolidated sediments. All of the transient water supplies obtain their water from wells of various size and depth. Some of these wells are completed in confined aquifers, while others are using unconfined aquifers. For the purpose of this report, depth of well, lithology, and nitrate data were used to determine weather the wells are in confined or unconfined aquifers. An accurate determination of the aquifer type is very important because no assessment area needs to be defined for the confined systems.

WELL INFORMATION

Well information for each system was obtained from the WSP's database, site visits, well completion reports, sanitary survey inspection reports, and published reports. A total of 66 wells are used by the 62 transient systems assessed in this report. The well tag number, which provides vital well information, was found for 48 of the 66 wells (Table 1). From the well tag information, ground water appropriation data, and with the nitrate sampling data it was concluded that 19 wells are completed in confined aquifers (Aquifer code "C"). The remaining 47 wells are completed in unconfined aquifers (Aquifer code "U"). Table 1 contains a summary of the well information for each system.

Good well location information for the Kent Co. transient systems was marginal at best at the start of this SWAP. It was decided that more accurate well locational information would have to be obtained to determine well contribution areas. Locations of 43 of the 47 unconfined wells were taken with a GPS and differential corrected to increase the precision of each location. Information was found that at least 45 of the 66 wells were completed after 1973, which is when the state adopted the well completion standards for wells. Almost all of the wells that were visited were in excellent condition and above grade.

HYDROGEOLOGY

Kent County is located on the Upper Eastern Shore of Maryland. The entire county is located in the Coastal Plain physiographic province. All of the wells in Kent County draw water from unconsolidated sediments. Ground water flows through pores between gravel, sand, and silt grains in unconsolidated sedimentary aquifers. Confined aquifers are those formations that are overlain by a confining layer such as clay or fine silt, which transmits very little water. Unconfined aquifers are those formations that do not have a confining layer. Unconfined aquifers are also known as water table aquifers. Precipitation that falls on the ground surface infiltrates directly into the unconfined aquifer in a short time. The unconsolidated sediment formations possess a large quantity of ground water. Transient water systems in Kent County pump water from one of four aquifers. The first, and the shallowest in Kent County, is the Quaternary Formation. The Quaternary aquifer is always unconfined in Kent County. The second aquifer is the Aquia Formation. This aquifer is also always unconfined in Kent County. The next aquifer is the Magothy. The Magothy Aquifer can be confined or unconfined depending on where in Kent County the well is drilled. The third aquifer, the deepest of these four that the Transient Systems draw from, is the Upper Patapsco Aquifer (formerly Non-Marine Cretaceous). This aquifer is always confined in Kent County.

Quaternary Aquifer (110C)

The Quaternary Formation is the youngest deposits on the Eastern Shore. Most of this formation is sand and gravel with some layers of silty clay and clay. The thickness of the deposits range from 10 to 100 feet across Kent County but most of the formation is less than 40 feet thick. The water quality of the Quaternary Formation can vary dependant on the local soil types and land use. One of the big concerns for this formation is farming which can cause pesticide contamination or elevated nitrate and/or nitrite levels. Low pH along with high iron is also a concern for some sources and must be treated before using (DNR, 1987).

Aquia Aquifer (125B)

The Aquia Formation was deposited in a shallow marine environment during the Paleocene period, around 60 million years ago. The formation consists of greenish-brown sand that is mixed with layers of grayish-green clay and shell debris. The outcrop area of the Aquia is wide band that extends from the northeast to the southwest across most of Kent County. Although the Aquia is known to contain hard water in most areas where it is a viable aquifer, from the calcium in the shell debris, the water is soft around the outcrop area. Low pH and high dissolved iron can sometimes be a problem at the outcrop area. Overall, in Kent County, the Aquia Formation water quality is an excellent source for drinking water (DNR, 1987).

Magothy Aquifer (211D)

The Magothy Aquifer was created in the Cretaceous age, between 66 and 144 million years ago. It consists of light gray to white loose sand and fine gravel, containing interbedded clay layers. The Magothy Formation underlies almost the

entire Eastern Shore. Part of the Magothy outcrop area is a band that extends from Tolchester Beach north east to the Sassafras River (Drummond, 1998). For this reason the Magothy Aquifer can be either unconfined or confined in Kent County. Since the Magothy is so extensive, water quality can vary from county to county. In some areas the Magothy contains high levels of Radium, but this was not found to be the case in Kent County. High Iron and/or manganese concentrations would be most likely encountered in sources drawing from the Magothy in Kent County. This aquifer usually requires treatment to be a source for drinking water in Kent County (DNR, 1987).

Upper Patapspco (217D)

The Upper Patapsco Formation is the deepest aquifer that water is pumped from for the transient systems in Kent County. The formation is consists of light-colored quartz sand, with some feldspar, lignite, and associated pyrite. This aquifer underlies all of Kent County. Treatment is almost always required to remove the high iron and/or manganese concentration from the water in this aquifer (DNR, 1987).

SOURCE WATER ASSESSMENT AREA DELINEATION

When Maryland's SWAP was developed the delineation area for the unconfined transient systems using <10,000 gpd was not yet determined. This was because of an ongoing study between The United States Geologic Survey and MDE. One of the objectives of this study was to determine ground water flow paths for systems pumping <10000 gpd in unconfined Coastal Plain aquifers. The study concluded that small users, pumping <10,000 gpd, have no effect on the ambient ground water flow in unconfined aquifers. Using this information MDE created a wedge shape delineation area that will be used for all the transient systems using <10,000 gpd from unconfined aquifers, where the ground water flow direction is known. The wedge is based on an annual recharge of 1 ft and ground water flow directions. The wedge shape has an angle of 60 degrees that will extend against the ground water flow direction for a length of 1000-ft (Figure 2). A circle with a radius of 1000 ft will be used for all systems that pump from unconfined aquifers where the ground water flow direction is not known. As defined in Maryland's SWAP, no delineation area will be created for the transient systems drawing from confined sources. This is because the monitoring of these wells for their regulated contaminants and geologic protection have established that they are not vulnerable to contamination.

POTENTIAL SOURCES OF CONTAMINATION

As stated in the introduction, the focus of this SWAP is on the sources of contamination that would cause a coliform or nitrite/nitrate problem in the unconfined aquifers. Potential sources of contamination can be broken into two types. The first type is point source contamination. Some examples of potential point source contaminants would be feed lots, discharge permits, and underground storage tanks. The second type of potential sources of contaminants is non-point sources. Some types of non-point

sources can include general row-crop farming; land application of waste, pesticide and herbicide application, and various land uses. On-site septic systems are often referred to as non-point pollution as they are very common in non-sewered residential areas. Over 300,000 households in Maryland rely on on-site sewerage disposal for domestic wastes. In this project the location of specific septic systems were identified. Therefore they have been included with point sources.

Point Sources

Potential point sources of contamination have been identified within the Source Water Assessment Area at 16 of the 43 unconfined systems. The WSP has located and mapped 18 on-site septic system for the 43 transient systems in Kent Co. Of the 18 mapped septic systems 9 are located inside the zone of contribution for the system's well. One system's contribution zone includes CERCLA site MD-469. Using WSP's current geographic information, 6 systems that have underground storage tanks (USTs) were identified near the supply wells within the well zone (Table 2). The locations of the UST were not field verified. The geographic information on the USTs is not accurate enough to determine whether or not some USTs are within the assessment areas. Although the volatile organic Compounds (VOC), which are the main contaminants of concern with UST's, are not sampled for under the current Transient System Regulations, they were mapped. All of the potential point sources of contaminants in source water assessment areas for unconfined wells are identified in figures 3a-3aa. Figure 3 shows where each individual system is located within the county.

Non-Point Sources

The Maryland Office of Planning's (MOP) 1997 Land Use map for Kent County was used to identify predominant types of land use within the SWAP areas (Figure 4). The largest proportion of land use for the SWAP areas is open urban land at 41.77%. The open urban land designation predominatly reflects the use of the property of the transient water supply. The next 3 land uses; pasture, low-density residential, and medium density residential contribute another 36.44% (Figure 5). These types of land use would be expected since most of the systems are located in small population centers in a rural county. These 3 types of land use are somewhat favorable within the assessment area, because there is a lower probability of ground water contamination compared to some types. Ground water contamination of unconfined aquifers is possible from a high density of multiple on-site systems, or from over fertilization of lawns and cropland. In spite of the dominance of cropland in the county this use is infrequently present within the SWAP areas.

