Shelter Island Center Municipal Wastewater Treatment System
Engineering Report

Submitted to:
Town of Shelter Island
38 North Ferry Road
Shelter Island, NY 11964-0907

December 13, 2021

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This report is supported by the New York State Department of Environmental Conservation's Non-Agricultural Nonpoint Source Planning Grant, contract #T00929GG.

The opinions, results, findings and/or interpretations of data contained herein are the responsibility of the Town of Shelter Island and do not necessarily represent the opinions, interpretation of policy of the State of New York.

EXECUTIVE SUMMARY

The Project Study Area consists of the eight Town buildings listed on Table ES-1 and identified on Figure ES-1. Table ES-2 lists the size and wastewater design flows for each building.

Table ES-1 Study Area Parcels and Ownership

Shelter Island Center Municipal Wastewater Treatment Project - Parcels to be Served				
Parcel #	**Parcel Use**	**SCTM**	**Street Address**	**Owner**
1	Public Library	700-15-2-34	37 N. Ferry Road	Library Society
2	Fire Depart Center Fire House	700-15-2-20.1	49 N. Ferry Road	Fire District
3	Town Youth Center / American Legion Hall (multi-purpose facility)	700-15-2-48.2	1 Bateman Rd	Town
4	Town Assessors + Tax Receivers Office	700-15-3-43	38 N. Ferry Road	Town
	Town Hall	700-15-3-43	38 N. Ferry Road	Town
	Building + Engineering Depart.	700-15-3-43	38 N. Ferry Road	Town
5	Town-owned residential housing	700-15-3-42	40 N. Ferry Road	Town
6	Police Depart. HQ	700-15-3-41	44 N. Ferry Road	Town
7	Justice Court Building	700-15-3-29	46 N Ferry Rd	Town
8	High School	700-15-3-58.1	33 N Ferry Rd	School District

Table ES-2 Parcel Wastewater Design Flows

Shelter Island Center Municipal Wastewater Treatment Project										
Parcels to be Served + School										
Parcel Count	**Parcel Use**	**Square Footage of Building(s)**			**Total**	**Approx Flow (gpd)**	**Hydraulic Load (gpd/sf)**			**Est. Design Flow (gpd)**
1	Public Library	3,258	3,066		6,324		0.03	0.06		282
2	Fire Depart Center Fire House	8,793			8,793		0.03			264
3	Town Youth Center / American Legion Hall (one facility with multiple purposes)	3,792	3,792		7,584	2,538				2,538
4	Town Assessors + Tax Receivers Office Bldg. Town Hall Building + Engineering Depart. Building	3,929	720	896	5,545		0.06	0.06	0.06	333
5	Town-owned residential housing	2,135			2,135	440				440
6	Police Depart. HQ	1,716	1,716		3,432		0.06	0.06		206
7	Justice Court Building	1,270	1,270		2,540		0.06	0.06		152
								SubTotal		4,215
School	Students & Staff	Code flow	7.5	gpd/person						1,980
								Grand Total		6,195

All properties in the Study Area, and nearby surrounding areas, rely on individual water supply wells and septic systems (predominately cesspools). Groundwater nitrate nitrogen levels have exceeded the drinking water standard in the Study Area. The high groundwater levels of nitrate-nitrogen have been determined due to the density of the use of conventional cesspools / septic systems. As the properties are at the top of their Subwatersheds, the properties are the cause of the high nitrate-N groundwater levels and the septic effluent will be in the aquifers for decades as they in areas with the longest groundwater travel times on Shelter Island.

