Preliminary Engineering Report
Northampton County Northern Node

Northampton County Northern Node Project
Eastern Shore of Virginia Public Service Authority
Northampton County, Virginia

April 5, 2011

Submitted to:
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Section 1 – Introduction

This Preliminary Engineering Report (PER) has been prepared for the Northampton County Board of Supervisors. The report presents the engineering studies and analysis for one of several proposed projects that are intended to provide new sewage collection and treatment facilities on the Eastern Shore.

The area of Virginia collectively known as the Eastern Shore (also called the Accomack-Northampton Planning District) is located on the southern portion of the Delmarva Peninsula. This land region comprises two counties: Northampton, which extends from the southernmost tip of the peninsula to approximately 35 miles north; and Accomack, located directly north of Northampton, extending to the Maryland border.

Virginia's Eastern Shore is an area rich in historical and natural resources, offering a unique quality of life for its residents and visitors. Exploration of these lands began as early as the 1500's and structures from early settlements can still be found in existence today. Many old homes have been restored and are now open to the public. The natural resources on the Eastern Shore are plentiful and rich, with the Chesapeake Bay to the west and the Atlantic Ocean to the east, productive soils, woodlands, a temperate climate, sand dunes, barrier islands, diverse plant and animal life, wetlands, marshes and miles of shoreline. The abundance and quality of the natural resources found on the Eastern Shore provide for an economy built upon agriculture and seafood, and also offer a scenic environment with natural habitats and many recreational opportunities.

One of the most important natural resources is the groundwater supply, which acts as the only source for domestic, agricultural and industrial water use on the Eastern Shore. The groundwater is from a sole source aquifer system that is recharged only by rainfall. The Eastern Shore was designated as a "Ground Water Management /Area" by the Virginia State Water Control Board in 1976 due to some declines in water levels, well interference and instances of contamination. In 1997 the entire Eastern Shore of Virginia was designated a “Sole Source Aquifer System” by the U.S. Environmental Protection Agency. This means that the entire supply of drinking water for this area comes from aquifers that are recharged only by surface waters. One of the major current and potential threats to the groundwater resources is from domestic sewage. Only a very small portion, approximately 15%, of the Eastern Shore is served by public sewer facilities. Most areas are served by septic tanks, while some have cesspools or pit privies. These systems all have a high potential for groundwater contamination. In addition, effluent from septic system pump-outs was until recently disposed of in three unlined, dirt-bermed, anaerobic septage lagoons located in Accomack County. These facilities are a major contamination threat to the precious groundwater resources of the Eastern Shore and have already affected the quality of groundwater, at least in their immediate surroundings. The development of central sewer systems and the provision of adequate treatment of the wastewater in the concentrated growth areas of the County are critical for the health of both the environment and the residents.

In December 1999, the **Eastern Shore of Virginia Public Service Authority (ESVPSA)** was created by Northampton and Accomack Counties in order to address the water and sewer needs of the area. The goal of the ESVPSA was to protect the precious water resources for the benefit of the residents, visitors, natural environment and the economy.

The first steps in realizing this goal was to include the establishment of central sewer systems in regions defined as growth areas, the development of facilities to handle septage and the abandonment of all unlined septage lagoons. Plans for doing this were well under way in 2004 but, in 2005, the County of Accomack withdrew from the ESVPSA and closed out the remaining studies which had not received support and/or funding to proceed to a construction project. The County of Northampton retained the ESVPSA and in July 2010, the ESVPSA was reorganized. This reorganization includes representatives from four of the towns as well as the county.. The ESVPSA currently owns no existing sewage facilities. The only significant treatment and collection facilities on the Eastern Shore have been provided by developers and individual towns with the exception of the mass drainfield system that has been constructed at the Northampton County Complex in Eastville. The reorganized ESVPSA has been chartered to pursue a regional wastewater system in the northern and southern portions of the county

Section 2 - Project Planning and Service Areas

Virginia's Eastern Shore is located on the southernmost part of the Delmarva Peninsula. It is bordered to the north by the State of Maryland, to the east by the Atlantic Ocean and to the west and south by the Chesapeake Bay. The specific service area for this project comprises only the County of Northampton which has a land area of 357 square miles and a combined water and land area of 696 square miles.

Project Planning Area

The planning area for the Northampton County Project consists of the entire land area within the County boundary on the Eastern Shore of Virginia. The goal of this project is to provide central sewer facilities to the citizens of the county in the concentrated growth areas. The County has identified one general service area within the project planning area, which is the focus of this report. This area has been identified by the County as a priority for a centralized sewer system, due to current and projected population demands and economic growth. Northampton County is composed of five towns (Exmore, Nassawadox, Eastville, Cheriton and Cape Charles). The two towns at the northern end of the county are Exmore and Nassawadox, the focus of this report and referred to as the Northern Node throughout the report. The two towns at the southern end of the county are Cheriton and Cape Charles. The improvements recommended in around Cape Charles and Cheriton will be referred to as the Southern Project and are outlined in a separate Southern Node PER. The County as a whole does not provide water or wastewater services to its residents; however, the Towns of Exmore and Cape Charles have taken on this responsibility for some or all of its residents. The Town of Nassawadox does not provide any water or wastewater services to its residents but is desirous of bringing such services to the Town in the future. The hospital in Nassawadox operates its own water distribution and wastewater treatment system which is in need of replacement in the near future. Poor drainfield soil conditions in the county area between Exmore and Nassawadox, referred to as Hare Valley in this report, create a need for wastewater service in the County area. The proposed service areas and line locations are shown on maps in the Appendix of this report.

Environmental Resources Present

An abundance of historic and natural resources can be found on the Eastern Shore. There are 20 historic sites located in Northampton County. Natural resources include productive soils, forests, open land, dunes, barrier islands, wetlands, the Chesapeake Bay and

Atlantic Ocean, beaches, marshlands and surface and groundwater sources. These resources allow for agriculture, timber harvesting and abundant seafood supplies. They also provide diverse habitats for an abundance of plant and animal life, and offer residents and visitors a unique blend of recreational and scenic opportunities.

Northampton County is the southernmost county on the Eastern Shore, extending approximately 35 miles in length with an average width of 6 miles. The environmental resources in this area are vast and plentiful, and have a large influence on the economy and quality of life in the County. There are approximately 50,000 acres of farmland, over 30,000 acres of forestland and around 35,000 acres of tidal wetlands in the region. The County is located completely within the Coastal Plain Physiographic Province, and much of it is within the 100-year flood plain.

There are currently 20 sites within the County listed on the National Register of Historic Places. A preliminary review indicates that no site will be affected by this proposed project. There are no sites of Archaeological significance in the County listed in the Atlas of Virginia Archaeology. The Virginia Department of Natural Heritage listing of Rare and Endangered Squirrel *(Sciurus niger cinereus)* and a vascular plant, Seabeach Amaranth *Amaranthus pumulis),* as extremely rare and critically imperiled.

A review of the available wetlands information indicates that no wetlands will be affected by the proposed project. A field investigation by the US Army Corps of Engineers will be performed to ensure that there are no wetlands located on the proposed disposal sites.

Population Trends and Growth

Between the years of 1930 and 1990, the population of the Eastern Shore of Virginia remained relatively stable. From 1990 and 2000, the area experienced a population increase from 44,764 to 51,398, an increase of 14.8%. During this same period the Median Household Income increased by 48% in Accomack County, from $20,431 to $30,250[1]. In Northampton County the Median Household Income income increased 56% from $18,117 to $28,276[1]. From 2000 to 2010, the overall population of the Eastern Shore has declined 11% to 45,553. The 2010 Census data for household income were not available at the time this report was completed.

Northampton County

The population in Northampton County declined slightly in the 1980's and 1990's. However, this trend reversed between 1990 and 2000, although growth was very gradual and limited (less than 1%). The 2010 US Census reports that Northampton County experienced a population decline of 5% to 12,389 which is a reversal of the projected population estimates.

The main population centers in Northampton County are the towns of Exmore Cape Charles, Cheriton, Eastville, and Nassawadox. While the County as a whole

decreased in population from 2000 to 2010, the Town of Exmore increased its population by 28.5% to 1,460. Exmore is the largest town in Northampton County and currently provides water and sewer services to some of its residents with interest in providing services to the entire town.

Within Northampton County, the initial primary service area for this project consists of the town of Exmore (Phase 1). Connections will be available along the force main route to the treatment facility area south of Nassawadox. This is referred to as the Northern Node Project. All of these areas have been identified in the County Comprehensive Plan as development areas, with past, present and predicted concentrated growth[2].

1 - US Census Bureau
2 - County of Northampton, Virginia Comprehensive Plan Update, 2009

Section 3 - Existing Facilities

There are five of small wastewater systems that exist in Northampton County and have a role in the development of the regional wastewater project for Northampton County.

1. In Northampton County, the only significant municipal wastewater treatment facility is owned and operated by the Town of Cape Charles. The newly constructed expansion is located on the East side of Town and serves the Town of Cape Charles. It is proposed in the Southern Project that this facility will be providing sewer service to the Town of Cheriton and some additional areas of the Town of Cape Charles and surrounding areas in the county. This treatment facility is presently being upgraded and construction is expected to be complete in late 2011. The facility will have a capacity of 250,000 gpd and will be capable of expansion to 500,000 gpd and beyond in the future as needed.