The Maryland Office of Planning 1996 Kent County Sewer map shows that only 3.5 percent of the county currently has sewer service (Figure 6). At this time there is no plan to extend or create new sewer services to the other 96.5 percent of Kent County.

WATER QUALITY DATA

Water quality data was reviewed from the Water Supply Program's database for Safe Drinking Water Act (SDWA) contaminants. All data reported is from the water supplied to consumers. 8 out of the 62 Kent County Transient Systems are known to have some type of water treatment. Table 3 summarizes the treatment methods and the reason for that treatment. With only 8 out of 62 systems having treatment it can be concluded that the ground water quality is good in Kent County. Only one of the systems uses disinfection. If coliforms in the finished water for the other 61 systems are not present this data can be used to evaluate ground water or source water quality. A review of the monitoring data, Table 4 and Table 6, indicate that the finished water supplied by the transient systems is also meeting health standards.

Nitrogen compounds/and (IOCs)

Water quality data indicates that the nitrogen levels for almost all of these 62 systems are <50% of the SDWA maximum contaminate level (MCL) standards with a few exceptions for nitrate (Table 4). Table 5 shows all of the nitrate samples that were above 50% of the MCL. Only these systems had levels greater than 50% of the MCL. If the result exceeded 10 ppm, which is the MCL for nitrate, it is shown in bold. Willards Delmarva Agri. Service no longer uses the unconfined well that their high nitrate samples came from.

None of the other IOC, almost all of which were nitrite samples, samples taken at any of the transient system exceeded even 50% of the applicable MCL.

Microbiological Contaminants

All of the transient water suppliers are routinely sampled at least quarterly for microbiological contamination. If this routine sample is positive the system must then resample within 24 hours or as soon as possible. This bacteriological sampling is required by the SDWA (Table 6). Twenty-five of the systems have never had a positive bacteriological sample. Only 5 systems, all without disinfection treatment, have had more than 5 positive samples since 1996.

SUSCEPTIBILITY ANALYSIS

Wells serving the Kent County Transient Water Systems all draw their water from wells in unconsolidated sedimentary aquifers. Some of these wells are in confined aquifers and others are in unconfined aquifers. The wells drawing from confined aquifers are protected, if the well is constructed correctly, and are not susceptible to contamination from surface activity. The unconfined aquifer wells are susceptible to contamination from surface activities. Kent County's unconsolidated sediments, and soil, provide protection from microbiological contamination as water percolates through the overlying soil and aquifer sediments. However, nitrate and other water-soluble contaminates can percolate through the soil and contaminate unconfined wells. This is evident in the elevated nitrate levels in a few unconfined wells (see Table 7).

Inorganic Compounds

Nitrate was found to be above 5 ppm or greater in 3 of the 62 systems. Willards Delmarva Agri. Service Inc. had to drill a new well, in a confined aquifer, as a source of drinking water because of the high nitrate levels. This system is a good example of how land use effected the shallow aquifer but did not effect the confined aquifer where the nitrate levels are very low. The very high levels and the ongoing storage of nitrogen compounds at Willards Delmarva Agri Service suggest that activities at this facility caused their old well to exceed maximum contaminant levels. Gregg Neck Boat Yard has had a high nitrate since 1997. A large percentage of the assessment area, according to the 1997 MOP land use, is medium density residential. This area does not have public sewer so multiple on-site septic systems are most likely contributing to the high nitrate levels in the unconfined aquifer. A large percentage of Bay County Campground's assessment area is cropland. The cropland may be the reason that this system has high nitrate levels. Both of these systems may want to drill deeper wells to alleviate the nitrate problem.

Microbiological Contaminants

As stated earlier in this report, if there are no well construction problems with a well drawing from a confined aquifer the supply should be safe from microbiological contamination. A review of table 6 indicates that 11 of the 19 confined systems have had at least one positive total coliform sample in the past five years. These 11 systems most likely have or have had at one time storage or a distribution problem or repair that introduced the coliform into the system. Correctly disinfecting the water system is very important after pulling a well pump or completing improvements to the distribution system. Wells may also be physically damaged from a vehicle hitting the well which can provide a route for microbial contaminants to enter a well.

The wells drawing from unconfined aquifers could be contaminated from various sources. However, a source of microbiologic contamination would have to be very close to a well because of the high filtration effectiveness of the unconsolidated soils. Maryland regulations require at least 100 feet between on-site septic systems and wells. This distance is adequate to prevent microbial (bacteriological) contamination from on-site septic systems unless there is a major construction problem in either or both the well or on-site septic system. If a well was not grouted or if the casing was damaged, a well would be susceptible to surficial sources of pathogens. Surface water can carry contaminants down a well if these conditions are present. Wells that are subject to flooding or wells finished below grade need to be sampled following rain events to ensure their integrity. As with the confined systems positive bacteriological samples are most likely from the storage and/or distribution problems.

MANAGEMENT OF THE SOURCE WATER ASSESSMENT AREA

With the information contained within this report, the individual water system owners as well as the Kent County government have a basis for protecting the drinking water supplies for their customers as well as themselves. Staying aware of the area delineated for source water protection, keeping track of current potential contamination sources, and evaluation of future development or changes within the assessment area are practices that will protect the water supply. Specific management recommendations for consideration are listed below. The following recommendations are intended for 1) a county-wide source water protection effort, and 2) for individual water systems.

Recommendations for County Agencies

- *Protection team*

  Kent County Health and Planning Departments should take note of these transient system assessment areas. The Health Department should inform field employees of these areas so that they can identify possible problems within the assessment areas while completing sanitary surveys. Both these agencies should work with the water suppliers, local residents, farmers and businesses to reach a consensus on how to protect the water supplies.

- *Planning/ New Development*

  Plans for new commercial development should consider placement of water supply wells a priority for such facilities as gas stations, and other users of hazardous materials. Additionally, ensuring the adequacy of the well to supply water for the facilities in the long term will ensure that additional wells in less desirable locations are not necessary.

  A countywide strategy for addressing water quality protection issues for small systems deserve consideration. A cooperative effort is needed to minimize future risks to contamination beyond minimum set back requirements.

- *Public Outreach*

  Conducting education outreach to the unconfined facilities listed in table 1. Important topics include: (a) under ground storage of materials in tanks and piping, (b) waste streams that may go into dry wells, septic tanks or other ground water discharge points, (c) reporting of spills, (d) material and chemical storage, and (e) monitoring well installation.

Recommendations for Individual Systems

- *Planning and Development*

  The system should be aware of where the assessment area is and evaluate the possible effects to their water supply before building or making other changes to their property. They should also voice their concerns to zoning officials when changes to neighboring properties are going to take place.

- *Monitoring*

  Systems should continue to monitor for all required SDWA contaminants as required by MDE. Systems that have been identified to have

underground storage tanks should do some additional sampling for VOCs. Six systems have been identified in this report.

- *Contaminant Source Inventory Updates/ Inspections*
  Water system owners should be aware of current potential sources of contamination as well as future sources. They should contact neighbors within the assessment area and explain the importance of informing the system or the county of any possible contamination events that may have happened or if they do happen. The owner should also make sure that the well is protected from damage from vehicles or other machinery. If the well is or was damaged for some reason it should be repaired immediately, and properly chlorinated, to avoid water supply contamination.
- *Changes in Use*
  Water system owners are required to notify Kent County Health Department if new wells are to be put into service. Drilling a new well outside the current source water assessment area would modify the area, therefore the WSP should be contacted if a new well is being proposed.

Reference

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

Maryland Department of Natural Resources (DNR), 1987, The Quantity and Natural Quality of Ground Water in Maryland: DNR Water Resources Administration.

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 Geologic Survey Report of Investigations No. 68.

