

Project Report  
Kent Island and Rural Queen Anne's County  
Queen Anne's County Onsite and Decentralized Wastewater Study

**Executive Summary:**

The Board of Commissioners in Queen Anne's County Maryland commissioned a study to assess the types and functionality of onsite wastewater systems prevalent in the Kent Island Area and in designated rural areas within the County. The study entailed an assessment of permits on file with the Queen Anne's County Health Department representing wastewater systems permitted on Kent Island and designated areas of the county. Permit files were reviewed to determine the type of permitted wastewater system serving a specific property. This entailed a comprehensive file-by-file review of the history of onsite systems at over 2500 dwelling units in Kent Island and over 150 in less densely developed, more rural areas of the county.

The study also entailed a review of the available soils information in the study areas with some actual field tests of the soil's hydraulic capability and background soil fertility levels. These parameters may become more critical or important if large, land based wastewater systems are assessed as a part of the overall wastewater management strategy for Queen Anne's County.

Onsite wastewater systems utilized early in the development of the Kent Island area consisted primarily of deep trench or deep pit systems which placed sewage into shallow groundwater. As these systems have malfunctioned through time, the most common repair or replacement option has been the deep trench or pit option. Few advanced onsite wastewater treatment systems have been employed and few mound or pressure dosed soil absorption systems have been installed as repair options.

The predominance of the groundwater penetrating systems suggests an indirect connection between individual onsite wastewater systems through the underlying groundwater and to the Bay and its tributaries. Seasonal groundwater penetrating systems meet the definition of a failed septic system.

Over 2000 onsite system permits reviewed indicate trench depths of over 8 feet. Review of soils information and original siting data from the permits indicate seasonal saturation was encountered at depths of less than 4 feet. This suggests that domestic wastewater is placed directly into groundwater which ultimately

flows into the Bay. In the target communities on Kent Island, the transit time from the onsite system to the Bay is short. The soil's hydraulic limitations also occasion soil surface breakthroughs in the worst cases leading to the County's concern for public health. It is recognized that the number and intensity of these system failures will only increase in time if not addressed in some manner. Exacerbating this issue is the very small lot size in the study area. The small lot size necessitates utilization of the groundwater penetrating systems as the only available option for repair.

In addition to the public health concerns, simple calculations assuming typical residential wastewater quality and limited occupancy indicates a potential for over 37,000 pounds of nitrogen input to the Bay from the onsite wastewater systems serving the Kent Island Area. Unless these indirect discharges are corrected, the input of nitrogen and other wastewater constituents will continue.

Nitrogen and pathogen removal technologies are available that may be employed at the individual home level. These systems are expensive to construct and operate and require a comprehensive management program to assure they remain in proper operating condition for the life of a property. The Maryland Department of the Environment (MDE), Groundwater Protection Branch and Chesapeake Bay Restoration program currently has no mechanism to issue operational permits designed to assure proper operation. In addition, these systems cannot rectify the hydraulic limitation of the soils. As such surface breakthroughs by the sewage would not be remedied nor would any existing 'backing-up' of the plumbing into the home during wet weather periods.

One solution to these problems may be a cluster system option using land based systems designed to handle the hydraulics and remove nutrients and pathogens. These land based options are recognized as viable by MDE, but they too must be managed to assure long term viability and to realize any mandated nutrient removal goals. These land based systems too help maintain base flow in streams and small watercourses.

Another alternative is the installation of a centralized watertight wastewater collection system from the highly developed portions of Kent Island to the QAC Sanitary District's wastewater treatment facility located in Stevensville. This facility operates in accordance with a NPDES permit and nutrient removal is required by permit condition.

The large lots permitted through the local health department since approximately the early 1990's possess significant potential to function hydraulically, treat pathogens via dry soil, and retain nutrients on site. Large lots (1 acre or more) permitted in accordance with current siting criteria and relying on soil treatment typically possess sufficient potential to retain nutrients and biological materials on site for treatment and renovation. The use of these properly sited, designed, and operated on-lot systems may help maintain base flow in receiving waters. The continued operation of the old sub-standard systems may maintain base flow, but with poor quality waters. In areas with slowly moving waters, this contravention of water quality may have serious implications for the Kent Island Communities.

In addition to examination of the data from individual residential and commercial properties in the target communities, several large areas of agricultural or silvicultural land were examined. This examination was an assessment of soil properties as published in the soil survey and analysis of soil samples collected adjacent to these properties. This analysis suggests that there are several large areas of forest land or agricultural land that may be suited to receive treated wastewater through a permitted reuse system. Based on assessment of all options, the community collection and either dispersed treatment or centralized treatment option appears to offer the most reliable of the options available for the Kent Island Communities. Since no large scale dispersed treatment options are available, use of the Public Utility District facility appears most cost effective. Use of this centrally managed facility also offers the greatest potential for assuring assets are available to improve treatment levels in the future. Asset management activities are emerging as critical concerns for infrastructure nationally. Building this local asset management capacity will become more critical in the future.