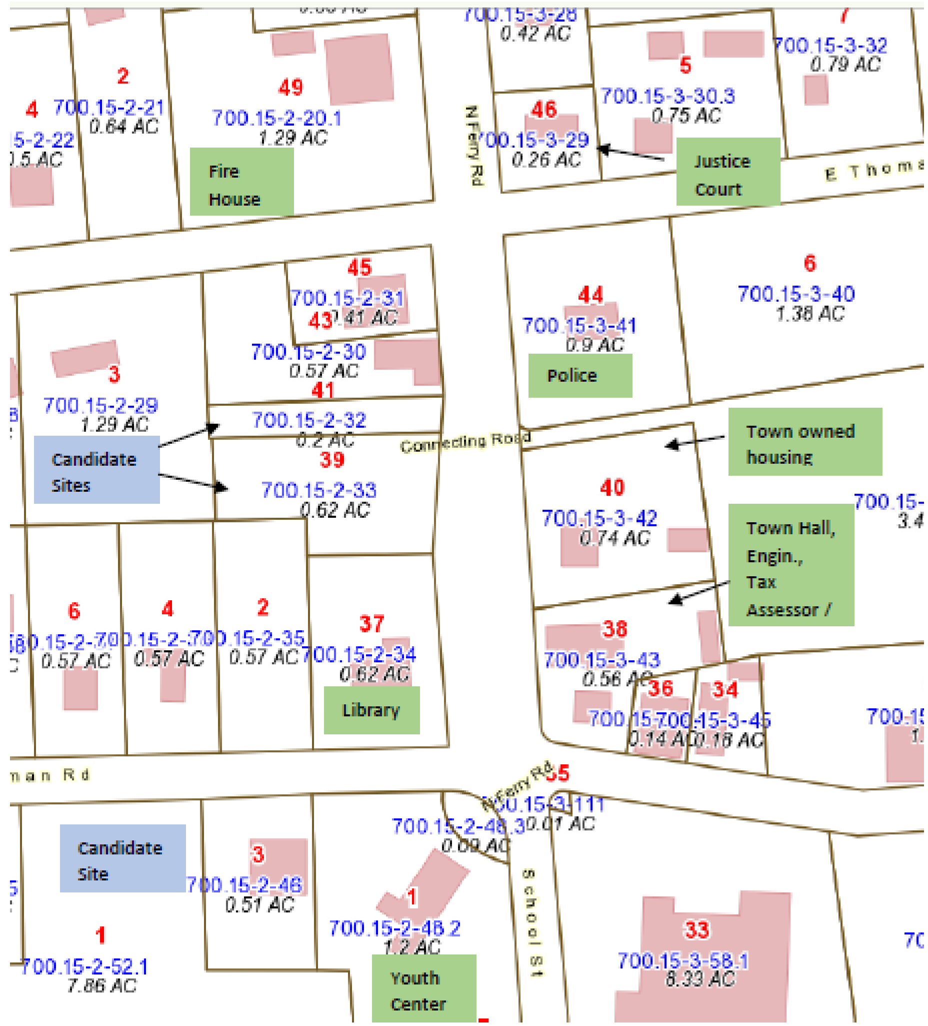

Figure ES-1 Location of Parcels to be Served

Due to public health setback distance requirements, the Fire Department (which only represents >5% of the design flow is the only properties that could install a code complaint advanced wastewater nitrogen removing system. While the school has evaluated implementing its own wastewater system, it is included in the Study Area due to the significant economic and environmental benefits of the proposed community wide wastewater system.

Consequently, an off-site community wide system is needed. Multiple Center Area properties were evaluated to locate the treatment and disposal system. However, due to the area being at the top of Subwatersheds with the resulting long (50 +/- year travel time to surface waters) and impacting downgradient water supply wells, other locations were evaluated with a focus on Town owned properties. The Klenawicus Airfield site was determined to be the most favorable location for the wastewater treatment and disposal facility.

Due to its simplicity and lower cost, the septic tank-effluent (STE) wastewater collection system, see Figure ES-1, is the proposed technology. Due to the undulating topography, a hybrid gravity (STEG) / low pressure (STEP) system is proposed, see Figure ES-2.