Other Sources of Data

Water Appropriation and Use Permits
Kent County Sanitary Survey Inspection Reports
MDE Water Supply Program (PDWIS) Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles
USGS Topographic 7.5 Minute Quadrangles
Maryland Office of Planning 1997 Kent County Land Use Map
Maryland Office of Planning 1996 Kent County Sewer Map

PWSID	System Name	Source #	Plant #	Use Code	Source Name	Ground Water Appropriation	Aquifer Code	Aquifer Type	Well Tag #	Casing Depth	Well Depth
1141082	ALEXANDER SPORTING FARMS	1	1	P	WELL	KE1997G001	211D	C	KE940048	132	152
1141058	AMERICAN LEGION POST #36	1	1	P	WELL		9999	U			
1141096	ASBURY METHODIST CHURCH	1	1	P	WELL	KE1979G003	125B	U	KE730914	87	125
1141014	BAY COUNTRY CAMPGROUND	1	1	P	WELL		125B	U	KE940075	140	160
1141092	BRAMPTON BED & BREAKFAST	1	1	P	WELL	KE1995G007	211D	C	KE920056	135	150
1141005	CARRIAGE COUNTRY CLUB	1	1	P	WELL	KE1974G009	125B	U	KE730228	67	130
1141037	CAULKS FIELD ONE STOP	1	1	P	WELL	KE1980G003	125B	U	KE731009	86	96
1141093	CHESAPEAKE FARMS	1	1	P	WELL		211D	C	KE940243	95	125
1141007	CHESTER RIVER YACHT CLUB	1	1	P	WELL	KE1955G002	125B	U	KE880418	72	87
1141087	CRESTVIEW SQUARE	1	1	P	WELL		9999	U			
1141084	DAVIS TEXACO INC	1	1	P	WELL	KE1987G006	125B	U	KE811457	90	100
1141010	DRAYTON MANOR RETREAT CENTER	1	1	P	WELL		211D	U	KE730732	97	118
1141081	DUPONT FISH & GAME	1	1	P	WELL	KE1993G003	125B	U	KE940077	129	139
1141011	DUTCH FAMILY DELI	1	1	P	WELL	KE1901G004	125B	U	KE810299	77	85
1141080	EASTERN NECK REFUGE	1	1	P	WELL	KE1978G102	217C	C	KE880321	574	630
1141089	EASTERN SHORE BIBLE CHURCH	1	1	P	WELL	KE1996G001	125B	U	KE920217	100	120
1141012	ECHO HILL CAMP	1	1	P	WELL	KE1993G004	211D	U	KE880561	57	72
1141091	ELK LODGE 2474	1	1	P	WELL	KE1973G004	125B	U	KE730101	123	136
1141097	FAITH UNITY FELLOWSHIP	1	1	P	WELL		9999	U			
1141088	FARMERS NATIONAL BANK	1	1	P	WELL		9999	U			
1141020	GEORGETOWN YACHT BASIN	1	1	P	WELL	KE1986G003	217C	C	KE810501	424	457
1141098	GRAVES CHAPEL UAME	1	1	P	WELL	KE1991G001	125B	U	KE880139	112	120
1141025	GREAT OAK LANDING	1	1	P	WELL 1	KE1974G003	211D	U			60
1141025	GREAT OAK LANDING	2	1	P	WELL 2	KE1974G003	211D	U			
1141024	GREAT OAK MANOR	1	1	P	WELL		211D	U			60
1141026	GREEN POINT MARINA INC.	1	1	P	WELL	KE1986G002	211D	U	KE810481	75	82
1141018	GREGG NECK BOAT YARD	1	1	P	WELL		125B	U	KE810690	67	72
1141099	HAWKEYES	1	1	P	WELL		125B	U			
1141083	HOPKINS GAME FARM	1	1	P	WELL	KE1998G003	211D	C	KE880762	118	158
1141002	HOWARD JOHNSONS	1	1	P	WELL	KE1959G001	125B	U			
1141029	INN AT MITCHELL HOUSE	1	1	P	WELL		211D	C	KE811166	43	50
1141085	JOES SHELL STATION	1	1	P	WELL	KE1960G001	125B	U			
1141031	KENT AGRICULTURE CENTER	1	1	P	WELL		9999	U			
1141071	KITTY KNIGHT HOUSE	1	1	P	WELL		211D	C	KE731132	96	103
1141033	LANGFORD BAY MARINA STORE	1	1	P	WELL	KE1971G005	125B	U	KE710083	70	80

Table 1, Well information for Kent County Transient Sytems

PWSID	System Name	Source #	Plant #	Use Code	Source Name	Ground Water Appropriation	Aquifer Code	Aquifer Type	Well Tag #	Casing Depth	Well Depth
1141034	LONG COVE MARINA	1	1	P	WELL		125B	U	KE810018	107	123
1141077	MILLINGTON FIRE DEPARTMENT	1	1	P	WELL	KE1975G003	125B	U			
1141038	MILLINGTON FOOD RITE	1	1	P	WELL	KE1957G602	125B	U			
1141061	MILLINGTON PIZZA	1	1	P	WELL	KE1989G001	125B	U	KE811190	140	150
1141068	MILLINGTON POOL	1	1	P	WELL		125B	U	KE700025	85	130
1141086	PEOPLES BANK OF MILLINGTON	1	1	P	WELL	KE1978G005	125B	U			
1141041	POMONA GENERAL STORE	1	1	P	WELL		211D	C	KE811322	130	140
1141095	PRESBYTERIAN CHURCH OF CHESTERTOWN	1	1	P	WELL	KE1990G001	211D	C	KE880354	115	130
1141073	RAUM CHAPEL CHURCH	1	1	P	WELL		211D	C	KE940026	87	101
1141009	RIVER CRABS	1	1	P	WELL	KE1974G002	125B	U	KE880573	25	40
1141055	ROBBINS DELI	1	1	P	WELL		9999	U			
1141045	ROCK HALL YACHT CLUB	1	1	P	WELL	KE1982G005	125B	U	KE731189	55	65
1141090	SHREWSBURY CHURCH	1	1	P	WELL	KE1998G008	211D	C	KE940391	85	100
1141070	ST JAMES CHURCH	1	1	P	WELL		211D	C	KE810854	165	175
1141069	ST PAULS CHURCH	1	1	P	WELL	KE1995G016	211D	C	KE920155	370	163
1141072	STARKEY FARM TRACTORS	1	1	P	WELL	KE1985G002	211D	U	KE810225	98	110
1141040	STILL POND MARKET	1	1	P	WELL	KE1987G024	211D	C	KE810865	70	80
1141048	SUDS & SODA	1	1	P	WELL	KE1983G005	211D	C	KE810144	112	122
1141027	THE WATER HOLE	1	1	P	WELL		9999	U			
1141094	THE WHARF AT HANDY POINT	1	1	P	WELL	KE1988G002	211D	U	KE810868	165	175
1141050	TOLCHESTER MARINA INC.	2	1	P	WELL	KE1971G007	110C	U	KE710091	37	42
1141050	TOLCHESTER MARINA INC.	1	1	P	WELL	KE1971G007	110C	U	KE730151	25	32
1141079	TOYS OUTDOOR STORE	1	1	P	WELL		9999	U			
1141063	VFW POST #652	1	1	P	WELL	KE1987G027	125B	U	KE811337	200	220
1141054	VONNIES MOTEL	1	1	P	WELL	KE1993G009	211D	C	KE880599	70	80
1141053	VONNIES RESTAURANT	1	1	P	WELL	KE1997G002	211D	C	KE940051	175	195
1141078	WILLARDS DELMARVA AGRI SERVICE INC	1	1	P	WELL 1	KE1958G003	211D	C			300
1141056	WORTON CREEK MARINA INC	1	1	P	WELL	KE1949G003	211D	U	KE811282	48	58
1141057	YMCA CAMP TOCKWOGH	1	1	P	WELL 1	KE1967G001	211D	U	KE810341	86	94
1141057	YMCA CAMP TOCKWOGH	2	1	P	WELL 2	KE1967G001	211D	U	KE811015	96	114
1141057	YMCA CAMP TOCKWOGH	3	1	P	WELL 3	KE1967G001	211D	U	KE811197	90	100