2. A private treatment system owned by Shore Health Services, Inc. is located on Hospital Avenue in Nassawadox. The plant serves Shore Memorial Hospital and several additional customers along Hospital Avenue. The facility is permitted for 100,000 gallons per day (gpd) and uses extended aeration treatment technology. The plant is currently at approximately 45% capacity (45,000 gpd), is 30 years old and does not consistently meet its VPDES discharge limits. The plant's discharge location is an unnamed tributary to Warehouse Creek, which flows to Nassawadox Creek and out to the Chesapeake Bay. The sludge generated in the treatment process currently has to be hauled to another treatment facility in Maryland due to the recent closing of the septage lagoons in Accomack County. There were never any facilities provided for the treatment, dewatering and disposal of bio-solids at this facility. The existing treatment plant lacks nutrient removal capacity and would require an upgrade in the future to meet nutrient removal limits. Currently, the facility owner participates in a nutrient exchange program due to the inability to meet discharge limits. It is proposed that this facility be taken off line in the future and its wastewater treated in new facilities that will be proposed in this project.

3. The Town of Exmore has a central sewer system to serve portions of the town. This system uses Grinder Pumps placed in existing septic tanks located in the Central part of Town. The sewage is then conveyed under pressure to a package type treatment facility located on the outskirts of Town and the wastewater is disposed in the ground with the use of several drip irrigation fields located at the plant site. The capacity of the facility is 60,000 gpd and and only serves a portion of the Town, 113 accounts. The capacity of the plant has been exceeded on several occasions and has been investigated for inflow and infiltration issues. The facility began operating in 2005 and has recently purchased and implemented a solids dewatering system to reduce the cost for

hauling bio-solid to landfill for disposal. There is another portion of the Town of Exmore known as the New Road Community (NRC) where approximately 125 homes are served by septic tanks with disposal of the effluent in a common mass drainfield. The only treatment provided is by the septic tanks and the facility was constructed in 1999.

4. The Bayview Community in Cheriton has a decentralized wastewater system that was constructed in 2004. The system consists of small holding tanks at the individual dwelling units that retain solids. The liquid portion of the wastewater then flows through a gravity sewage collection system to a common pumping station. The wastewater is then pumped to a wastewater treatment system where the treated effluent is then distributed to a series of drainfields below ground by low pressure dosing. The County is expected to assume ownership and responsibility for operation of the system in the near future. This facility provides service to approximately 120 homes and has a capacity of 31,500 gpd. The monthly residential sewer fee for the Bayview Community customers is $39.

   This facility is a stand alone system and will not be a part of the Northern or Southern Projects but will remain in operation.

5. Northampton County owns a small system that provides service to the County Complex. It was constructed in 2008 and consists of a package type treatment facility that discharges to mass drainfield. There are no plans to change the operation of this facility as part of the Northern or Southern Projects.

The majority of residents in Northampton County are without access to centralized sewer systems with treatment facilities and are served by private septic tanks and drainfields. The Virginia law requires that septic tanks be pumped at least once every five years.

Currently, effluent obtained from septic tank pump-outs has to be hauled to a facility in Maryland for treatment and disposal. Until recently, it was disposed of in three unlined, anaerobic, dirt-bermed lagoons in Accomack County. They have recently been closed for further operation but the septage remains in place in each of the lagoons. Two of the septage lagoons were owned and operated by Bundick Well and Pump Company. One lagoon is located near the Town of Atlantic, while the other lagoon is near Mappsville. The third lagoon was owned by Boggs Water and Sewage and is located near the Town of Wachapreague.

These ponds are all located in Accomack County in relatively remote, wooded areas where odor complaints are currently not a large concern. The lagoons are open to the atmosphere and thus their levels are affected by precipitation, which allows for potential overflow events. Records show that the earthen berms surrounding the structures have been breached in the past. This situation allows

for the potential contamination of nearby surface waters. The lagoons also pose a constant threat to groundwater quality. With the sandy soils and high water table on the Eastern Shore, these unlined lagoons have a high probability for leaching contaminants into the groundwater supply. Preliminary testing has shown that the lagoons could be a definite source of pollution to the aquifer and the degree and extent of contamination could increase if these facilities are not remediated in the future. The location of the three lagoons is shown in the appendix of this report. Even though they are located in Accomack County, their location could affect the water supply for Northampton County.

Condition of Existing Facilities

Nassawadox Sewage Treatment Plant

This system is owned by Shore Health Services, Inc. and is being operated under VPDES Permit VA0027537. This plant is an extended aeration type facility permitted for 100,000 gallons per day. Current average flows to the facility are approximately 45,000 gpd and the facility has not been operating satisfactorily for an extended period of time. Some maintenance, including replacement of the in-stream communitor, and structural repairs to the aeration lagoon are required. The facility was never provided with any means for bio-solids treatment, dewatering or disposal and these solids must be hauled to Maryland for treatment and disposal. Consideration should be given to installing bio-solids treatment and dewatering facilities if the plant is to continue in operation. The existing treatment plant lacks nutrient removal capacity and would require an upgrade in the future to meet nutrient removal limits. Currently, the facility owner participates in a nutrient exchange program due to the inability to meet discharge limits.

Exmore Wastewater Facilities

Presently the Town of Exmore has two separate and independent treatment and disposal systems in operation.The system that serves a small group of houses on the west side of Town is referred to the New Road Community (NRC) System. The system was constructed in 1999 and includes septic tanks at each of 125 houses with gravity flow to three pumping stations that pump to a mass drain field. There is no further treatment of the septic tank effluent before the application to the drain field which has a design capacity of 50,000 gallons per day. Presently this system is suitable for continued use and the current facilities are adequate. Average Daily wastewater flows from the houses presently connected to this system are 15,000 gallons per day. There have been no reports of any noticeable infiltration or inflow into the system to date. The facility has no means for dealing with the solids that are generated in the individual septic tanks at each house which needs to be addressed with any expansion on the facilities. It is likely that additional flow capacity could be realized from this facility if the

wastewater was given additional treatment prior to the drainfield. The feasibility and cost of using these existing disposal facilities to gain additional capacity for the Town should be investigated as part of later phases of this project. The operation of the facilities is in compliance with the existing permit requirements and the Clean Water Act.

The collection and treatment facilities that serve other parts of the Town on the East side of Route 13 were constructed in 2005. This system uses small diameter low pressure sewers for the transmission of wastewater with Septic Tank Effluent Pump (STEP) Units located at each individual connection. The treatment and disposal facilities are located along Seaside Road near the Town Limits. The collection system is in need of service to remove solids from the STEP tanks. Recent solids dewatering devices have been implemented to reduce the cost of hauling for disposal. There have been ongoing problems with the operation of the facility due to excessive amounts of infiltration and inflow entering the collection system as well as high pressures due to the lack of suitable air release mechanisms along the transmission lines. Measures to control inflow and infiltration have been implemented by the Town, but there have not been significant storm events to observe the impacts of the measures. The process used for the treatment facility is a sequencing batch reactor (SBR) which is a steel package type plant placed directly on top the ground. Recent problems with controlling the process have required a building to be added around the unit for temperature control of the process. The disposal system uses Drip Irrigation lines adjacent to the treatment facility for disposal of the treated effluent. The existing facilities have a design capacity of 60,000 gallons per day (gpd), with an average daily flow during dry weather of 40,000 gpd. There are currently 113 accounts being served by the system and wet weather flows to the treatment facility often exceed the design rate of 60,000 gpd. The system is currently in compliance with all requirements from the Department of Environmental Quality and the Clean Water Act.

Financial Status of Existing System - Exmore

The town of Exmore provides sewer and water services to some residents and businesses. The proposed wastewater system does not replace, utilize, or remove any of Exmore’s existing wastewater components or customers. Therefore, a financial status of the Town services will not be included in this report.

Section 4 - Need for Project

This project fills a number of significant needs on the Eastern Shore. It addresses concerns for the health and safety of the inhabitants, the environment, and anticipated growth in the service areas.

Health and Safety

The most important issue that this project addresses is the health and safety of residents and visitors on the Eastern Shore. Groundwater is the only drinking water source for the entire area and only a very small portion is treated before use. The sole source aquifer is extremely susceptible to contamination due to the sandy soils and high water table levels where septic systems and abandoned septage lagoons are located along the main recharge spine of the groundwater system. If contamination occurs, it could lead to illness, environmental degradation, the loss of a viable water supply and even the loss of human life. Widespread pollution has not yet been reported in the aquifer and this project seeks to lessen the threat to this valuable water source. The development of the proposed facilities will allow for the abandonment of septic tanks and drainfields in the concentrated growth areas for this project in the County.

Current System Deficiencies

The proposed new collection facilities proposed for this project will allow for the abandonment of the virtually all of the existing septic tank systems in the Town, many of which are malfunctioning, and prevent the groundwater contamination from these systems in this growth area of the County.

Growth

Currently, development is hindered by reliance on individual septic systems, which are dependent upon good soils. Such soils are relatively scarce on the Shore and the placement of new septic tanks must be carefully controlled. This project will support growth in the population and the economy in the town of Exmore. The areas of Hare Valley and the town of Nassawadox will be provided the baseline infrastructure to address limited soils capacities and opportunities for economic growth. Growth capacity of 20% over 30 years has been provided in the proposed new facilities, along with provisions for ease of expansion in the future. The design will be based on 400 GPD per ERC and additional capacity will be available based on an expected flow of approximately 200 GPD/ERC. The design number of ERC's for the entire project area is 507.

With the central sewer systems proposed for this project, growth and new economic opportunities will be possible in the service areas which include opportunities for residential, commercial and industrial development. The area

has a long history of economic losses and missed opportunities due to its failure to provide sewer service to existing and potential businesses. With the proposed facilities in place, the individual towns can control development and any opportunities that may arise will no longer be missed due to a lack of wastewater services.

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Section 5 – Alternatives Considered

Several alternatives were considered for each major component of the proposed wastewater system. Constructability, operability, and required maintenance were several key factors considered in selection of each component. The selected alternative should be suitable for construction in areas with high water table, require minimal operator attention and maintenance components.