The Barclay, Price, Queen Anne, and Templeville areas have more options available because soil materials in these areas may be well suited for large land based systems. Soil sampling in these areas suggest soil fertility levels are satisfactory for agricultural and silvicultural crops, soil properties are conducive for land treatment, and large areas of agricultural and silvicultural land is present.

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**Background:** Onsite wastewater systems have been an important part of the infrastructure in Queen Anne's County (QAC) for many years. Nationally and throughout Maryland, the practices associated with the siting, sizing, design, installation and operation of these systems have changed dramatically over the last 50 years. The Onsite Wastewater Management program within the State of Maryland is conducted by representatives of the State assigned to individual county offices. In this capacity, these individuals are responsible for assuring that State programs are conducted properly. The prime responsibility for the onsite wastewater program is the Maryland Department of the Environment, Groundwater Protection Division. Local support for the program is accomplished through the Environmental Health Section within the Queen Anne's County Department of Health, a division of the Maryland Department of Health and Mental Hygiene.

This report is not intended as an assessment of the current status of the onsite wastewater systems permitting program in QAC. Rather, the two purposes of this report are:

1. An assessment of onsite wastewater systems in the Kent Island study area and a discussion of collection and point, non-point or land based wastewater management options available for the proper treatment and disposal of the effluent.
2. An assessment of wastewater management practices in several of the small rural centers (Queen Anne, Barclay, Price, and Templeville) located through the county and a discussion of collection and non-point or land based wastewater management options available to these dispersed rural communities.

Present statewide practice in Maryland utilizes scientific principles and sound planning as a component of the onsite wastewater management program. Presently the standard of practice in the State of Maryland for environmental health practices associated with the onsite wastewater treatment and disposal systems requires a dry soil treatment zone of at least 4 feet between the bottom of the disposal system and the seasonal high groundwater. The State of Maryland recognized this requirement was unlikely to be met in many areas of the Eastern

Shore Counties and allowed a deviation from the 4 feet of dry soil treatment in defined management zones upon the approval of a Groundwater Protection Report for each County and its subsequent incorporation into each County's Comprehensive Water and Sewerage Plan.

Queen Anne's County currently utilizes a minimum 2 foot dry soil treatment zone for new development in much of Kent Island. Code compliance is essential to protect public health, environmental quality, community investment, and property investment and ultimately contribute to the restoration of the Chesapeake Bay water quality efforts.

Many of the old systems (initial installation dates early 1990's and previous) investigated on Kent Island do not even meet this 2-foot dry soil zone requirement. These systems are hydraulically malfunctioning to the extent of soil surface breakthrough into lawns or adjacent ditches. This hydraulic failure, combined with no dry soil pathogen treatment zone, has caused a public health concern for some time. Incorporation of the variance into the wastewater permitting program has resulted in the proliferation of small lot systems throughout the study area. The small lot sizes eliminate potential to develop the more traditional soil treatment systems whenever repairs are required.

The Chesapeake Bay restoration effort has identified thirteen (13) essential program elements necessary to reestablish the quality of Bay waters; correcting improperly operating septic systems constitutes one of those elements. Nutrients and microorganisms (i.e. bacteria and virus particles) are introduced to the Bay through many sources including improperly designed and operated onsite wastewater systems. The Bay Restoration act requires implementation of nutrient removal strategies to correct an ongoing problem. The problem was created in part by onsite wastewater systems installed prior to the State requiring dry treatment zones. Correcting the nutrient issues in the Bay will require addressing existing systems that have contributed to the current water quality problems as well as assuring that future systems are installed and operated in accordance with sound design principles.

The EPA Report, Potential for Nutrient Loadings from Septic Systems to Ground and Surface Water Resources and the Chesapeake Bay (USEPA, 1997), indicates the nitrogen input to the Chesapeake Bay from a variety of point and non-point sources. Total Nitrogen input to the Bay from all onsite wastewater sources is reported as over 22,410,000 pounds per year. The report lists nitrogen input from the over 8500 onsite wastewater systems in the county (reported in this 1997

report) as over 150,000 pounds per year. This value may not reflect the propensity of groundwater penetrating onsite wastewater systems utilized in Queen Anne's County.

In 2002 the State of Maryland passed the Bay Restoration Fund program that instituted a fee for discharge of pollutants within the boundaries of the State. The sewer use ordinance established a fee of \$2.50 per month per equivalent dwelling unit for discharges; regardless of the point of discharge, whether to surface waters or to the land, which thereby included individual septic systems

**Introduction:** The Kent Island area of Queen Anne's County (QAC) began to develop intensively following construction of the Chesapeake Bay Bridge in the early 1950's. Building permit activity in the Kent Island area increased dramatically through the 1960's and 1970's. Since there was no community-wide wastewater collection and treatment system, development relied on the septic or onsite wastewater system. Other areas of the county also rely on the onsite options and the practices utilized in these small communities were assessed by examining available permitting data available the Health department.