Table 1 (continued), Well information for Kent County Transient Systems

Type	Within Assessment for	PWSID	Potential Contaminate	Figure Shown
UST	Hawkeyes	1141099	VOC	Figure 3q
UST	Millington's Transients	Multiple	VOC	Figure 3u
UST	Dutch Family Deli	1141011	VOC	Figure 3a
UST	Toy's Outdoor Store	1141079	VOC	Figure 3x
UST	River Crabs	1141009	VOC	Figure 3s
UST	Langford Bay Marina	1141033	VOC	Figure 3s
CERCLA	Dutch Family Deli	1141011	VOC	Figure 3a
On Site Septic	Joe's Shell Station	1141085	Bacteria, Viruses, Nitrogen	Figure 3a
On Site Septic	Peoples Bank of Millington	1141086	Bacteria, Viruses, Nitrogen	Figure 3u
On Site Septic	Dutch Family Deli	1141011	Bacteria, Viruses, Nitrogen	Figure 3a
On Site Septic	Faith Unity Fellowship	1141097	Bacteria, Viruses, Nitrogen	Figure 3m
On Site Septic	Green Point Marina	1141026	Bacteria, Viruses, Nitrogen	Figure 3p
On Site Septic	The Warf at Handy Point	1141094	Bacteria, Viruses, Nitrogen	Figure 3p
On Site Septic	Eastern Shore Bible Chruch	1141089	Bacteria, Viruses, Nitrogen	Figure 3j
On Site Septic	Hawkeyes	1141099	Bacteria, Viruses, Nitrogen	Figure 3g
On Site Septic	Worton Creek Marina	1141056	Bacteria, Viruses, Nitrogen	Figure 3z

Table 2, Known Potential Contaminant Point Sources Within the Source Water Assessment Areas

PWSID	PWS Name	Plant ID	Aquifer Type	Treatment Method	Reason for Treatment
1141025	Great Oak Landing	01	U	pH Adjustment	Corrosion Control
1141031	Kent Agriculture Center	01	U	Ion Exchange	Iron Removal
1141048	Suds and Soda	01	C	pH Adjustment	Corrosion Control
1141087	Crestview Square	01	U	pH Adjustment	Corrosion Control
1141088	Farmers National Bank	01	U	pH Adjustment	Corrosion Control
1141092	Brampton Bed and Breakfast	01	C	Ion Exchange	Iron Removal
1141092	Brampton Bed and Breakfast	01	C	Ion Exchange	Softning
1141093	Chesapeak Farms	01	C	Hypochlorination, Post	Disinfection
1141093	Chesapeak Farms	01	C	Ion Exchange	Iron Removal
1141093	Chesapeak Farms	01	C	pH Adjustment	Corrosion Control
1141093	Chesapeak Farms	01	C	Filtration	Particulates
1141095	Presbiterian Church of Chestertown	01	C	Ion Exchange	Iron Removal

Table 3, Known Treatment Methods for Kent County Transient Systems

PWSID	PWS Name	Plant ID	Nitrate		IOCs (except Nitrate)	
			No. of Samples	No. of Samples > 50% MCL	No. of Samples	No. of Samples > 50% MCL
1141082	ALEXANDER SPORTING FARMS	01	3	0	1	0
1141058	AMERICAN LEGION POST #36	01	8	0	6	0
1141096	ASBURY METHODIST CHURCH	01	3	0	3	0
1141014	BAY COUNTRY CAMPGROUND	01	7	2	2	0
1141092	BRAMPTON BED & BREAKFAST	01	3	0	3	0
1141005	CARRIAGE COUNTRY CLUB	01	2	0	1	0
1141037	CAULKS FIELD ONE STOP	01	9	0	6	0
1141093	CHESAPEAKE FARMS	01	5	0	5	0
1141007	CHESTER RIVER YACHT CLUB	01	7	0	4	0
1141087	CRESTVIEW SQUARE	01	4	0	3	0
1141084	DAVIS TEXACO INC	01	5	0	2	0
1141010	DRAYTON MANOR RETREAT CENTER	01	9	0	6	0
1141081	DUPONT FISH & GAME	01	4	0	2	0
1141011	DUTCH FAMILY DELI	01	10	0	8	0
1141080	EASTERN NECK REFUGE	01	5	0	3	0
1141089	EASTERN SHORE BIBLE CHURCH	01	4	0	2	0
1141012	ECHO HILL CAMP	01	10	0	4	0
1141091	ELK LODGE 2474	01	2	0	2	0
1141097	FAITH UNITY FELLOWSHIP	01	3	0	2	0
1141088	FARMERS NATIONAL BANK	01	6	0	4	0
1141020	GEORGETOWN YACHT BASIN	01	7	0	3	0
1141098	GRAVES CHAPEL UAME	01	3	0	3	0
1141025	GREAT OAK LANDING	01	6	0	2	0
1141024	GREAT OAK MANOR	01	6	0	3	0
1141026	GREEN POINT MARINA INC.	01	5	0	3	0
1141018	GREGG NECK BOAT YARD	01	8	8	3	0
1141099	HAWKEYES	01	2	0	1	0
1141083	HOPKINS GAME FARM	01	6	0	2	0
1141002	HOWARD JOHNSONS	01	9	0	7	0
1141029	INN AT MITCHELL HOUSE	01	3	0	2	0
1141085	JOES SHELL STATION	01	5	0	3	0
1141031	KENT AGRICULTURE CENTER	01	3	0	2	0
1141071	KITTY KNIGHT HOUSE	01	6	0	3	0
1141033	LANGFORD BAY MARINA STORE	01	8	0	4	0
1141034	LONG COVE MARINA	01	6	0	3	0
1141077	MILLINGTON FIRE DEPARTMENT	01	6	0	3	0
1141038	MILLINGTON FOOD RITE	01	9	0	7	0
1141061	MILLINGTON PIZZA	01	9	0	7	0
1141068	MILLINGTON POOL	01	2	0	2	0
1141086	PEOPLES BANK OF MILLINGTON	01	4	0	3	0
1141041	POMONA GENERAL STORE	01	11	0	7	0
1141095	PRESBYTERIAN CHURCH OF CHESTERTOWN	01	3	0	3	0
1141073	RAUM CHAPEL CHURCH	01	6	0	3	0
1141009	RIVER CRABS	01	3	0	3	0
1141055	ROBBINS DELI	01	8	0	5	0
1141045	ROCK HALL YACHT CLUB	01	4	0	4	0
1141090	SHREWSBURY CHURCH	01	4	0	3	0
1141070	ST JAMES CHURCH	01	2	0	2	0
1141069	ST PAULS CHURCH	01	5	0	4	0

Table 4, Total Water Quality Samples collected for Transient Systems

PWSID	PWS Name	Plant ID	Nitrate		IOCs (except Nitrate)	
			No. of Samples	No. of Samples > 50% MCL	No. of Samples	No. of Samples > 50% MCL
1141072	STARKEY FARM TRACTORS	01	7	0	5	0
1141040	STILL POND MARKET	01	10	0	6	0
1141048	SUDS & SODA	01	8	0	5	0
1141027	THE WATER HOLE	01	8	0	7	0
1141094	THE WHARF AT HANDY POINT	01	2	0	2	0
1141050	TOLCHESTER MARINA INC.	01	9	0	3	0
1141079	TOYS OUTDOOR STORE	01	6	0	3	0
1141063	VFW POST #652	01	4	0	2	0
1141054	VONNIES MOTEL	01	10	0	4	0
1141053	VONNIES RESTAURANT	01	9	0	3	0
1141078	WILLARDS DELMARVA AGRI SERVICE INC	01	9	4	5	0
1141056	WORTON CREEK MARINA INC	01	11	0	3	0
1141057	YMCA CAMP TOCKWOGH	01	17	0	6	0