Project Alternatives Considered

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Vacuum Sewers	Packed Bed Filter	Low Pressure Dosing Drainfield
Low Pressure Sewers	Sequencing Batch Reactor (SBR)	Drip Irrigation
Gravity Sewers	Extended Aeration	Enviroseptic

Collection System Alternatives

The alternative to the existing on-site treatment using septic tanks and drain fields is to collect wastewater from each site and convey it to one or more central treatment sites. The collection systems to be considered include gravity systems, vacuum systems, and pressure sewers.

Three primary methods of collection were examined for each area. The first was the use of conventional gravity collection systems with pumping stations to convey the waste to the treatment facility. The second collection alternative was the installation of vacuum collection sewer systems with vacuum sewers and a pumping station to convey the waste to the treatment facility. The third method was the use of grinder pumps and pressure sewers.

Gravity System

Gravity systems are the most common form of sewer collection. A conventional gravity system would consist of 8-inch collection sewers that would discharge into larger trunk sewers that would convey the wastewater to a pumping station. The pump station would then pump the wastewater through a force main to the treatment site.

Advantages:

1. Simple system with very high reliability and convenience.

2. Sewers can handle grit and solids.
3. Less maintenance required.

Disadvantages:

1. Generally more pumping stations required.
2. Pumping station failure affects entire system.
3. Generally, collection system cannot be extended beyond initial service area when growth occurs.
4. Higher construction costs than other systems.
5. Required manholes are a source of infiltration.
6. Extended power outages could result in overflows

Because of the nature of the subsurface conditions on the Eastern Shore, a number of concerns exist that will affect construction and operation costs of the proposed facilities. One issue of special concern is the high water table in this area. Sandy soils and running sand conditions are also a concern. Due to the additional costs incurred with these construction methods make gravity sewer is not further evaluated for this report.

Vacuum System

Vacuum collection uses collector sewers that are maintained under a vacuum, by vacuum pumps. Wastewater flow from the individual service connections is by gravity to a small collection tank. As the level in the collection tank reaches a preset level, the vacuum valve assembly opens and the effluent flows into the collector sewers. Vacuum collector sewers are installed in the same general locations as gravity sewers, but at a shallower bury depth.

A vacuum pump station is required to pull wastewater collected into a vacuum tank, from where it is pumped and conveyed by force main to the treatment site.

Advantages:

1. Wastewater can be conveyed uphill for short distances.
2. Smaller sewer lines (less costly) can be used.
3. Bury depths for vacuum sewers are less than gravity and therefore less costly.
4. No groundwater leakage into system.
5. No manholes required.
6. Fewer pump stations required than for gravity systems.

Disadvantages:

1. Maintenance costs for collection tanks and vacuum valves can be higher than for a gravity system.

2. Pumping station failure affects entire system.
3. Extended power outages could result in overflows

Pressure Sewer System

This collection system requires installing a prepackaged, positive displacement, or other type of pump in a tank to be located near the property line fronting the roadway. The pump will lift the wastewater and convey it to a collection main that will flow to the treatment site. The collection mains will follow the same general route as a gravity system.

Advantages:

1. Wastewater can be conveyed uphill.
2. Smaller sewer piping (less costly) can be used.
3. Bury depths for pressure sewers are less than gravity.
4. Manholes are not required.
5. Reduced infiltration.
6. User pays for electricity to operate the pump.

Disadvantages:

1. Maintenance of all individual pumps will be required to be done by the utility.
2. Extended power outages could result in overflows.

The property acquisition requirements for the collection systems in this project will involve obtaining sites for the vacuum/pumping stations. The number of sites for pumping stations and their respective sizes will depend on the routes that are chosen. Right-of-ways and easements will also be required for the sewer installation and maintenance. All of the necessary property will need to be acquired by the County for construction of the proposed facilities. The estimated property acquisition costs are included in the estimated costs of the pump stations and related facilities.

Treatment Alternatives

1. Packed Bed Filter Systems

Options

- **Packed Bed Filter Systems - FAST by Bio-Microbics**: A Fixed Activated Sludge Treatment (FAST) wastewater treatment system is a pre-engineered modular apparatus designed to treat wastewater from small communities. FAST is a fixed film, aerated system utilizing a combination of attached and suspended

growth, capable of nitrification and denitrification in a single tank This combination includes the stability of fixed film media and the effectiveness of proven activated sludge treatment, making the FAST system very reliable.

A FAST system provides an ideal home for large volumes of friendly organisms in the inner aerated media chamber to digest the wastewater and turn it into a clear, odorless, high-quality effluent. The attached growth system assures that more organisms remain inside the system instead of being flushed out, even during times of peak hydraulic flows. During times of low usage, the large volumes of thriving organisms prevent a dying-off of the system, making FAST equally well suited to intermittent use applications.

Proper conditions are present to allow nitrification and denitrification to occur in the same tank without any system modifications. Special patented technology allows FAST to consistently reduce nitrogen levels-including nitrates and all other nitrogen species by an average of 70%.

Advantages:

1. Generally it is the most economical system of this type based on capital and installation costs.
2. Lowest operating and maintenance costs.
3. Suitable for construction in areas of high water table.

Disadvantages:

1. Requires periodic removal and disposal of settled and sloughed materials from the tanks

- **Packed Bed Filter Systems - AdvanTex:** The influent enters the recirculation-blend tank, where it blends with the contents of the tank. A septic tank effluent pump in the recirculation-blend tank transports the blended effluent to an automatic distribution valve, then to a distribution manifold in the filter pod. The biofilter pod contains a manufactured textile medium contained in watertight tanks. The influent is distributed to the individual tanks through a dosing system and is sprayed above the textile tilter medium. Air is introduced with a fan and exhausted through an installed vent. The system operates in a similar manner to the other Packed Bed Filter Systems.

  After passing through the filter media, the treated effluent passes out of the filter pod to the recirculation valve. The valve automatically splits or diverts the flow between the recirculation-blend tank and the final discharge; the valve also controls the liquid level in the tank. During extended periods of low flow into the system, 100% of the treated effluent is returned to the tank.

Advantages:

1. Timer controlled pump in recirculation tank doses filter system in a controlled manner.

Disadvantages:

1. Needs a costly 40,000-gallon (minimum) recirculation blend tank.
2. Higher installation and capital costs.
3. Higher shipping cost from west coast manufacturer.

2. Sequencing Batch Reactor

- **Aqua-Aerobic**: In order to achieve optimum clarity of the treated effluent, the system works on a periodic fill and draw principle (Sequential Batch Process). During day and night hours, raw sewage enters the aeration surge tank chambers. This chamber is sized to hold the daily wastewater flow, plus a minimum 50% safety margin. The system only processes one batch every 4 hours, or 1/6 of the daily wastewater flow. This gives the system the ability to handle the occasional shock load without any detrimental effect on the effluent quality.

  Every 4 hours the transfer pump pumps for 30 minutes from the aeration chamber filling the clarifier chamber with mixed liquor until it reaches the weir and overflows back to the aeration chamber, thus skimming off floatables for further treatment. Then a 3-hour perfectly quiescent period follows.

  After the 3 hour settling period, the effluent pump, which is suspended half way up in the clarifier chamber, starts and transfers the clear supernatant to the drip irrigation pump chamber leaving 1/2 of the volume in the bottom for the sludge return pump. When the liquid reaches a predetermined level, a float switch stops the effluent pump and starts the sludge return pump transferring the remaining settled sludge to the front end of the aeration chamber for additional biological digestion. Immediately, another 4-hour cycle is initiated for six cycles per day.

  The sequencing batch process of this system is not affected by flow variations. The sewage is retained in the large aeration surge chamber and only a predetermined volume is transferred to the clarifier chamber every 4 hours.

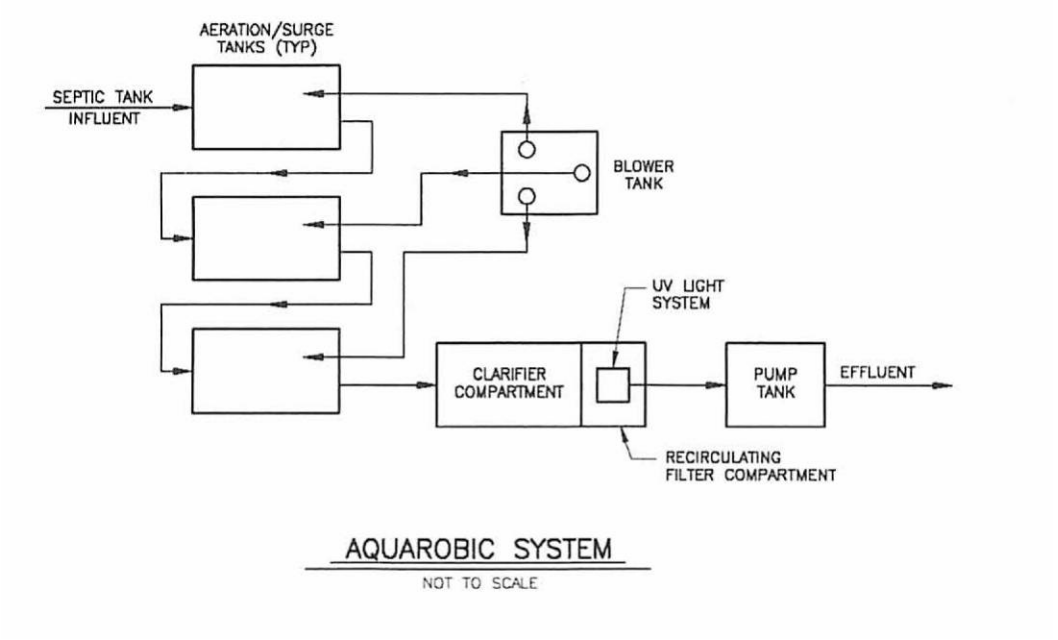
SBR treatment requires a high degree of operator attention and high energy costs compared to packed bed filter treatment; therefore, SBR will not be considered further.