In 1989 the Groundwater Protection Plan for Maryland was modified for QAC to allow development of onsite wastewater systems in certain areas with 2 feet of separation between the zone of waste application and seasonal saturation.

In May 2005, the Commissioners in QAC commissioned a study of the onsite wastewater systems as defined in a proposal as three task areas:

Task 1 – Kent Island Estates and Romancoke

Task 2 – Other Kent Island Communities

- a. Kent Point Farms
- b. Tower Gardens
- c. Queen Anne's Colony
- d. Kentmorr
- e. Chesapeake Estates
- f. Sunny Isle of Kent
- g. Normans (Batts Neck)
- h. Matapeake Estates
- i. Marling Farms
- j. Dominion

### Task 3 – Other County Areas

- a. Barclay
- b. Templeville
- c. Price
- d. Queen Anne

The purposes of the study was to determine the degree of compliance with current laws and rules influencing development and use of onsite wastewater systems and to describe options available to provide safe and effective, sustainable wastewater management systems for the residents of Queen Anne’s County and to assure the natural resources in the area are protected adequately.

**Procedures:** Prior to examining permit data for the QAC communities, Maryland State Rules and Regulations governing the development and use of onsite wastewater systems were consulted to determine current State of Maryland mandated requirements for onsite wastewater systems utilized throughout the State. Additionally, assessments of the Groundwater Protection Rules and the Rules for Municipal Wastewater Management were accomplished. This assessment included, but was not limited to, a review of separation requirements between the bottom of wastewater system effluent dispersal trenches and the top of the shallow, unconfined groundwater system, soil loading rates, buffer requirements between water supply wells and onsite wastewater systems, and buffer requirements between surface water and onsite systems. Presently, the State has no mandated management requirements for sub-surface wastewater treatment and dispersal systems.

Following the assessment of state and local rules and regulations, the soils information for the county was examined. This soils information was available through the Modern Soil Survey of Queen Anne’s County and the QAC GIS system. Further, soil resources in the Kent Island area were examined to ascertain any potential to host wastewater recycling and reuse system utilizing land application guidelines established by Maryland Department of the Environment (Guidelines for Land Treatment, MDE –WMA-001-07/03). Clearly, sites are present in the Kent Island area consistent with the provisions contained in these land application guidelines, once the wastewater is properly treated, and many of these sites are considered prime agricultural resources.

Additionally, the Groundwater Protection Plan for Queen Anne’s County (1989 and updated 1995) was consulted. This plan established management zones

essential in the protection of groundwater resources. The report indicates that new onsite wastewater systems installed utilizing groundwater penetrating options are not permitted in the county and are to be utilized only as repair options. This groundwater protection plan suggested that systems failing to meet criteria for onsite systems should be connected to the centralized QAC Sanitary District facility.

The study plan developed purported to examine the onsite wastewater permits issued to, and on file in support of, building activities in several QAC communities. The target communities and general permit information is presented in Table 1, Permitted Onsite Wastewater Systems in Kent Island Area of QAC (Tasks 1 and 2) and Table 2, Permitted Onsite Wastewater Systems in Barclay, Price, Queen Anne, and Templeville (Task 3). These two tables indicate the anticipated level of compliance with a true groundwater protection program.

In addition to the assessment of the treatment currently utilized, options for development of community collection and land based treatment options were assessed on a preliminary basis in the more rural communities located off Kent Island. This assessment involved examination of the soil resources in the area and analysis of soil materials to determine soil fertility levels. Those soil fertility levels are important in determining the potential for land based wastewater management systems. The results of the soil fertility testing are presented for these communities are presented in Table 3, Background Soil Fertility Levels in Target Queen Anne's County Communities. The soil materials for the testing were collected from areas near the community on the edge of agricultural fields. Samples were collected using standard agricultural practice (a one inch diameter stainless steel core sampler) and a composite sample was collected from the areas. These soil tests are preliminary and are not to be used for design purposes, rather as background.

The initial QAC study plan called for an assessment of permits in the target communities of Kent Island and a less comprehensive, but statistically sound assessment of permit data in the more rural areas of QAC. The permits assessed in these communities do not represent a lot-by-lot assessment of permits rather a sampling of permits issued in the communities.

The files were examined to determine the type of onsite wastewater system utilized at a specific property. The types of dispersal systems represented in the files include trench systems, pit or dry well systems, low pressure pipe systems, and sand lined trench systems. Permit information when available may include

information concerning the location of a system on a specific property, the characteristics of the site and soil system such as depth to groundwater and estimated soil permeability, well location, etc.

Trench depth or liquid placement is a critical factor in assessing the performance of a soil based, onsite wastewater system. Typically, the bottom of the effluent dispersal system was located at a depth of between 6 feet and as much as 12 feet. Few systems were installed at depths of 4 feet or less. This is critical since the soils information suggests that seasonal water tables are present in many of the soils represented in the area at depths of 48 inches or less. This placement data suggest that the majority of systems installed in the Kent Island area of QAC are installed in intimate contact with shallow groundwater tables. Review of permit data for the outlying communities suggests that similar system (very deep trench or bed systems) placement was used throughout the county.