Table 4, (cont) Total Water Quality Samples collected for Transient Systems

PWSID	PWS Name	Plant ID	Contaminant Name	MCL (PPM)	Sample Date	Result (PPM)
1141014	BAY COUNTRY CAMPGROUND	01	NITRATE	10	08/13/1996	6.1
1141014	BAY COUNTRY CAMPGROUND	01	NITRATE	10	06/23/1997	**15**
1141018	GREGG NECK BOAT YARD	01	NITRATE	10	02/24/1997	9.4
1141018	GREGG NECK BOAT YARD	01	NITRATE	10	10/22/1997	9.2
1141018	GREGG NECK BOAT YARD	01	NITRATE	10	02/26/1998	9
1141018	GREGG NECK BOAT YARD	01	NITRATE	10	09/29/1998	8.8
1141018	GREGG NECK BOAT YARD	01	NITRATE	10	12/08/1998	9.4
1141018	GREGG NECK BOAT YARD	01	NITRATE	10	03/17/1999	9
1141018	GREGG NECK BOAT YARD	01	NITRATE	10	02/03/1999	9.3
1141018	GREGG NECK BOAT YARD	01	NITRATE	10	05/31/2000	8.8
1141078	WILLARDS DELMARVA AGRI SERVICE INC.	01	NITRATE	10	09/30/1998	**41.6**
1141078	WILLARDS DELMARVA AGRI SERVICE INC.	01	NITRATE	10	10/08/1998	**31.4**
1141078	WILLARDS DELMARVA AGRI SERVICE INC.	01	NITRATE	10	10/13/1998	**33.2**
1141078	WILLARDS DELMARVA AGRI SERVICE INC.	01	NITRATE	10	05/18/2000	**29.2**

Table 5, Nitrate results greater than 50% of the MCL of 10 PPM

PWSID	PWS Name	Aquifer Type	Total No. of Samples	No. of Positive Samples
1141082	ALEXANDER SPORTING FARMS	C	8	0
1141058	AMERICAN LEGION POST #36	U	16	2
1141096	ASBURY METHODIST CHURCH	U	9	0
1141014	BAY COUNTRY CAMPGROUND	U	9	1
1141092	BRAMPTON BED & BREAKFAST	C	18	6
1141005	CARRIAGE COUNTRY CLUB	U	9	0
1141037	CAULKS FIELD ONE STOP	U	17	2
1141093	CHESAPEAKE FARMS	C	9	0
1141007	CHESTER RIVER YACHT CLUB	U	41	17
1141087	CRESTVIEW SQUARE	U	16	2
1141084	DAVIS TEXACO INC	U	15	2
1141010	DRAYTON MANOR RETREAT CENTER	U	21	2
1141081	DUPONT FISH & GAME	U	10	0
1141011	DUTCH FAMILY DELI	U	16	1
1141080	EASTERN NECK REFUGE	C	11	0
1141089	EASTERN SHORE BIBLE CHURCH	U	14	2
1141012	ECHO HILL CAMP	U	20	2
1141091	ELK LODGE 2474	U	8	0
1141097	FAITH UNITY FELLOWSHIP	U	7	0
1141088	FARMERS NATIONAL BANK	U	15	1
1141020	GEORGETOWN YACHT BASIN	C	16	0
1141098	GRAVES CHAPEL UAME	U	7	0
1141025	GREAT OAK LANDING	U	5	0
1141024	GREAT OAK MANOR	U	12	0
1141026	GREEN POINT MARINA INC.	U	17	3
1141018	GREGG NECK BOAT YARD	U	15	0
1141099	HAWKEYES	U	9	1
1141083	HOPKINS GAME FARM	C	13	0
1141002	HOWARD JOHNSONS	U	28	8
1141029	INN AT MITCHELL HOUSE	C	8	0
1141085	JOES SHELL STATION	U	12	1
1141031	KENT AGRICULTURE CENTER	U	10	3
1141071	KITTY KNIGHT HOUSE	C	9	0
1141033	LANGFORD BAY MARINA STORE	U	13	1
1141034	LONG COVE MARINA	U	13	0
1141077	MILLINGTON FIRE DEPARTMENT	U	16	1
1141038	MILLINGTON FOOD RITE	U	15	0
1141061	MILLINGTON PIZZA	U	17	2
1141068	MILLINGTON POOL	U	5	1
1141086	PEOPLES BANK OF MILLINGTON	U	10	0
1141041	POMONA GENERAL STORE	C	19	1
1141095	PRESBYTERIAN CHURCH OF CHESTERTOWN	C	7	0
1141073	RAUM CHAPEL CHURCH	C	12	2
1141009	RIVER CRABS	U	6	1
1141055	ROBBINS DELI	U	13	0
1141045	ROCK HALL YACHT CLUB	U	13	2
1141090	SHREWSBURY CHURCH	C	11	1
1141070	ST JAMES CHURCH	C	12	1

Table 6, Routine and repeat bacteriological samples for each system since 1996.

PWSID	PWS Name	Aquifer Type	Total No. of Samples	No. of Positive Samples
1141069	ST PAULS CHURCH	C	15	3
1141072	STARKEY FARM TRACTORS	U	13	2
1141040	STILL POND MARKET	C	35	11
1141048	SUDS & SODA	C	19	5
1141027	THE WATER HOLE	U	17	2
1141094	THE WHARF AT HANDY POINT	U	7	1
1141050	TOLCHESTER MARINA INC.	U	16	1
1141079	TOYS OUTDOOR STORE	U	12	0
1141063	VFW POST #652	U	10	0
1141054	VONNIES MOTEL	C	18	2
1141053	VONNIES RESTAURANT	C	20	1
1141078	WILLARDS DELMARVA AGRI SERVICE INC	C	14	1
1141056	WORTON CREEK MARINA INC	U	15	0
1141057	YMCA CAMP TOCKWOGH	U	22	0

Table 6, (Cont.) Routine and repeat bacteriological samples for each system since 1996.

PWSID	System Name	Source #	Aquifer Type	Nitrate Susceptibility			Microbiological Susceptibility			
				Detected in Signif. Amounts*	Source Present in SWAP	Susceptible	Detected in Signif. Amounts**	Source Present in SWAP	Is Well Integrity a Factor	Susceptible
1141058	AMERICAN LEGION POST #36	1	U	NO	NO	NO	NO	NO	NO	NO
1141096	ASBURY METHODIST CHURCH	1	U	NO	NO	NO	NO	NO	NO	NO
1141014	BAY COUNTRY CAMPGROUND	1	U	YES	YES	YES	NO	NO	UNKNOWN	NO
1141005	CARRIAGE COUNTRY CLUB	1	U	NO	NO	NO	NO	NO	UNKNOWN	NO
1141037	CAULKS FIELD ONE STOP	1	U	NO	NO	NO	NO	NO	NO	NO
1141007	CHESTER RIVER YACHT CLUB	1	U	NO	NO	NO	YES	NO	NO	UNKNOWN
1141087	CRESTVIEW SQUARE	1	U	NO	NO	NO	NO	NO	NO	NO
1141084	DAVIS TEXACO INC	1	U	NO	NO	NO	NO	NO	NO	NO
1141010	DRAYTON MANOR RETREAT CENTER	1	U	NO	NO	NO	NO	NO	NO	NO
1141081	DUPONT FISH & GAME	1	U	NO	NO	NO	NO	NO	NO	NO
1141011	DUTCH FAMILY DELI	1	U	NO	YES	NO	NO	YES	NO	NO
1141089	EASTERN SHORE BIBLE CHURCH	1	U	NO	YES	NO	NO	YES	NO	NO
1141012	ECHO HILL CAMP	1	U	NO	NO	NO	NO	NO	UNKNOWN	NO
1141091	ELK LODGE 2474	1	U	NO	NO	NO	NO	NO	NO	NO
1141097	FAITH UNITY FELLOWSHIP	1	U	NO	NO	YES	NO	YES	NO	NO
1141088	FARMERS NATIONAL BANK	1	U	NO	NO	NO	NO	NO	UNKNOWN	NO
1141098	GRAVES CHAPEL UAME	1	U	NO	NO	NO	NO	NO	NO	NO
1141025	GREAT OAK LANDING	1	U	NO	NO	NO	NO	NO	UNKNOWN	NO
1141025	GREAT OAK LANDING	2	U	NO	NO	NO	NO	NO	NO	NO
1141024	GREAT OAK MANOR	1	U	NO	NO	NO	NO	NO	UNKNOWN	NO
1141026	GREEN POINT MARINA INC.	1	U	NO	YES	NO	NO	YES	NO	NO
1141018	GREGG NECK BOAT YARD	1	U	YES	YES	YES	NO	NO	NO	NO
1141099	HAWKEYES	1	U	NO	YES	NO	NO	YES	NO	NO
1141002	HOWARD JOHNSONS	1	U	NO	YES	NO	YES	YES	NO	YES
1141085	JOES SHELL STATION	1	U	NO	YES	NO	NO	YES	UNKNOWN	NO
1141031	KENT AGRICULTURE CENTER	1	U	NO	NO	NO	YES	NO	UNKNOWN	YES
1141033	LANGFORD BAY MARINA STORE	1	U	NO	NO	NO	NO	NO	NO	NO

Table 7, Summary of Susceptibility of Transient Water Supplies to Nitrate, and Microbiological Organisms.