Advantages:

1. Better removal of nitrogen, phosphorous and ammonia than Packed Bed Filter Systems.
2. Large operational flexibility.

Disadvantages:

1. Requires more than one unit for continuous flow.
2. Requires frequent removal and disposal of sludge.
3. Energy consumption is high.
4. Hard to adjust cycle times for small communities.
5. Needs costly concrete foundations.
6. Complex operation requiring close operator attention.



3. Extended Aeration

This is a well-proven activated sludge process with a reasonably good aeration period for nitrification and BOD removal. This process provides secondary treatment with an effluent suitable for discharge into surrounding waters. This system is costly, requires solids handling and disposal facilities and is maintenance intensive and therefore will not be considered further.

Discussion:
The FAST System is recommended for this location due to the ease and lower cost of construction in the areas of high water table and sandy soils. Based on this, detail costs for comparison were only performed on this option for comparison.

Disposal System Alternatives

1. **Discharge to Chesapeake Bay or Tributaries**: Due to the much higher treatment costs and extensive permitting associated with achieving the acceptable nitrate limits for discharge to the Chesapeake Bay and its tributaries, this option was not explored further for this project.

   Advantages:

   1. Requires no land purchases for disposal system
   2. Does not require any operation or maintenance time for disposal of effluent.

   Disadvantages:

   1. Requires a higher degree of treatment as compared to land disposal.

2. **Low Pressure Drainfield:** A low pressure drainfield system is a shallow, pressure dosed soil absorption system with a network of small diameter perforated pipes placed 10- to 18-inches deep in 12- to 18-inch wide trenches. A pump moves the effluent from the treatment system to the manifold to the distribution laterals in the trenches under a low pressure (3 to 5 feet of head). The laterals are PVC pipes with small holes, placed in narrow gravel filled trenches.

   Advantages:

   1. Distribution through pressurized laterals disburses the effluent uniformly throughout the entire drainfield area.
   2. Less land area required for the absorption system than gravity flow drainfield.
   3. Shallow placement of trenches promotes evapotranspiration and promotes growth of aerobic bacteria.
   4. Periodic dosing and resting cycles enhance aerobic conditions in the soil.

   Disadvantages:

   1. Limited storage capacity around laterals.
   2. Monitoring and maintenance of the system is required.

3. **Drip Irrigation:** Drip irrigation distribution is a method of pressure distribution capable of delivering small precise volumes of wastewater effluent to the infiltration surface. The system consists of a pump, a distribution unit, supply manifolds, dripline

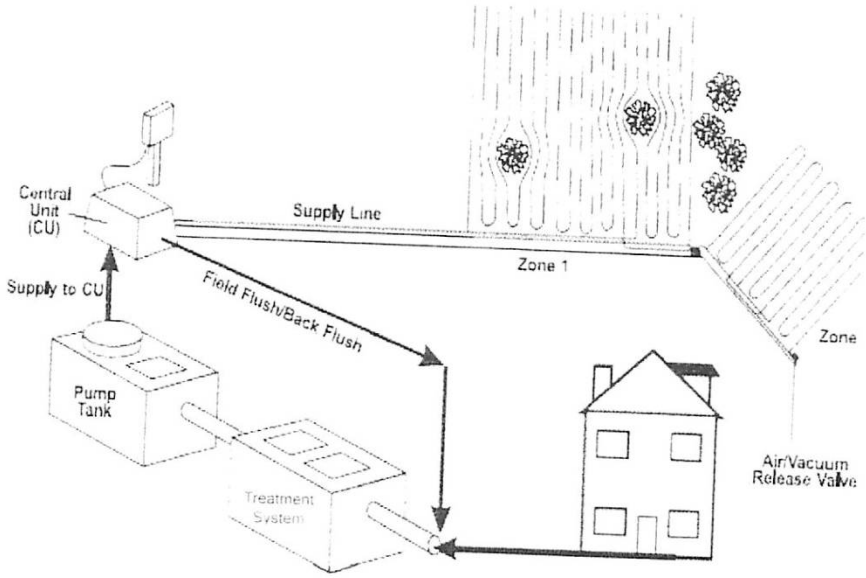
and emitters, and vacuum release valves. The dripline is normally a ½ inch diameter flexible tube with emitters spaced 1 to 2 feet along its length.

Advantages:

1. Less site disruption during construction.
2. Can be adapted to irregular shaped areas.

Disadvantages:

1. Requires regular operation and maintenance.
2. More costly to construct than other systems.
3. Requires filtering effluent and constant maintenance.



3. **Enviro-Septic® Drainfield:** Enviro-Septic is a patented multi-stage effluent treatment system. The system consists of a corrugated plastic pipe with exterior ridges and skimmers protruding into the pipes interior. The perforated pipe is wrapped with a layer of coarse fibers and is then covered with a geotextile material. The pipe is installed underground and surrounded with sand. The system is then covered with a layer of topsoil. The basic stages that occur within the system include; effluent enters the pipe and is cooled to ground temperature; suspended solids separate from the liquid effluent: skimmers capture grease and solids from the

effluent as it goes through perforations in the pipe; the mat of coarse fibers separates more suspended solids; effluent passes to the geotextile and grows a protected bacterial surface; sand wicks the liquid from the geotextile fabric.

Advantages:

1. Requires less land area.
2. Adapts to irregular and/or sloping sites.
3. Provides some additional treatment of the effluent.

Disadvantages:

1. Gravity flow does not evenly distribute effluent throughout the system.
2. Difficulty of installing pipes level on sloping ground.
3. System must be vented.

Section 6 – Selection of an Alternative(s)

Design Criteria

In order to consider treatment and disposal requirements for this project, it was first necessary to estimate the quantity of wastewater expected to require treatment in the service area proposed. The number of residential units, schools and commercial facilities was determined for the service area proposed. The equivalent residential connections (ERC) were estimated to be two bedroom units, on average, allowing for the occupancy of four residents per unit. Based on the Virginia Department of Health Sewage Collection and Treatment Regulations, 100 gallons per day (gpd) per person should be used as a design basis in computing sewage flow estimates for new sewage works.

The Town of Exmore has an existing sewer treatment system for a portion of the town, with a 2010 average flow of 45486 gpd, 238 connections or 329 ERC. Thus, the average flow based on sewer usage is 138.3 gpd per ERC and significantly less than the SCAT regulations value of 400 gpd per ERC. 2010 water consumption data from the Town water system is 57,597,000 with 740 water connections. This averages to 213 gpd per connection. However, an estimated 10% of consumption is used for fire fighting, irrigation, and other outdoor uses and does not enter the sewage system, with an average of 192 gpd per connection. Based on these lower use rates, flows for sewer system design is based on 200 gpd per ERC.

Schools were estimated to have an average of 500 students with an estimated flow of 16 gpd per student. Within the service area there is a wide variety of commercial establishments with varying demands for wastewater treatment. An estimated average flow of 600 gpd has been used for each commercial user for this study if no more specific information was available.

The estimated volume requirements of wastewater treatment for the proposed service area estimated in the following table:

Northern Node

Description	ERC Quantity	Flow (gpd)	Estimated Flow (gpd)
Exmore	225	400	90,000
Hare Valley	86	400	34,400
Nassawadox	44	400	17,600
Giddens Rd	11	400	4,400
Exmore Commercial	38	400	15,200
Hare Valley Commercial	8	400	3,200
Nassawadox Commercial	17	400	6,800
Giddens Rd Commercial	0	400	0
Medical Community	75	400	30,000
Total	504		201,600

This represents the maximum probable flow from the proposed service area if 100% of all potential customers connected to the system.

System design capacities and ultimate capacities are provided in the following table:

Proposed Ultimate Capacity

Design Capacity Required @ 400 gpd/ERC	201,600 gpd
20 year growth at 20% , excluding medical community	34,320 gpd
Ultimate Capacity Required @ 400 gpd	235,920 gpd

This represents the design ultimate capacity of the collection system.
The Hare Valley, Nassawadox and Giddens Road connections are from lots adjacent to the proposed force main. Design for 100% Residential and Commercial connections in Exmore and 50% of the Residential and Commercial connections adjacent to the force main route @400 gpd/ERC.

100% of Exmore @ 400gpd/ERC	=	263 ERC	105,200 gpd
50% of Hare Valley, Nassawadox, Giddens Rd @ 400gpd/ERC	=	83 ERC	33,200 gpd
100% Medical Community @ 400gpd/ERC	=	75 ERC	30,000 gpd
Total =		421 ERC	168,400 gpd

Anticipated Actual Flow@ 200 gpd/ERC

100% of Exmore @ 200gpd/ERC	=	263 ERC	52,600 gpd
50% of Hare Valley, Nassawadox, Giddens Rd @ 200gpd/ERC	=	83 ERC	16,600 gpd
100% Medical Community @ 400gpd/ERC	=	75 ERC	30,000 gpd
Total =		421 ERC	99,200 gpd

This represents the probable average daily flow of wastewater from the initial service area.

The treatment system will be initially designed to accommodate a wastewater flow of 99,200 gpd and will be expandable to an ultimate capacity of 235,920 gpd. The ultimate design capacity of the collection system is based on a flow of 400 gpd per ERC. The anticipated actual initial wastewater flow to the system is 99,200 gpd, based on 200 gpd per ERC.

Service Area Map

A map indicating the proposed layout of the wastewater system in the service area is included in the Appendix of this report. The map details the locations of the

vacuum/pumping station, treatment and disposal facilities and proposed routing of the vacuum and force main lines for the collection system. Both alternatives for treatment and disposal are shown for clarity.

Land Requirements

Approximately 0.5 acres of land will need to be acquired by the County for a vacuum/pumping station and approximately 50 acres for a treatment and disposal facility including septage receiving, solids dewatering, and dispersal.

A soil feasibility study was conducted for a potential disposal facility south of Nassawadox. The study was performed to determine the soil potential for disposal of up to 650,000 gpd of treated residential and commercial wastewater, far in excess of the design or anticipated daily flows.