Recent system installations (early 1990's and current) permitted under current health department procedures and utilizing current staff have developed large lot sizes and permitting procedures in compliance with current recognized practice. The large lot sizes and the utilization of a site and soil analysis procedure should result in development of systems consistent with state practice.

### **Onsite Wastewater Systems: Kent Island (Tasks 1 and 2)**

Permit histories were examined dating back to the late 1960's through the present. The assessment of the permit data indicates that the majority of the onsite wastewater systems permitted in the Kent Island communities assessed are groundwater penetrating systems. Typical practices were for the soil materials in areas of the lot permitted as receivers for wastewater to be removed to depths of 6 to 15 feet, filled with sand or gravel, perforated pipe is placed atop the gravel or sand and the area covered with soil. Excess soil is removed from the area.

The number of onsite system permits assessed in the target Kent Island communities are presented in Table 1 and represent the number of permit files available in the Kent Island area for review by the team from McKim & Creed in the Environmental Health Section of the QAC Health Department. The accuracy of these files as representative of the number of building lots with onsite systems is not questioned. The numerical values presented in the table represent health department file information for residential, commercial, recreational, and

community facilities located in the Kent Island communities listed and examined for purposes of this report.

Table 1, Permitted Onsite Wastewater Systems in Kent Island Area of QAC

Community	Permits Assessed	Groundwater Penetration	Unknown	Possible Compliant	LPP or other
Chesapeake Estates	124	77	39	8	? <sup>1</sup>
Dominion	136	55	41	40	7
Kent Island Estates	795	?	?	?	29
Kentmorr	100	50	18	32	4
Marling Farms	312	93	49	170	7
Queen Anne Colony	231	141	45	48	21
Romancoke	272	45	137	90	15
Tower Gardens	89	58	11	20	6
Kent Point	24	12	2	12	2
Sunny Isle	33	10	5	18	3
Batts Neck	48	14	6	34	4
Matapeake Est.	22	10	2	12	1

1. A “?” in the table indicates inadequate information available to assess a value

### Onsite Wastewater Systems: Rural Areas (Task 3)

Specific findings for each of the remaining target communities are presented in Table 2, Wastewater System Design and Installation Criteria, QAC Communities, below. These data summarize the depth of placement of systems, the type of system and the potential for onsite wastewater system designs consistent with Maryland Criteria for Onsite wastewater Systems (Maryland Administrative Code). The replacement systems are installed in accordance with the groundwater protection plan for the county, but the plan is inconsistent with groundwater and surface water protection criteria generally accepted for onsite systems.

New onsite wastewater systems installed since early 1990’s are generally developed on large acreage tracts and at soil loading rates consistent with

accepted practice. Utilization of these design practices on the new properties should eliminate issues as described on many of the older lots.

Table 2, Wastewater Systems QAC Rural Areas

Community	Permits Assessed	Groundwater Penetration	Unknown	Possible Compliant	LPP/ATU/SF
Barclay	58	32	4	2	2
Price	24	20	? <sub>1</sub>	4	?
Queen Anne	29	20	2	7	?
Templeville	21	10	?	11	2

1. A “?” in the table indicates inadequate information available to assess a value

The supporting documentation for these system numbers is attached for each of the target communities. The purpose of this report is to demonstrate the data available for the communities and to suggest potential uses for these data to develop long term and sustainable wastewater management solutions for the area. The values represented for the communities were obtained by examining each permit on file and updating information provided by the County. These community files are presented in the appendix to this report.

### Nutrient Considerations

Nutrient input based on typical flows of 69 gallons per person per day [American Water Works Association] and assume 4 people per household [2000 Census] (assumes majority of residential units occupied by mature adults, few children). Anticipated flow from the 2500 homes in the target area is calculated as:

$$2500 \text{ homes} \times 4 \text{ people/home} \times 69 \text{ gal/person/day} = 414,000 \text{ GPD}$$

Assuming the septic system operates properly, the significant contribution to the environment is ammonium nitrogen. Typical ammonium concentrations from septic systems are 25 to 40 mg/l. The nitrogen contribution from these systems may be calculated as:

$$0.41 \text{ MGD} \times 30 \text{ PPM} - \text{NH}_4 \times 8.34 \times 365/\text{d/yr} = 37,442 \text{ pounds ammonium/yr}$$

Ammonium is troublesome since it converts to nitrate in aerobic environments and nitrate is often a limiting nutrient where eutrophication of surface waters is an issue.

These sample calculations do not assume any losses for nitrogen that may occur in the hyporheic zone. The unknown in these assumptions and associated calculations is the attenuation in the hyporheic zone (the area where groundwater flow enters surface water). Typically this zone attenuates a significant amount of nitrogen. Estimates of the activity in this zone suggest losses of as much as 50% in Nitrogen. The contribution of nitrogen to the Bay from the direct penetration of wastewater into shallow groundwater is estimated to be over 10,000 pounds per year. This zone is biologically active and occurs in the saturated area between groundwater and surface water. Chemical transformations for nitrogen generally result in denitrification, but the level of biochemical conversion has not been well established and may change as seasonal variations in temperature modify biological activity.