* Nitrate detected in significant amounts: Any system that had a sample >50% of the MCL, of 10 ppm, in the last 5 years.

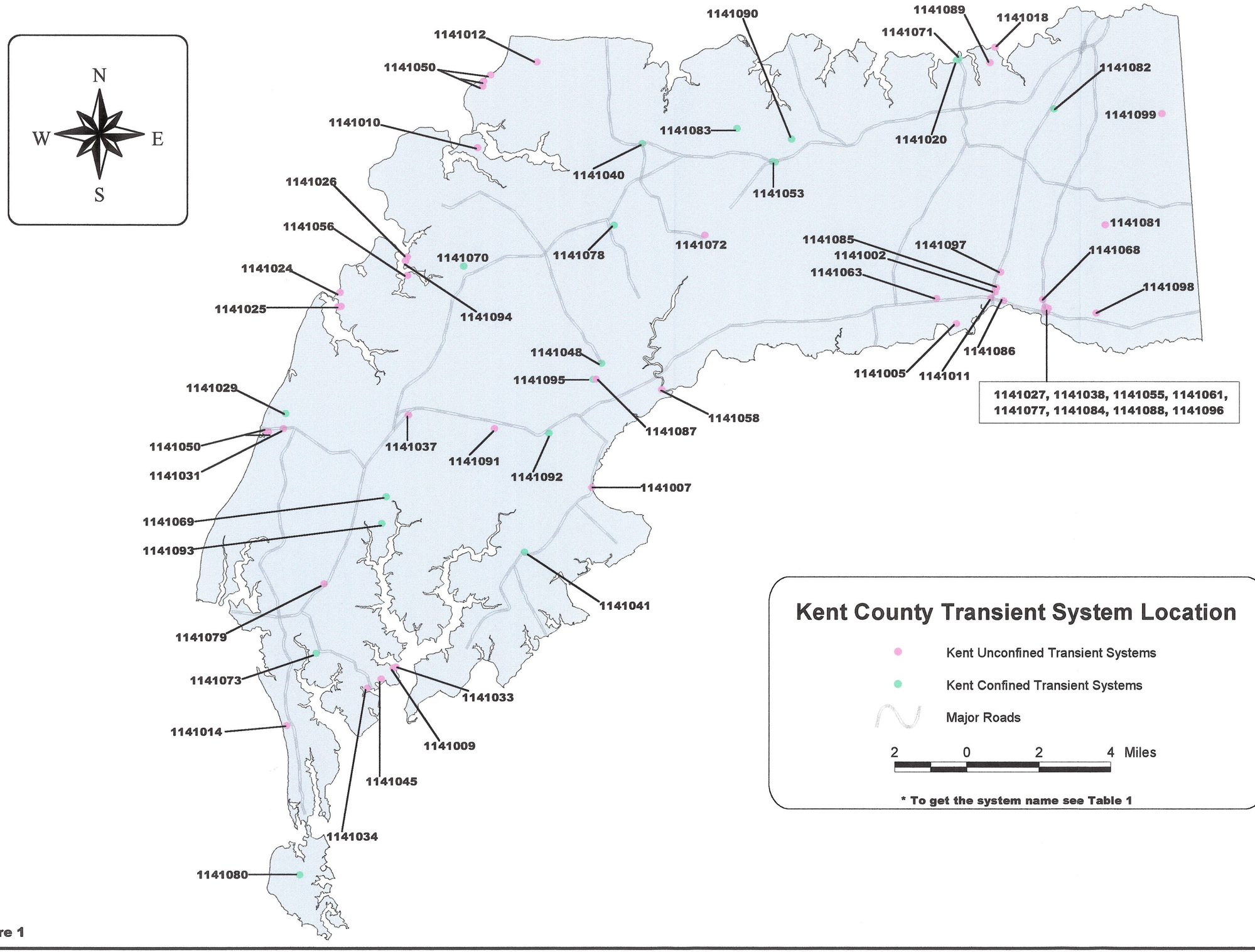
** Microbiological organisms detected in significant amounts: Any system whose monitoring results were positive >25% of the time in the last 5 years.

				Nitrate Susceptibility			Microbiological Susceptibility			
PWSID	System Name	Source #	Aquifer Type	Detected in Signif. amounts	Source Present in SWAP	Susceptible	Detected in Signif. amounts	Source Present in SWAP	Is Well Integrity a Factor	Susceptible
1141034	LONG COVE MARINA	1	U	NO	NO	NO	NO	NO	NO	NO
1141077	MILLINGTON FIRE DEPARTMENT	1	U	NO	NO	NO	NO	NO	NO	NO
1141038	MILLINGTON FOOD RITE	1	U	NO	NO	NO	NO	NO	UNKNOWN	NO
1141061	MILLINGTON PIZZA	1	U	NO	NO	NO	NO	NO	NO	NO
1141068	MILLINGTON POOL	1	U	NO	NO	NO	NO	NO	NO	NO
1141086	PEOPLES BANK OF MILLINGTON	1	U	NO	YES	NO	NO	YES	NO	NO
1141009	RIVER CRABS	1	U	NO	NO	NO	NO	NO	NO	NO
1141055	ROBBINS DELI	1	U	NO	NO	NO	NO	NO	NO	NO
1141045	ROCK HALL YACHT CLUB	1	U	NO	NO	NO	NO	NO	NO	NO
1141072	STARKEY FARM TRACTORS	1	U	NO	NO	NO	NO	NO	NO	NO
1141027	THE WATER HOLE	1	U	NO	NO	NO	NO	NO	UNKNOWN	NO
1141094	THE WHARF AT HANDY POINT	1	U	NO	YES	NO	NO	YES	UNKNOWN	NO
1141050	TOLCHESTER MARINA INC.	2	U	NO	NO	NO	NO	NO	NO	NO
1141050	TOLCHESTER MARINA INC.	1	U	NO	NO	NO	NO	NO	NO	NO
1141079	TOYS OUTDOOR STORE	1	U	NO	NO	NO	NO	NO	UNKNOWN	NO
1141063	VFW POST #652	1	U	NO	NO	NO	NO	NO	NO	NO
1141056	WORTON CREEK MARINA INC	1	U	NO	YES	NO	NO	YES	NO	NO
1141057	YMCA CAMP TOCKWOGH	1	U	NO	YES	YES	NO	YES	NO	NO
1141057	YMCA CAMP TOCKWOGH	2	U	NO	YES	YES	NO	YES	NO	NO
1141057	YMCA CAMP TOCKWOGH	3	U	NO	YES	YES	NO	YES	NO	NO

Table 7 (continued), Summary of Susceptibility of Transient Water Supplies to Nitrate, and Microbiological Organisms.

* Nitrate detected in significant amounts: Any system that had a sample >50% of the MCL, of 10 ppm, in the last 5 years.

** Microbiological organisms detected in significant amounts: Any system whose monitoring results were positive >25% of the time in the last 5 years.