The potential site was determined to be suitable by the Certified Professional Soil Scientist for the flows anticipated for this project. The majority of the site appears to be composed of Bojac (1A) soils with K-1 permeability of 2 feet per day and K-2 lower permeability of 4 feet per day. Depth of the high seasonal water table will determine the lower limit for calculating groundwater mounding and loading rates of each specific dispersal area.

Project Costs

The summary of estimated probable construction costs, operating expenses, and the present worth of construction costs plus 20 years of operating expenses for each alternative considered are indicated in the following table.

Construction Costs: Alternative 1 – Nassawadox Treatment Plant

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Exmore Grinder + *Other Grinder = $5,918,860	FAST $2,101,720 Packed Bed Filter	Low Pressure $361,800
Exmore Vacuum + *Other Grinder = $6,079,661	Advantex $3,861,900 Packed Bed Filter	Drip Irrigation $792,845
		Enviroseptic $1,572,890

* Nassawadox, Hare Valley, Giddens Road
Note: The highlighted cells indicate the lowest construction cost alternative.

Construction Costs: Alternative 2 – Exmore Treatment Plant

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Exmore Grinder + *Other Grinder = $5,758,340	FAST $2,101,720 Packed Bed Filter	Low Pressure $361,800
Exmore Vacuum + *Other Grinder = $6,445,572	Advantex $3,861,900 Packed Bed Filter	Drip Irrigation $792,845
		Enviroseptic $1,572,890

Annual Operating Expenses: Alternative 1 – Nassawadox Treatment Plant

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Exmore Grinder + *Other Grinder = $140,066	FAST $120,340 Packed Bed Filter	Low Pressure $7,000
Exmore Vacuum + *Other Grinder = $44,590	Advantex $125,560 Packed Bed Filter	Drip $19,056
		Enviroseptic $26,662

* Nassawadox, Hare Valley, Giddens Road

Note: The highlighted cell indicates the lowest annual operating expense alternative.

Annual Operating Expenses: Alternative 2 – Exmore Treatment Plant

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Exmore Grinder + *Other Grinder = $140,066	FAST $120,340 Packed Bed Filter	Low Pressure $7,000
Exmore Vacuum + *Other Grinder = $54,940	Advantex $125,560 Packed Bed Filter	Drip $19,056
		Enviroseptic $26,662

Detailed estimates of capital and operating expenses are included in the Appendix of this report.

Present Worth of Construction & Operating Expense

The present worth was determined for a 20 year period of annual operating expenses that are increasing at 2% per year. The interest rate used was 4.875% in accordance with RUS Instruction 1780. The highlighted cells below indicate the selected alternatives.

Alternative 1 – Nassawadox Treatment Plant

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Exmore Grinder + *Other Grinder = $6,058,926	FAST $2,222,060 Packed Bed Filter	Low Pressure $388,462
Exmore Vacuum + *Other Grinder = $6,124,251	Advantex $3,987,460 Packed Bed Filter	Drip $811,900
		Enviroseptic $1,575,552

*Nassawadox, Hare Valley, Giddens Road

Notes: Dollar amounts in the matrices represent the sum of first year construction costs and operation & maintenance expenses. The highlighted cells indicate the selected alternatives. Detailed estimates are included in the Appendix of this report.

Alternative 2 – Exmore Treatment Plant

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Exmore Grinder + *Other Grinder = $5,898,406	FAST $2,222,060 Packed Bed Filter	Low Pressure $388,462
Exmore Vacuum + *Other Grinder = $6,500,512	Advantex $3,987,460 Packed Bed Filter	Drip $811,900
		Enviroseptic $1,575,552

From the capital and operating costs data above, the two options were compared by performing a present worth analysis to give a more in depth comparison of the alternatives. Although, the initial capital costs are not the lowest, the present worth value is the lowest due to annual operating expenses.

Alternative 1 was a vacuum collection system within the town of Exmore with a force main to convey the wastewater to a proposed treatment facility south of Nassawadox. Additional connections are made to the force main by properties directly adjacent to the force main through the use of low pressure grinders.

Alternative 2 was a vacuum collection system within the town of Exmore and force main conveying sewage to a treatment facility near Exmore and a low pressure collection system with pump station and force main from Nassawadox to a treatment facility near Exmore. Additional connections are made to the force main by properties directly adjacent to the force main through the use of low pressure grinders.

The analysis started with the initial capital costs and then calculated the present worth value of the corresponding operation and maintenance costs for each option and added it to the capital cost. The remaining salvage value of each alternative was added to the present worth costs to give a final number that more accurately compares the two alternatives. As can be seen from the summary of results above, the present worth analysis clearly shows that Alternative 1 is the less expensive alternative by $1,189,548.

This analysis represents one method for the comparison of alternatives. There are other factors that should be considered when evaluating options of this magnitude that may not be apparent in a simple comparison of numbers alone. One of these factors is the overall goal of the County to create a regional system that will minimize duplication of efforts and manpower to provide the most cost effective facilities for providing treatment and disposal of wastewater for the entire county. This principle involves plans minimizing the number of future facilities until growth requires expansion of these services.

Present Worth Summary

Alternative 1	**Alternative 2**
Present Worth	Present Worth
$10,502,016	$11,691,156

The detailed calculations for the Present Worth Analysis are included in the Appendix.

Section 7 – Proposed Project

The Northern Node proposed project is presented as Exmore – Phase 1 is potentially a multiple phased project that will provide wastewater collection and treatment opportunities for the towns of Exmore and Nassawadox and the surrounding areas in Northampton County. The system will be capable of being extended north and south along Route 13 and Bayside Road as desired in the future or outside of the Town as growth in the area requires.

The proposed collection system selected within Exmore will be a vacuum system which will consist of a series of 4, 6 and 8 inch pipes that will convey the wastewater to a single vacuum station. From this point the wastewater will be pumped via force main to the treatment plant site south of Nassawadox**.** Along the force main route and in Nassawadox, individual low pressure grinder pumps will discharge to the force main from Exmore and will be conveyed further to the treatment plant. The collection system has been sized to provide capacity for the connection of the existing medical campus and some future connections for Nassawadox and Hare Valley.

The treatment method selected for the proposed alternative is packed bed filter, FAST. The treatment facility is located south of Nassawadox and provides a septage receiving station, ultraviolet disinfection, and sludge dewatering.

Dewatered sludge may be utilized for production of compost by combining the sludge with a mixture of wood chips and tree trimmings. A composting facility may be added in a future phase or developed by a private business separate from the treatment facility. Future compost generation from the dewatered sludge can be distributed at bulk rates or packaged and sold through commercial vendors creating additional revenue sources and business opportinities.

The disposal of the treated wastewater effluent will utilize a subsurface discharge through low pressure drainfields and will require permitting by the Virginia Department of Health. The high level of treatment and UV disinfection create the potential for reuse of treated effluent for non-edible plants by local nurseries. Funds for reuse components may be installed in a future phase or through cooperation with private businesses desireous of low cost and green alternatives for irrigation. A reuse alternative creates the potential to prolong the life of the drainfields and equipment and create revenue opportunities for the wastewater treatment system owner.

A septage receiving station and treatment system for pumpout of septic tanks will be located at the treatment site. This receiving station will be the only septage receiving station in Northampton County and southern Accomack County. The receiving station utilizes a computerized system to facilitate billing and provides a source of revenue that helps lower the overall monthly rates required for residential connections to the system.

A cost summary of the proposed project is included in this section of the report. Detailed

estimates of probable construction costs are contained in the Appendix.

Advantages/Disadvantages

In order to develop a regional collection and treatment system for the towns of Exmore and Nassawadox and the County areas in between, a multiple phased project was developed. The town of Exmore, with the highest rate of growth in the county and highest population density in the Northern Node, serves as the starting point for Phase 1. Since the cost of wastewater treatment is a major factor in the affordability of these services, it was also necessary to eliminate leakage into the system from surface water to minimize treatment costs. The County has limited resources for operational personnel and it was imperative to also minimize the amount of operator attention for all of the facilities involved. The selected alternative is compatible with existing comprehensive plans for the service areas involved and satisfies public and environmental concerns. The collection system recommended will eliminate extraneous groundwater due to infiltration, as it is essentially a closed system and operated primarily off of vacuum. It will consist of one pumping station with a backup power supply, which will provide a very high degree of reliability. The treatment alternative selected requires less maintenance and power than conventional treatment systems, creating lower annual expenses.

Project Design

Treatment

MyFAST treatment is proposed for this project. The treatment unit prescribed is capable of meeting current effluent discharge regulations for the state and Chesapeake Bay. Future expansion of the plant can be achieved through installation of additional modular treatment components that are available in multiple capacities (2000gpd to >40,000gpd).

Pumping Stations

The single pumping station required for this project is shown on the project layout maps in previous sections of this report. The pumping station will be a combination vacuum and pumping station and will include a generator as a separate source of power for backup in the event of a power outage to satisfy reliability requirements for this project.

Collection System Layout

The layout of the proposed vacuum collection system and force main is shown on maps in the Appendix. The detailed line lengths have been included in the detailed cost estimates in the Appendix of this report. They include the line sizes as well as accessories required for the system. The key advantage of the vacuum collection system is that it can be easily and cost effectively constructed in an area such as the Eastern Shore that has a high water table and relatively porous soils and has the advantage of extending the

system without the need for additional pumping stations. It also has the advantage of the elimination of the surface water intrusion into the system that often occurs on gravity type systems, severely reducing the capacity of the treatment and disposal system for expansion in the future.

In order to accommodate connections along the force main route, low pressure grinders are proposed. The density of the county area along the force main does not support a larger central collection system such as a vacuum collection system. Future phases of this northern node project may include the option for a larger central collection system located near the more densely populated areas.