Acreage per home lot ranges in size from small lots adjacent to waterways and Bay to lots containing over 1 acre. Average lot size appears to be less than one half acre and the nutrient loading per acre is not excessive, but the loading is discharged to groundwater where input to surface water is problematic.

### **Hydraulic Considerations**

A very preliminary physical assessment of the potential hydraulic conductivity in the shallow groundwater aquifer system was accomplished through a series of shallow well pump-out tests conducted on vacant properties in the Queen Anne Colony, Kent Island Estates, and Romancoke areas. The shallow well pump-out tests were accomplished in October 2005 when water tables were expected to be low. A 3.5 inch diameter hand auger was used to advance an auger hole to a depth of 10 feet. A sand lens was encountered at depths ranging from 6 to over 9 feet. Watertables were measured at 72 inches initially and rose to 36 inches following the testing. The measured permeability of the underlying sand aquifer was determined to be over 5 feet per day. The permeabilities measured 5 feet per day in the slowest condition and 15 feet per day in areas with defined topographic gradients – where there was over 10 feet of fall between the test site and the Bay or a tributary. It should be noted that potable water wells are only required to be located 50 feet from the disposal fields. Permeabilities of 15 feet per day do not allow for much removal of any pathogens.

Rural sections of the county may support a variety of land based wastewater management systems should community collection and treatment be desired. The soil testing indicates some of the soil resources in the target communities are well suited to support land based wastewater treatment. This preliminary conclusion is based on review of published soils information contained in the modern Soil Survey of Queen Anne's County and limited soil testing to ascertain background soil fertility levels. This document lists soil resources throughout the county and provides interpretative materials concerning soil properties. Properties such as seasonal water-table depth, permeability, and drainage potential are listed in this survey. Agricultural and silvicultural fields throughout the county are well suited to receive treated wastewater based on preliminary review of this survey and limited assessment of large land areas in the Kent Island area and on the mainland east of the target communities. Soils with moderate permeability (0.6 to 2.0 inches per hour) and with water-tables located greater than 24 inches below the soil surface are typically well suited as receivers for reclaimed water. The high quality wastewater generated at the QAC facility is well suited to apply to land. Addition of water from the target communities will increase the volume of water available for discharge and potentially for beneficial reuse. Further testing of individual sites will be required to assure land treatment potential, but golf courses, recreational lands, agricultural fields and forested sites all benefit from well managed reuse programs.

The potential for land based treatment is increasingly important as regulatory agencies impose more stringent limits on discharges to nutrient sensitive waters. Land based treatment utilizing a portion of the water collected and treated from target communities may offer an option to reduce nutrient loadings to the bay. Golf courses and recreational areas often require water to optimize plant growth and create desirable landscapes.

The modern soil survey of Queen Anne's County indicates that areas containing the following soil resources may be suitable to host land based wastewater management through some form of surface irrigation: Matapeake, Matapex, and Nassawango. These soil materials are discussed in Appendix 2, attached.

These options are selected as a non-point source discharge because of the sensitivity of the water resources in the area. Soil test results are presented in table 3 below.

Table 3, Soil Test Results Queen Anne’s County

Test Parameter	Barclay	Queen Anne	Templeville	Price
OM (%)	0.4	0.7	0.5	0.6
pH (SU)	5.7	5.9	5.7	6.0
P (mg/kg)	128 (A)	145 (A)	88 (L)	161 (A)
K (mg/kg)	101 (A)	90 (A)	67 (L)	152 (A)
Ca (%)	55 (A)	61 (A)	70 (A)	50 (L)
Mg (%)	12 (A)	10 (A)	8 (L)	8 (L)
Cu (mg/kg)	1.2 (A)	1.8 (A)	0.9 (A)	1.3 (A)
Zn (mg/kg)	2.0 (A)	1.7 (A)	1.9 (A)	2.1 (A)

“A” signifies adequate nutrient available, “L” is a potential nutrient deficiency

Soil fertility levels in the rural communities are well suited for production of a wide variety of agricultural and silvicultural crops. Soil pH and nutrient levels can be adjusted as required to optimize soil productivity and potential for proper performance of a land based wastewater system. Slow rate spray irrigation systems onto permitted or dedicated land or onto a non-dedicated site as an irrigation resource for recreational lands has offered an excellent option for reusing treated wastewater beneficially. A dedicated receiver site is one permitted by appropriate regulatory agencies and dedicated to wastewater application. A non-dedicated site is typically a recreational or common-use site such as a golf course or park where there is human contact and reclaimed water is used as an irrigation resource. The reuse quality standards are very stringent. Typical reuse standards are: BOD 5 mg/l or less, TSS 5 mg/l or less, Coliform between 2.2 counts/100 ml and 14 counts/100 ml. Agencies may impose standards for ammonium or nitrogen, but the land based systems typically utilize these as nutrients.