Kent County Transient System Location

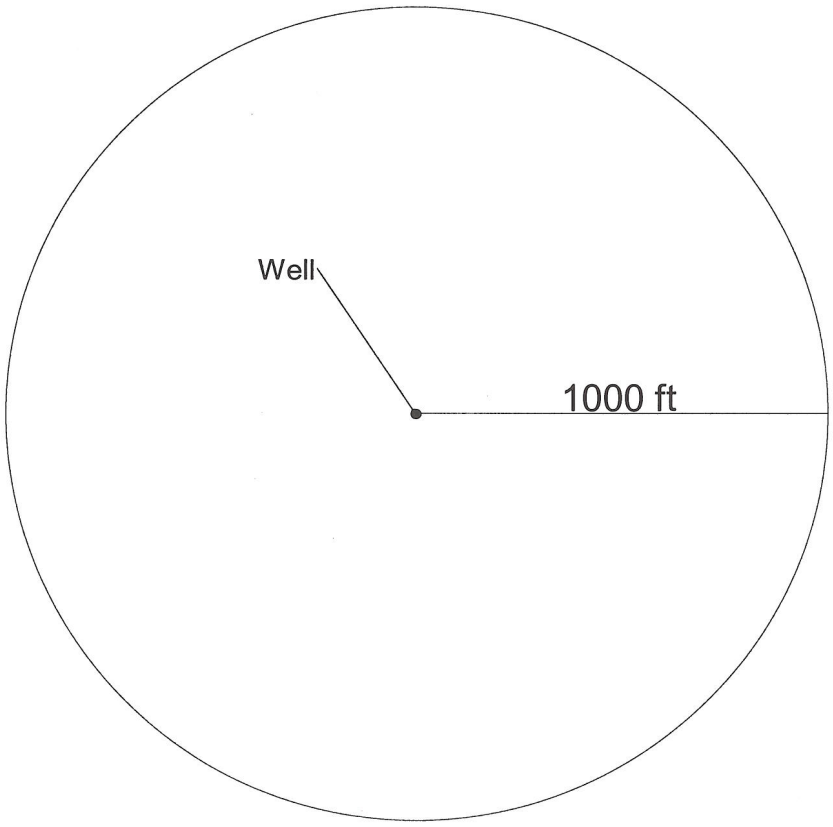
- Kent Unconfined Transient Systems
- Kent Confined Transient Systems
- Major Roads

2 0 2 4 Miles

*** To get the system name see Table 1**

Figure 1

Circle and Wedge Delineation Areas



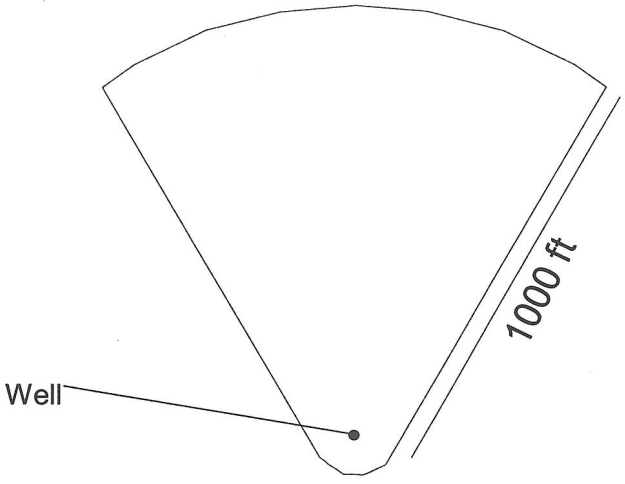


Figure 2

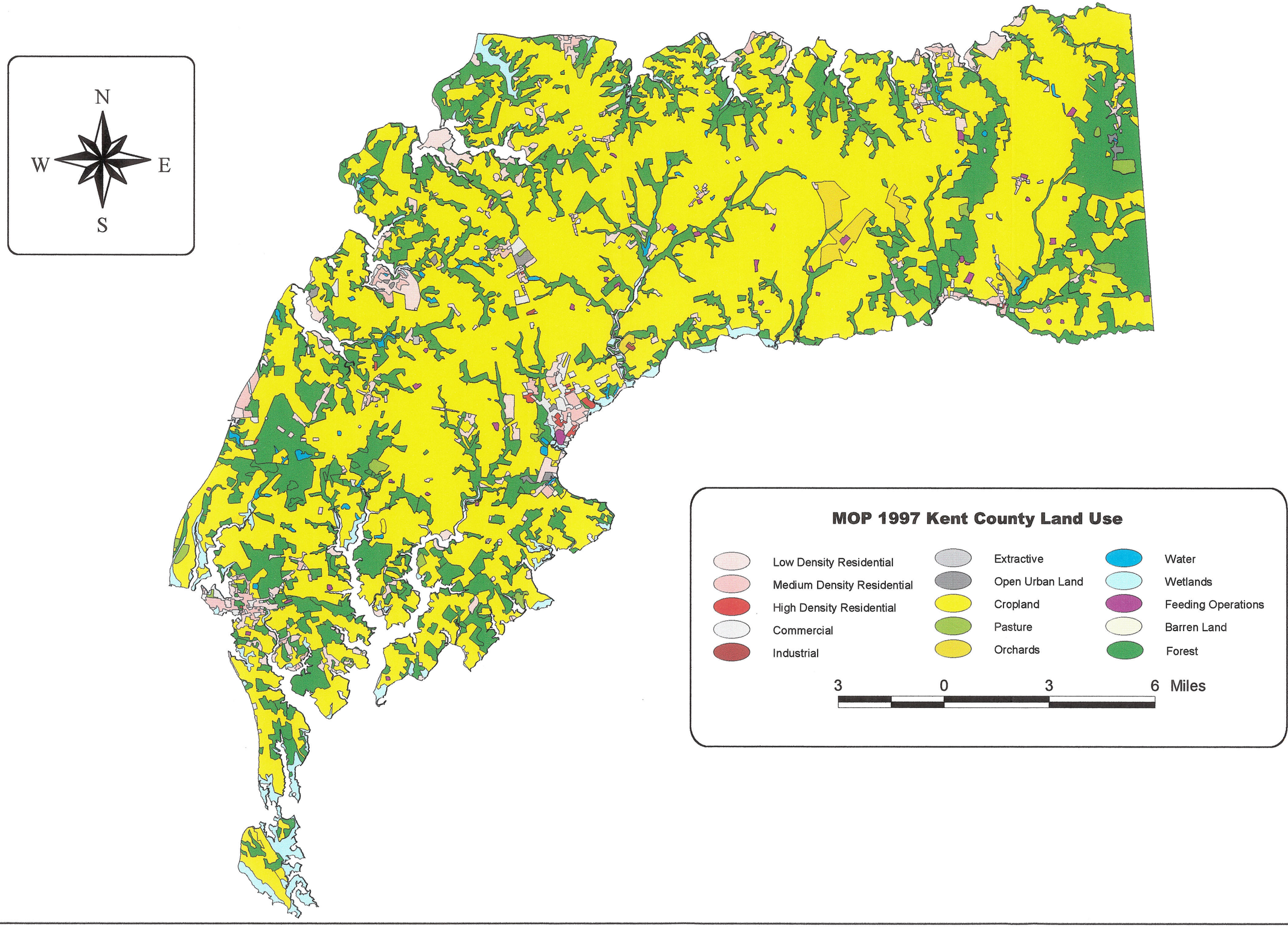

N
W
E
S
MOP 1997 Kent County Land Use
Low Density Residential
Medium Density Residential
High Density Residential
Commercial
Industrial
Extractive
Open Urban Land
Cropland
Pasture
Orchards
Water
Wetlands
Feeding Operations
Barren Land
Forest
3 0 3 6 Miles

Figure 4

Figure 4 Kent County SWAP Land Use Summary

Land Use Type	Land Use Code	Counts in SWAPs	Acres in Swap	% of Total Area
Open Urban Land	21	13	393.69	41.77
Pasture	41	17	144.75	15.36
Low Density Residential	11	22	108.86	11.55
Medium Density Residential	12	10	89.85	9.53
Commercial	14	21	85.72	9.10
Orchards	42	3	33.87	3.59
Industrial	16	12	44.12	4.68
High Density Residential	13	2	8.35	0.89
Forest	43	3	7.22	0.77
Cropland	22	2	6.10	0.65
Extractive	18	2	4.70	0.50
Water	50	1	10.89	1.16
Barren Land	242	1	1.95	0.21
Feeding Operations	241	1	1.67	0.18
Wetlands	60	1	0.70	0.07
	Totals	111	942.44	100.00