Estimate of Probable Construction Cost

The probable construction cost of the selected alternative is:

Vacuum Sewer & Force Main	$5,304,707
Hare Valley Potential Connections	$389.070
Nassawadox Potential Connections	$317,628
Giddens Road Potential Connections	$68,256
FAST Treatment	$2,101,720
Solids Dewatering	$146,000
Low Pressure Dispersal	$405,000
Total Construction Cost	**$9,001,672**

Detailed cost estimates are included in the Appendix for contingencies, legal, engineering fees, and other expenses.

Rate Schedule

The following Rate Schedule was used in developing the initial annual operating budget and the seven year cost projection:

Connection Charge	$1,000
Availability Charge (Residential)	$2,500/connection
Availability Charge (Commercial)	$3,500/connection
Service Charge	$45/mo./ERC

Residential customers will not pay a connection or availability charge, if they elect to connect prior to construction.

Estimated Annual Operating Expenses

The seven year cash flow analysis is included in the appendix of this report, which indicates that the project is financially feasible based on the requirements stated and the assumptions noted.

Proposed Yearly Operating Budget

Eastern Shore of Virginia Public Service Authority

Operating Revenues	
Existing and New Residential Service Charges @ $45.00/mo/ERC	$ 162,000
Existing and New Commercial Service Charges @ $110.00/mo/ERC	$ 38,280
Hospital Campus Sevice Charges	$ 70,800
New Inspection and Account Fee @$200	$ 200
Total Operating Revenues	**$ 331,280**
Operating Expenses	
Total Operation and Maintenance costs for Collection System	$ 47,667
Total costs for Treatment and Disposal	$ 120,340
Debt Service Payment for new facilities	$ 133,944
Total Operating Expenses	**$ 302,001**
Net Income or Loss	**$ 27,279**

Potential Funding Sources	
DEQ – VRLF	$ 1.5 million
Rural Development	$ 4.3 million
DHCD	$ 1.5 million
Loans	$ 4.0 million
Total	**$ 11.3 million**

The rate analysis for the proposed project uses several assumptions:

- 65% grants/funding contributions
- 35% loan
- Loan terms: 0% interest; 30 year term

Section 8 - Conclusions and Recommendations

1. Based upon the estimated construction costs of the various options available to the County at this time, we have concluded from the present worth analysis, that utilizing a combination of vacuum and low pressure grinder collection system, FAST treatment, and low pressure dispersal is the most feasible and cost effective method of wastewater collection. Our analysis of the expected income or loss from the first year of operation is shown in the previous section and further supports this conclusion, assuming that the initial rates for all customers begin at a minimum of $45.00 per month for each equivalent residential connection. Our analysis shows that the operational losses for low pressure grinder system for the entire service area are significantly higher than the vacuum system due to the higher costs of operation and maintenance. From this it can be concluded that the monthly minimum rates to support a low pressure collection system would be significantly higher than the $45.00 per month proposed with the vacuum system and would not be acceptable.

2. The feasibility of this project is very sensitive to the number of initial connections on the systems in the early stages of development of the project. This study is based on the assumption that 100% of the residential and commercial properties within the Exmore Phase 1 service area will sign up. Along the force main in Hare Valley and Nassawadox, 50% of the potential connections are assumed. Significant efforts will be required in order to secure the service agreements and connections. Modifications will need to be made to the financial program as changes take place.

3. We have performed an initial cash flow projection over a twenty-year period of operation on a preliminary basis to assess the long-term viability of this project. We have determined the amount of debt that would have to be incurred by the County using certain assumptions. For the purposes of this initial analysis, we have assumed that the project receives a combination of grants and forgivable loans from the Department of Environmental Quality, US Department of Agriculture Rural Development, and Virginia Department of Housing and Community Development in the amount of at least 65% of the project cost or $7.3 million. Based upon those figures and an assumed interest rate of 0% percent on loans or bonds that would have to be issued on this project for the funds remaining, we have concluded that an initial minimum monthly charge of $45.00 per equivalent residential connection and a connection charge of $1,000 per single family residential equivalent will be required for future connections after construction is completed. In addition, an availability charge of $2,500 will be required to be paid by all new residents locating within the service areas of the project in the future. Based upon these assumptions, we have concluded that a positive cash flow will begin in the first year of operation and increase with growth to a positive cash balance of approximately $42,940 in the fifth year. This is assuming a flat rate of $45/month per equivalent residential connection for the

first five years of operation, then increasing 2% annually.

4. In the first year of operation, a 110% coverage of expenditures is achieved. It is apparent that additional interim financing will be required for the first three years of operation in order to achieve the desired coverage ratio of 115% for servicing of the loans for this project. The associated charges for this have been included in the estimated costs for this project.

5. The median household income (MHI) for Northampton County in 2008 was $34,501. This is 58% of the MHI for Virginia as a whole, which is $59,330.[1,2] This demonstrates a very limited ability for the residents in this area to afford central waste treatment systems. Guidelines from other federal agencies would indicate that the affordable rate per month for the local MHI would be $43. Financial analysis of the project cost indicates the need for a significant amount of grant money and low interest loans for this project to become affordable for the residents in the area. Therefore, additional funding should be sought by the County from other agencies to assist in reducing project costs and reduce the rates to an affordable level for the residents.

Sources:
1 - Bureau of Labor Statistics, Local Area Unemployment Statistics (LAUS) data.
2 – U.S. Census Bureau, American Community Surveys, 2009

Appendix A

Project Alternative Maps

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Norther Node - Alternate 1
Exmore - Phase 1 (2/23/11)

N

TO EXISTING MASS DRAIN FIELD

EXIST WWTP

EXISTING DRIP IRRIGATION FIELDS

Legend

- Vacuum Station
- Exist Pump Station
- Sewer Treatment Plant
- Force Main
- Collection
- Phase 1
- Phase 2
- Phase 3
- Phase 4
- Existing FM
- Existing 3.0"
- Existing 2.0"
- Existing 1.5"
- Existing Service
- No Service

0 550 1,100 2,200 3,300 4,400 Feet

HURT & PROFFITT
INCORPORATED

Northern Node - Alternate 2
Exmore - Phase 1 (2/23/11)

N

TO EXISTING MASS DRAIN FIELD

EXIST WWTP

EXISTING DRIP IRRIGATION FIELDS

0 550 1,100 2,200 3,300 4,400 Feet

Legend

- Pump Station
- Vacuum Station
- Exist Pump Station
- Sewer Treatment Plant
- Force Main
- Phase1
- Collection
- Phase 2
- Phase 3
- Phase 4
- Existing FM
- Existing 3.0"
- Existing 2.0"
- Existing 1.5"
- Existing Service
- No Service

Appendix B

Opinion of Probable Construction Cost:
- Collection Systems
- Treatment Systems
- Disposal Systems

Northampton County North Node
Opinion of Probable Construction Costs: Exmore - Phase 1 Grinder System

Exmore				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
8" Low Pressure Main	2,950	LF	$45	$132,750
6" Low Pressure Main	5,080	LF	$35	$177,800
4" Low Pressure Main	6,008	LF	$31	$186,248
8" Isolation Valve	2	EA	$1,500	$3,000
6" Isolation Valve	11	EA	$1,500	$16,500
4" Isolation Valve	11	EA	$1,500	$16,500
Eone Residential Grinder Package	225	Set	$6,300	$1,417,500
Eone Commercial Grinder Package	25	Set	$9,000	$225,000
Installed Pump Station	1	LS	$350,000	$350,000
6" Force Main to Hare Valley/Rte 13 JCT	19,900	LF	$34	$676,600
6" Isolation Valve	3	EA	$1,600	$4,800
8" Force Main to Nassawaddox Trmt Plant	16,400	LF	$40	$656,000
8" Isolation Valve	3	EA	$1,800	$5,400
Air Relief Valve	6	EA	$2,000	$12,000
Road Bores	1,000	LF	$250	$250,000
Pavement Repairs	13,000	LF	$35	$455,000
Vac Station Site Preparation	1	LS	$50,000	$50,000
Maintenance of Traffic	1	LS	$30,000	$30,000
Field Service Technician (Eone) - full-time	1	LS	$70,000	$70,000
Mobilization	1	LS	3.00%	$142,053
Permits, Bonds, Fees	1	LS	5.00%	$236,755
Subsurface Utility Location	1	LS	$30,000	$30,000
Total				$5,143,906

Northampton County North Node
Opinion of Probable Construction Costs - Phase 1 Dispersal System

Low Pressure Drainfield				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Clearing & Grubbing	1	LS	$6,000	$6,000
Erosion & Sediment Control	1	LS	$4,000	$4,000
Site Work	1	LS	$25,000	$25,000
Electrical	1	LS	$20,000	$20,000
Dosing Tanks	2	EA	$70,000	$140,000
Distribution System	1	LS	$48,000	$48,000
Drainfields	24	EA	$5,500	$132,000
Mobilization	1	LS	3%	$11,250
Permits, Bonds, & Fees	1	LS	5%	$18,750
Total				$405,000

Drip				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Clearing & Grubbing	1	LS	$6,000	$6,000
Erosion & Sediment Control	1	LS	$8,000	$8,000
Pump	1	EA	$8,000	$8,000
Supply Lines	1	LS	$90,000	$90,000
Tubing	660,845	LF	$1.00	$660,845
Electrical	1	LS	$20,000	$20,000
Total				$792,845

Enviro-Septic				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Clearing & Grubbing	1	LS	$6,000	$6,000
Erosion & Sediment Control	1	LS	$8,000	$8,000
Supply Lines	1	LS	$90,000	$90,000
Pipe	77,310	LS	$19	$1,468,890
Total				$1,572,890

Northampton County
Opinion of Probable Construction Costs - Phase 1 Treatment System