### Study Results

The assessment suggests that few of the older onsite wastewater systems installed in the target communities meet current standards for onsite systems. Two general types of soil systems are currently permitted in the QAC area. These are a trench system and a pit system. A soil based onsite domestic wastewater treatment system is typically installed at a depth of 30 to 48 inches. This allows a zone of unsaturated natural soil below a dispersal system for wastewater treatment and renovation. Based on the review of permit data available, this

treatment zone is typically not present in the older systems present in the target communities.

Review of permit data indicates that the hydraulic loading utilized to size a wastewater system under current regulations is between 0.5 and 1.0 gallons per square foot per day. The more conservative liquid loading is utilized in the trench based systems while the higher loading is utilized to size a pit system. Trench systems may contain up to 200 linear feet of 2 to 3 foot wide trench while a typical pit system may cover between 115 and 400 square feet.

The depth of trenches utilized in the past within the target communities suggest that soil dispersal component for many of the systems are excavated into the shallow groundwater, filled with gravel or slag and utilized as disposal rather than dispersal systems for septic tank effluent. A less common option is the pit system. In the pit system, large pits are excavated to depths ranging from 8 or 9 feet to over 20 feet. These pits are filled with gravel or slag and septic tank effluent is dispersed over the material – typically relying on simple gravity distribution to spread liquid over the trench or pit system. These deep trench and deep pit systems assure septic tank effluent is placed in intimate contact with shallow groundwater since the area loading is small and the liquid loading is moderately high. These pit systems are disposal systems rather than soil dispersal systems. Assuming the quality of the septic tank effluent discharged into the shallow groundwater is typical of septic tank effluent reported in USEPA design manuals (typical BOD: 150 – 200 mg/l; typical TKN 45 mg/l, typical fecal coliform levels 1,000,000 to 10,000,000 counts/100 ml) this disposal practice violates standards for protection of these water resources.

Table 1 lists the prevalence of these sub-standard dispersal systems in the Kent Island study area communities. Based on the information contained in this table, the Queen Anne Colony subdivision has the highest frequency of pit systems while all of the target communities have a significant number of systems considered groundwater penetrating. These groundwater penetrating systems had been common or standard practice in the area prior to the adoption of the Groundwater Protection Report.

The use of groundwater penetrating systems has been approved in other Eastern Shore communities. Dorchester County approved use of lagoon systems for individual homes and these were assessed through an EPA demonstration project. The primary difference between a pit system or deep trench system and a lagoon system is the surface area required. The typical onsite lagoon system

serving the few residential facilities in Dorchester County measure approximately 150 feet by 150 feet. The retention time for liquid in these lagoon systems provides treatment beyond that afforded in a septic tank/pit or trench system.

The highest percentages of systems in the Kent Island area which may not comply with some established standard are found in Romancoke and the number of compliant systems is low. The Kent Island communities pose the most significant environmental and health challenge observed.

The Barclay, Price, Queen Anne, and Templeville areas pose less significant risk because soil materials in these areas may be well suited for large land based systems. The quality of the permit data precludes any reasonable conclusion regarding system sufficiency.

Several permits have been issued for the development of aerobic treatment units (ATU's) followed by some form of soil absorption or pit system. The ATU may be an effective tool for removal of some organic matter, but these mechanically intensive systems do little to remove nutrients as nitrogen and phosphorus. An ATU can be designed and operated to meet moderately stringent nutrient removal goals, but there is no evidence that the systems employed in the Kent Island area are intended as nutrient removal systems. Further, there is no evidence that the ATU's are permitted with anything other than an improvement permit. No monitoring requirements appear to be imposed through the permits issued for these technologies.

A long term operation and maintenance program may be developed for the ATU's utilized to meet performance standards. North Carolina and Virginia have employed mechanical or aerobic treatment systems in areas of environmental concern. The State requirements impose only a very minimum of quarterly monitoring on these advanced treatment units.

## **Options analysis**

### **Kent Island (Tasks 1 and 2)**

1. No Action: A "no action" option only exists where risk to public health and groundwater quality is minimal. This option would allow the continued use of groundwater penetrating systems as the preferred option for use in Kent Island and other areas of the County

2. Development and associated maintenance of code compliant onsite: Site and soil conditions encountered throughout the QAC Kent Island area suggest that nutrient removing technologies would be required to meet standards imposed through the Chesapeake Bay Restoration Program. Nutrient removal systems followed by soil absorption systems may be developed. The cost of onsite nutrient removal systems ranges from \$20,000 to \$25,000 per system (treatment unit and soil dispersal system). In addition, these systems must be monitored frequently to assure proper system performance. North Carolina has established operation and maintenance criteria for advanced treatment units serving single family facilities. The application of these rules (15 A NCAC, Chapter 18, section 1900) requires systems utilizing mechanical components and permitted as repairs or new installations since 1992 to be managed through a management entity as defined in rule. The operation and maintenance requirements established in rule necessitate a minimum of 4 inspections per year. Typical inspection costs by private service providers are \$100.00 to \$150.00 per visit and testing is an additional cost. It must be noted that these systems may still not function hydraulically and many of the smaller existing lots may have insufficient room for the construction of such systems.
  