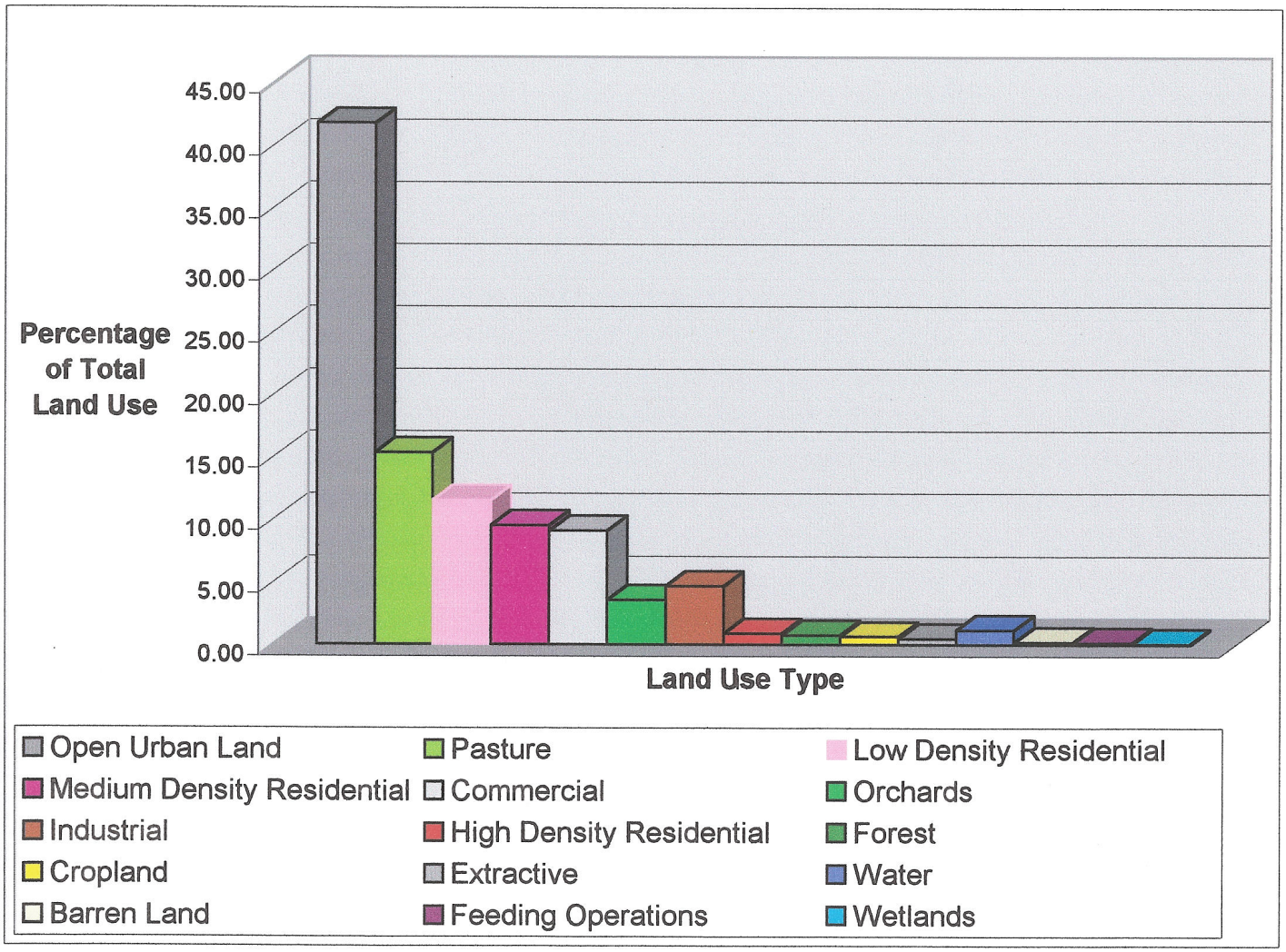


Figure 5

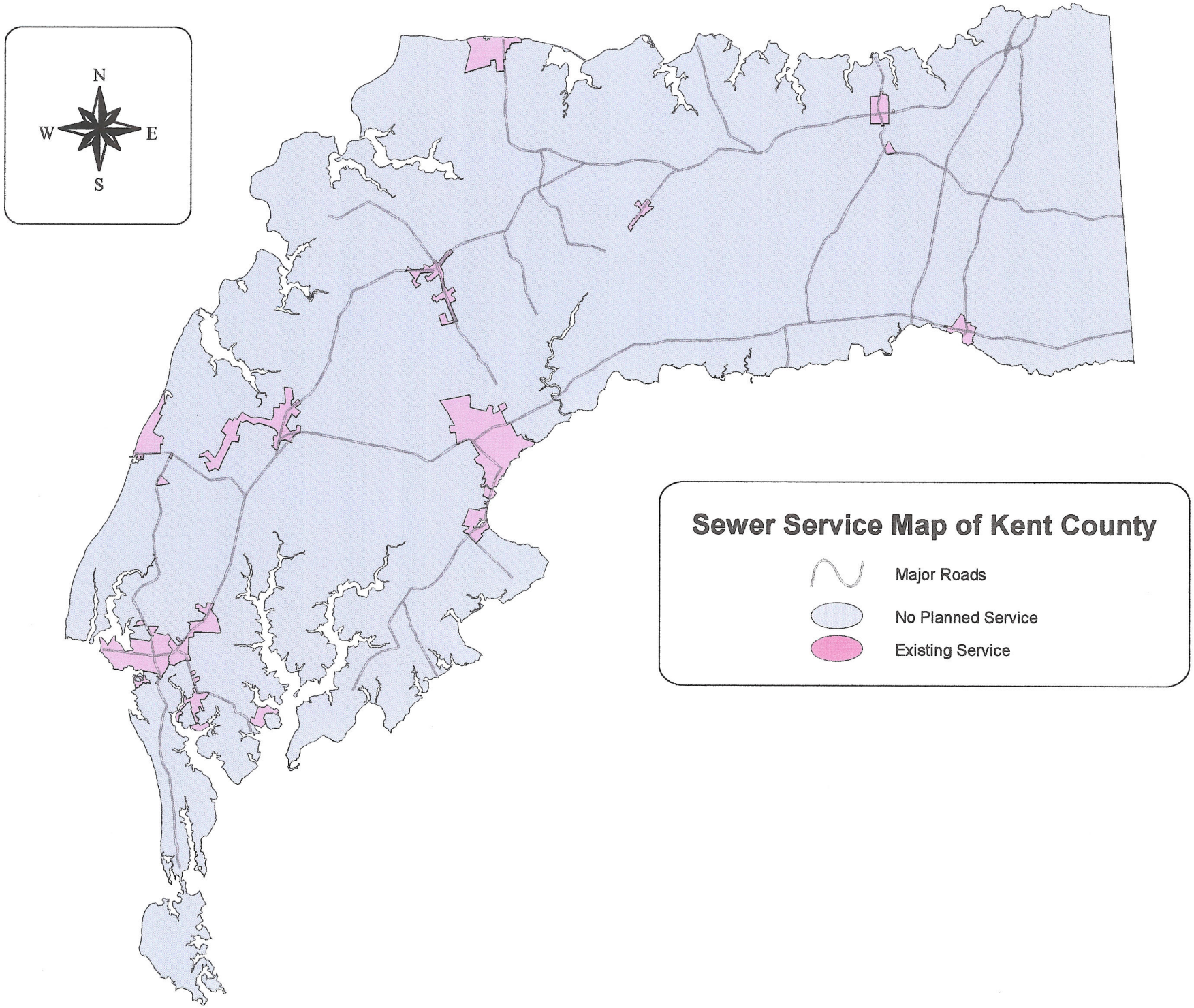

N
W
E
S
Sewer Service Map of Kent County
Major Roads
No Planned Service
Existing Service

Figure 6