Exmore FAST by Bio-Microbics				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Clearing & Grubbing	1	AC	$3,000	$3,000
Erosion & Sediment Control	1	LS	$6,000	$6,000
Site Electrical	1	LS	$70,000	$70,000
Site Work	1	LS	$100,000	$100,000
Bar Screens & Conveyors	1	LS	$100,000	$100,000
Equalization Tank, 40,000 Gal	4	EA	$75,000	$300,000
Recirculation Tank, 40,000 Gal	2	EA	$75,000	$150,000
Blowers	2	EA	$30,000	$60,000
MyFAST 4.0, Pumps, & Sludge remover	1	LS	$600,000	$600,000
Concrete Tank for Unit	4	EA	$100,000	$400,000
Install MyFAST	4	EA	$30,000	$120,000
Sludge Digestor Tank	2	EA	$20,000	$40,000
Mobilization	1	LS	3%	$57,270
Permits, Bonds, & Fees	1	LS	5%	$95,450
Treatment System Cost				$2,101,720

AdvanTex by Orenco				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Filtration - Salnes	2	EA	$250,000	$500,000
Bar Screens & Conveyors	1	LS	$100,000	$100,000
Recirculation Tank, Gal	108800	GAL	$2.00	$217,600
Tank Access Equip	12	LS	$500	$6,000
Pump Equip	12	EA	$2,000	$24,000
Control Panel + $1100 per pump	2	EA	$3,500	$19,000
Recirculation Splitter Valve	4	EA	$2,200	$8,800
Ventilation Fan	4	EA	$300	$1,200
AdvanTex Filter - AX100	36	EA	$16,000	$576,000
Denitrification	1	LS	$500,000	$500,000
Septic Tank -3	300000	EA	$2.00	$600,000
Tank Access Equip	12	LS	$500	$6,000
Pump Equip	3	EA	$2,000	$6,000
Control Panel + $1100 per pump	2	EA	$3,500	$10,000
Install tanks and equipment	1	LS		$1,287,300
Treatment System Cost				$3,861,900

Northampton County North Node
Opinion of Probable Construction Costs: Phase 1 - Hare Valley Connections

Hare Valley				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Grinder (residential)	46	EA	$6,300	$286,650
Check Valve	46	EA	$600	$27,600
Demolish Septic Tank	46	EA	$1,000	$46,000
Mobilization	1	LS	3.00%	$10,808
Permits, Bonds, Fees	1	LS	5.00%	$18,013
Total				$389,070

Northampton County North Node
Opinion of Probable Construction Costs: Phase 1 - Nassawadox Connections

Nassawadox				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Grinder (residential)	27	EA	$6,300	$170,100
Grinder (commercial)	4	EA	$9,000	$36,000
Check Valve	55	EA	$600	$33,000
Demolish Septic Tank	55	EA	$1,000	$55,000
Mobilization	1	LS	3.00%	$8,823
Permits, Bonds, Fees	1	LS	5.00%	$14,705
Total				$317,628

Northampton County North Node
Opinion of Probable Construction Costs: Phase 1 - Giddens Road Connections

Giddens Road				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Grinder (residential)	8	EA	$6,300	$50,400
Check Valve	8	EA	$600	$4,800
Demolish Septic Tank	8	EA	$1,000	$8,000
Mobilization	1	LS	3.00%	$1,896
Permits, Bonds, Fees	1	LS	5.00%	$3,160
Total				$68,256

Notes:
1. Assumes 50% of residents with property adjacent to force main will connect.

Northampton County North Node
Opinion of Probable Construction Costs: Exmore Phase 1- Vacuum System

Exmore				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
8" Vacuum Main	2,950	LF	$50	$147,500
6" Vacuum Main	5,080	LF	$40	$203,200
4" Vacuum Main	6,008	LF	$36	$216,288
3" Service Lateral	133	EA	$1,200	$159,060
8" Isolation Valve	2	EA	$1,800	$3,600
6" Isolation Valve	11	EA	$1,800	$19,800
4" Isolation Valve	11	EA	$1,800	$19,800
AIRVAC Valve Pit Package (Proposed Conn.)	133	Set	$4,100	$543,455
AIRVAC Valve Pit Package (Existing Conn.)	-	Set	$4,100	$0
Single Buffer Tank	2	EA	$5,300	$10,600
Spare Parts	1	EA	$5,960	$5,960
Installed Vacuum Station	1	EA	$766,900	$766,900
6" Force Main to Hare Valley/Rte 13 JCT	19,900	LF	$34	$676,600
6" Isolation Valve	3	EA	$1,600	$4,800
8" Force Main to Nassawaddox Trmt Plant	16,400	LF	$40	$656,000
8" Isolation Valve	3	EA	$1,800	$5,400
Air Relief Valve	6	EA	$2,000	$12,000
Road Bores	1,000	LF	$250	$250,000
Pavement Repairs	13,000	LF	$35	$455,000
Vac Station Site Preparation	1	LS	$50,000	$50,000
Maintenance of Traffic	1	LS	$30,000	$30,000
House Connection (Same Side)	108	LS	$1,500	$162,675
House Connection (Opp. Side)	108	LS	$3,000	$325,350
Business Connection (Same Side)	12	LS	$2,500	$30,000
Business Connection (Opp. Side)	12	LS	$5,000	$60,000
Field Service Technician (Airvac) - full-time	1	LS	$70,000	$70,000
Mobilization	1	LS	3.00%	$146,520
Permits, Bonds, Fees	1	LS	5.00%	$244,199
Subsurface Utility Location	1	LS	$30,000	$30,000
Total				$5,304,707

Appendix C

Present Worth Analysis

Present Worth Analysis

Community Name: Northampton County - North Node, Exmore - Phase 1

Federal Discount Rate for Water Resources Planning (Interest Rate) i = 0.04875

Number of Years, n = 20 years

Alternate 1:

Initial Capital Costs =	$9,001,672
Annual Operations & Maintenance Costs =	$120,340
Future Salvage Value =	$39,850
Present Worth of 20 years of O & M =	$1,515,726

PW = $\text{Annual OM} * \frac{(1+i)^n - 1}{i*(1+i)^n}$

Present Worth of 20 yr Salvage Value =	$15,381

PW = $\text{FSV} * \frac{1}{(1+i)^n}$

Alternative 2 Total Present Worth =	$10,502,016

Alternate 2:

Initial Capital Costs =	$9,503,423
Annual Operations & Maintenance Costs =	$175,280
Future Salvage Value =	$50,713
Present Worth of 20 years of O & M =	$2,207,715

PW = $\text{Annual OM} * \frac{(1+i)^n - 1}{i*(1+i)^n}$

Present Worth of 20 yr Salvage Value =	$19,574

PW = $\text{FSV} * \frac{1}{(1+i)^n}$

Alternate 1 Total Present Worth =	$11,691,564

Appendix D

Opinion of Probable Cost for Selected Alternative : Alternative 1 – Exmore – Phase 1 With Nassawadox Treatment Plant

Northampton County North Node
Opinion of Probable Construction Costs: Alternate 1 - Exmore - Phase 1

Description	Cost	
Vacuum Sewer & Force Main	$	5,304,707
Hare Valley Potential Connections	$	389,070
Nassawadox Potential Connections	$	317,628
Giddens Road Potential Connections	$	68,256
Septage Receiving Facility	$	269,291
Treatment Plant	$	2,101,720
Solids Dewatering	$	146,000
Low Pressure Dispersal	$	405,000
Subtotal	**$**	**9,001,672**

Construction Contingencies	10.00%	$900,167
Interim financing	LS	$72,000
Start-up	LS	$10,000
Meetings	LS	$25,000
O&M Manual	LS	$40,000
Railroad Permits	LS	$0
Legal	LS	$50,000
Property/Easement Acquisition	LS	$300,000
Engineering	8.20%	$597,287
Construction Administration	1.00%	$72,840
Construction Inspection	2.50%	$182,100

Total Probable Construction Cost - Exmore - Phase 1	**$11,251,066**

Notes:

1. Includes 1 treatment plant south of Nassawaddox with approximately 120,000 gpd capacity (including 30,000 gpd medical). The proposed treatment facility includes 20% additional capacity for future connections.

2. Provides 250 vacuum connections in the town of Exmore.

3. Provides force main from Exmore to treatment plant, south of Nassawadox.

4. Provides force main capacity for initial and future connections from the Hare Valley area and the town of Nassawadox.

5. Provides a septage receiving facility.

6. Composting production facility is not included.

7. Assumes 50% of the 91 potential connections adjacent to the force main in Hare Valley will desire connection.

8. Assumes 50% of the 55 potential connections adjacent to the force main in Nassawadox will desire connection.

9. Assumes 50% of the 16 potential connections adjacent to the force main on Giddens Road will desire connection.

10. Does not provide pretreatment, pump station, or special connections for the hospital/medical community.

11. The proposed collection system in Exmore does not remove customers from the existing Exmore collection systems.

Appendix E

Rate Schedule
with
Intial Annual Operating Budget

7-Year Cash Flow
Rate Schedule with Initial Operating Budget
Northampton County
Exmore - Phase 1

Wastewater System: Alternate 1 - Exmore - Phase 1 Updated: Thursday, March 31, 2011