3. Development of Cluster systems: Areas within target communities may be developed with appropriately sized treatment units followed by soil based treatment units. Utilization of cluster systems where suitable soil materials are present within a reasonable distance of the target communities will reduce the costs of the collection system to convey liquid to a central treatment facility but will require the acquisition of suitable lands. The systems will require operator attention to assure proper long term operation. Cluster systems may be most suitable in the communities assessed off the Kent Island environs simply because of land availability. Nonetheless, some areas are available for cluster systems in the Kent Island area. Estimated costs for cluster systems including collection and treatment may be as high as \$25,000 to \$30,000 per connection using alternative collection technology and a land based, sub-surface wastewater system. These costs may be higher depending on land costs, high land cost will increase these values and these estimates were based on a land cost of \$7500.00/acre. Cluster systems must be managed more intensively than individual onsite wastewater systems.

4. Development of Community Collection and decentralized or distributed treatment: Throughout the Kent Island area soil materials are successfully supporting a variety of agricultural and silvicultural activities. These land areas are well suited to receive reclaimed domestic wastewater through traditional land application systems as permitted through MDE. Further, receiver sites are available that may benefit from use of high quality reclaimed water as an irrigation resource. An alternative land based treatment option potentially suited for use in the area is a constructed wetland system incorporated into wetland infiltration basins. Estimated costs for community systems including collection and land based treatment may be as high as \$20,000 to \$30,000 per connection using alternative collection technology and a land based, sub-surface wastewater system. These costs are based on a land cost of \$7500.00/acre. The per unit cost will increase if cost for land acquisition is greater. Collection system costs depend entirely on the linear footage of collection system. Community systems must be managed more intensively than individual onsite wastewater systems or the small cluster systems. These community based systems utilize similar treatment and dispersal as the small cluster and require significant operator attention, but since the number of connections is potentially high, operational costs may be less on a per customer basis.
5. Development of Community collection and treatment at QAC Sanitary District facility: The Sanitary District of Queen Anne's County currently operates a facility permitted to discharge treated liquid to the Bay. The addition of the target communities will consume capacity in this facility, but will assure the liquid generated in the area is treated according to conditions listed in the NPDES permit. The intent of the NPDES process is to reduce the pounds of pollutant discharged to surface waters. The renewable permits issued to QAC Sanitary District better assure targeted nutrient removal goals are met than do individual permits for individual systems.

### **Rural Areas (Task 3)**

1. No Action in rural areas: A "no action" option exists where risk to public health and groundwater quality is minimal. This option would allow the continued use of groundwater penetrating systems as the preferred option for use in Barclay, Prince, Templeville, Queen Anne, other rural areas of the County

2. Development of code compliant systems in rural areas: Site and soil conditions encountered throughout the more inland rural areas of QAC suggest that nutrient removing technologies would not be required to meet standards imposed through the Chesapeake Bay Restoration Program unless surface waters are located adjacent to wastewater systems. Where required, nutrient removal systems followed by soil absorption systems may be developed, but in those portions of the county with sufficient separation distance to surface waters (say 100 feet) code compliant soil absorption systems could be developed. The cost of onsite wastewater treatment and dispersal systems without nutrient removal ranges from \$10,000 to \$15,000 per system (treatment unit and soil dispersal system). The treatment system requirement exists because of limited separation distance to groundwater. In addition, these systems must be monitored frequently to assure proper system performance. North Carolina has established operation and maintenance criteria for advanced treatment units serving single family facilities. The operation and maintenance requirements established in rule necessitate a minimum of 4 inspections per year. Typical inspection costs by private service providers are \$100.00 to \$150.00 per visit and testing is an additional cost.

3. Development of Collection and Land Based Cluster in rural areas: Throughout the rural communities assessed, soil materials are currently supporting a variety of agricultural and silvicultural activities. These land areas supporting these activities are well suited to receive treated domestic wastewater through traditional land application systems as permitted through MDE. Further, potential wastewater receiver sites are available that may benefit from use of high quality reclaimed water as an irrigation resource. An alternative land based treatment option potentially suited for use in the area if sub-surface hydrology is supportive is a constructed wetland system incorporated into wetland infiltration basins. Estimated costs for community systems including collection and land based treatment may be as high as \$20,000 to \$25,000 per connection using alternative collection technology and a land based wastewater treatment system. Land acquisition cost will influence these values and this estimate is based on a land cost of \$7500.00/acre. Collection system costs depend entirely on the linear footage of collection system. Community systems must be managed more intensively than individual onsite wastewater systems or the small cluster systems. These community based systems require significant operator attention, but since the

number of connections is potentially high, operational costs may be relatively low on a per customer basis.

4. Development of Community collection and centralized treatment at QAC Sanitary District facility: The Sanitary District of Queen Anne's County currently operates a facility permitted to discharge treated liquid to the Bay. The addition of the target communities in the isolated rural areas of the county is not recommended since the extensive transmission system costs are potentially high and capacity at the QAC PUD may be better allocated to high development density areas of the county.

## **Conclusions:**

### **Kent Island (Tasks 1 and 2)**

Onsite wastewater systems utilized in the Kent Island area do not meet current requirements as contained in current MDE Rule for system design or operation nor do these systems meet the intent of the Chesapeake Bay Protection Act. The onsite wastewater systems utilized in these target communities are considered, based on permit data available from the local environmental health department, to be placing septic tank effluent into shallow groundwater. There are few aerobic treatment units utilized in these communities. The ATU may provide some benefit regarding removal of organic matter, but little nutrient removal unless specifically designed and operated to achieve performance standards. Repairs to existing onsite wastewater systems must continue with reliance on these groundwater penetrating systems because there is no potential for adequate dispersal based on plat limitations. The best that can be hoped for is some limited nutrient removal from managed pre-treatment units. Based on assessment of all options, the community collection and either dispersed treatment or centralized treatment option appears to offer the most reliable of the options available. The limited availability of suitable land throughout the target community suggests that the use of the NPDES permitted facility operated by the Queen Anne's County Public Utility District offers the most cost effective and sustainable of the wastewater management options available. The QAC PUD facility currently does produce treated effluent meeting treatment levels established in the USEPA Guidelines for Water Reuse suitable for application onto land. Should land based treatment be required as an adjunct or as a conjunctive element of the current permit, that option can be added to the existing permit.

### **Rural Areas (Task 3)**

The Barclay, Price, Queen Anne, and Templeville areas pose less significant risk because soil materials in these areas may be well suited for large land based systems. The quality of the permit data precludes any reasonable conclusion regarding system sufficiency. Examination of permit data does suggest that there are groundwater penetrating systems installed in these communities, but the proximity of these systems to surface waters is not as significant as in the Kent Island Communities. Groundwater penetrating systems are currently permitted and these systems may be required as on-lot repairs in the future because of site constraints imposed by current plats.

### **Queen Anne's County (Tasks 1, 2, and 3)**

Many of the onsite wastewater systems reviewed do not meet current standards for design, installation, operation and maintenance requirements imposed by current standards. Groundwater penetrating systems are typical in the communities surveyed. Many jurisdictions expressly forbid installation or operation of these systems and when encountered, property owners are forced to bring these systems up to a standard (USEPA Title 5, Underground Injection Control).

Compliance with federal rule imposed through the underground injection control program expressly forbids direct placement of wastewater into shallow groundwater. Soil absorption systems are recognized as a viable option, and the soil absorption option is based on providing between 12 and 24 inches of unsaturated flow through a soil. There is no evidence of flow through unsaturated soil on most sites assessed in Queen Anne's County.

Options for onsite wastewater management systems are severely limited. To comply with state mandate, systems must remove nutrients. Few onsite technologies are available that will meet stringent nutrient limits. Those that may meet these limits will require an extensive management and oversight program that will prove costly to either residents or the county.

Based on this assessment of systems and options, the community collection and treatment at the QAPUD facility option appears to be the most effective and sustainable of the options available. A community collection and treatment option provides a cost effective and sustainable wastewater solution for wastewater management in the Kent Island Communities studied. Collection

technologies are available that can be installed with minimal disruption to residents and all collection options should be assessed as a second phase to the county's effort to address viable and sustainable, long term wastewater management strategies for residents of Queen Anne's County.

Collection and treatment systems can be planned to allow for incorporation of recycle and reuse systems in the future as total maximum daily load (TMDL) conditions and Chesapeake Bay Protection Act requirements are imposed on wastewater systems operated in the area. County operated and maintained wastewater systems offer a sustainable option for long term management of wastewater in Queen Anne's County. The Public Utility District system provides a mechanism to assure assets are available for the life of this infrastructure to provide safe and effective wastewater management for residents of Queen Anne's County.

The small lots in the Kent Island communities are not well suited as permanent receiver sites for treated domestic wastewater. The collection system proposed through the Kent Island communities offers a viable option for assuring sufficient volume of liquid is available to achieve proper levels of wastewater treatment at the PUD facility. The wastewater treatment and reclamation facility operated by the Public Utility District offers a program:

1. To assure high levels of wastewater treatment are consistently achieved,
2. To assure assets required to manage wastewater flows in the future are available, and
3. To assure options necessary to comply with future daily load requirements imposed through Bay Management activities are implemented.

Management through the existing Public Utility District appears to offer a cost effective, environmentally sound option for managing wastewater that is protective of both public health and Chesapeake Bay water quality in accordance with mandates contained in the Bay Preservation Act.