Service Start: 12/1/2011

Operational Year #		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Fiscal Year		**FY 11**	**FY 12**	**FY 13**	**FY 14**	**FY 15**	**FY 16**	**FY 17**
Residential Water Rate and Sales Information								
1	Minimum Monthly Residential Service Charge	$45.00	$45.00	$45.00	$45.00	$45.00	$45.90	$46.82
2	Average Monthly Commercial Service Charge	$110.00	$110.00	$110.00	$110.00	$110.00	$112.20	$114.44
2a	Hospital Campus Service Charge	$5,900.00	$6,077.00	$6,259.31	$6,259.31	$6,259.31	$6,321.90	$6,385.12
3	Projected Total Initial Residential Connections (ERC)	298						
4	Projected New Residential Connections per year (ERC)	2	2	2	2	2	2	2
5	Total Residential Connections	300	302	304	306	308	310	312
6	Projected Total Initial Commercial Connections	29						
7	Projected New Commercial Connections per year (ERC)	0	0	1	0	1	0	0
8	Total Commercial Connections	29	29	30	30	31	31	31
9	Availability Charge = $2,500 (Res) for new connections	$0	$2,500	$2,625	$2,756	$2,894	$3,039	$3,191
10	Availability Charge = $3,500 (Comm) for new connections	$0	$3,500	$3,675	$3,859	$4,052	$4,254	$4,467
11	Connection Charge = $1,000 (Res) and (Comm)	$0	$1,000	$1,025	$1,051	$1,077	$1,104	$1,131
12	Inspection and Accounting Fee for new connections	$100	$100	$150	$100	$150	$100	$100
Annual Revenues								
13	Existing and New Residential Service Charges	$162,000	$163,080	$164,160	$165,240	$166,320	$170,748	$175,287
14	Existing and New Commercial Service Charges	$38,280	$38,280	$39,600	$39,600	$40,920	$41,738	$42,573
14a	Hospital Campus Service Charges	$70,800	$72,924	$75,112	$75,112	$75,112	$75,863	$76,621
15	Availability Fee (New connections - Residential)	$0	$5,000	$5,250	$5,513	$5,788	$6,078	$6,381
16	Availability Fee (New connections - Commercial)	$0	$0	$3,675	$0	$4,052	$0	$0
17	Connection Fee (New connections - Residential)	$0	$2,000	$2,050	$2,101	$2,154	$2,208	$2,263
18	Connection Fee (New connections - Commercial)	$0	$0	$1,025	$0	$1,077	$0	$0
19	New Inspection & Account Fee (New connections)	$200	$200	$450	$200	$450	$200	$200
	Septage Receiving Fees	$60,000	$60,600	$61,206	$61,818	$62,436	$63,061	$63,691
20	**TOTAL REVENUES**	**$331,280**	**$342,084**	**$352,528**	**$349,584**	**$358,308**	**$359,895**	**$367,017**
Annual Operation Expenses								
21	Total O&M Collection System	$47,667	$49,097	$50,570	$52,087	$53,650	$55,259	$56,917
22	Total O&M Treatment Facility	$120,340	$122,145	$123,977	$125,837	$127,724	$129,640	$131,585
24	**SUBTOTAL OPERATION EXPENSES**	**$168,007**	**$171,242**	**$174,547**	**$177,924**	**$181,374**	**$184,900**	**$188,502**
New Debt								
25	Level Debt Payment for Loan Amount	$133,994	$133,994	$133,994	$133,994	$133,994	$133,994	$133,994
26	**SUBTOTAL NEW DEBT**	$133,994	$133,994	$133,994	$133,994	$133,994	$133,994	$133,994
27	**TOTAL EXPENSE**	**$302,001**	**$305,236**	**$308,541**	**$311,918**	**$315,368**	**$318,894**	**$322,496**
	Net Profit/Loss	**$29,279**	**$36,848**	**$43,986**	**$37,665**	**$42,940**	**$41,001**	**$44,521**
	Accumulated Cash Flow Balance	**$29,279**	**$66,126**	**$110,113**	**$147,778**	**$190,718**	**$231,719**	**$276,240**

Assumptions

1. Monthly Service Charge is a flat rate and increases at a rate of 2% per year starting in FY 16.
2. Availability and Connection fee is not charged for initial customer base (residential) for first year. For the purposes of the model, commercial connection fees are assumed to be part of the grants and community contributions (65% of project costs).
3. Availability Charge is $2,500 for new Residential and $3,500 for new Commercial connections made after the project is awarded and escalates at 5% per year.
4. Connection Charge fee is $1,000 for new Residential and new Commercial connections made after the project is awarded and escalates at 2.5% per year.
5. Inspection and Accounting fee for new accounts remains constant through 2040.
6. Interest rate on the financed amount for the project = 0 %
7. Term of the amount financed = 30 years
8. Total initial customer base is 100% of existing occupied residential + commercial within the Phase 1 Boundary shown on the town map of Exmore in this report.
9. Any hospital or community contributions will be subtracted from the total project cost prior to determining grant/loan amounts & residential/commercial monthly rates.
10. Total grants and community contributions assumed to be 65% of project costs.
11. Total loan amount assumed is 35% of project costs.
12. Initial annual equipment renewal and replacement cost is $47,020 and escalates at approximately 2% per year.
13. Septage receiving fees are based on an estimated 600,000 gallons annually at $0.10/gallon with a 1% increase in revenue each year.
14. The financial model, project cost, and proposed components are based on current regulations.

Wastewater System Updated: Thursday, March 31, 2011

Service Start: 12/1/2011

Operational Year #		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Fiscal Year		**FY 11**	**FY 12**	**FY 13**	**FY 14**	**FY 15**	**FY 16**	**FY 17**
	Annual Revenue	$331,280	$342,084	$352,528	$349,584	$358,308	$359,895	$367,017
	Annual Expenses	$302,001	$305,236	$308,541	$311,918	$315,368	$318,894	$322,496
	Yearly Cashflow Reserve	$29,279	$36,848	$43,986	$37,665	$42,940	$41,001	$44,521
	Percentage of Expenses (Revenue/Expense ratio)	109.69%	112.07%	114.26%	112.08%	113.62%	112.86%	113.80%
	Deficit to achieve 115% Revenue to Expense ratio	$16,021	$8,938	$2,295	$9,122	$4,365	$6,833	$3,854

Appendix F

Septage Lagoon Location Map

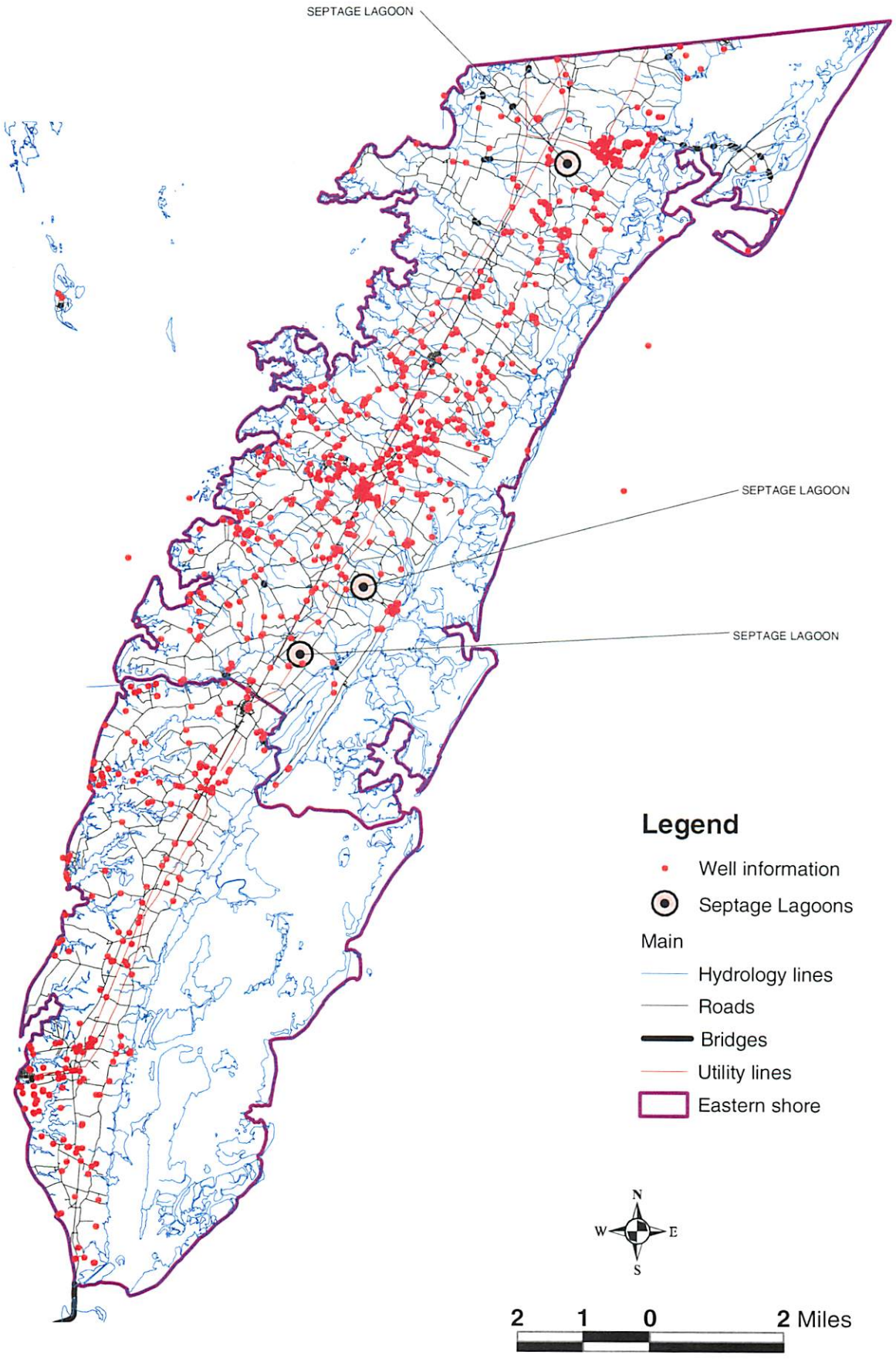
SEPTAGE LAGOON
SEPTAGE LAGOON
SEPTAGE LAGOON
Legend
Well information
Septage Lagoons
Main
Hydrology lines
Roads
Bridges
Utility lines
Eastern shore
N
W
E
S
2 1 0 2 Miles

EXHIBIT NO. 1