Due to its simplicity / lower cost of operation, ability to be predominately all underground and high nitrogen removal capability, the Nitrex treatment technology is proposed for treatment and subsurface disposal.

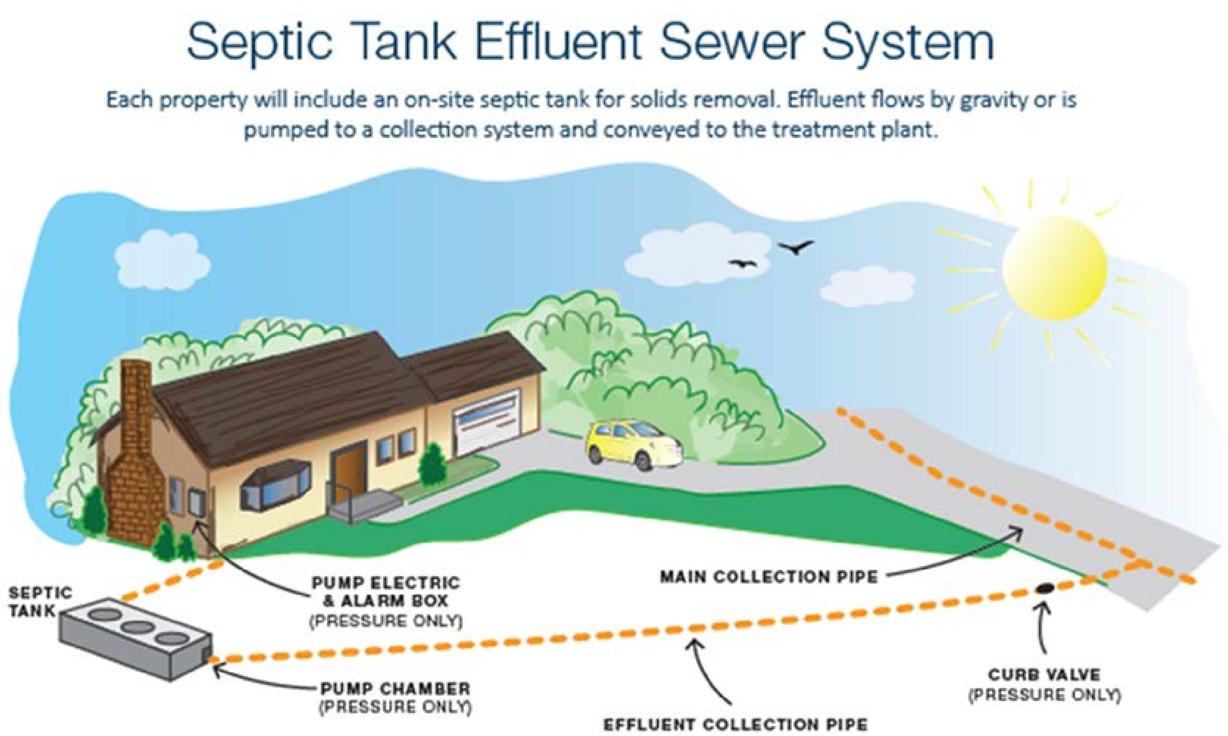

Figure ES-2 STEP – STEG Illustration

Figure ES-3 presents a Plan View of the proposed wastewater system. Table ES-3 presents our opinion of probable cost for implementing the wastewater system, annual O&M costs and local costs at various grant funding levels.

Figure ES-3 Preliminary Collection System Layout – Airfield Site

Table ES-3 Summary of Opinion of Alternatives Probable Cost

WWTF Location	Capital Costs	Annual O&M	Flow	
Airfield	$ 3,865,960	$ 79,150	6,200 gpd	

Local Capital Costs, Grant Funding & User Charges Scenarios					
Grant Funding	**0%**	**25%**	**50%**	**75%**	**90%**
Local Capital Costs	$ 3,865,960	$ 2,899,000	$ 1,933,000	$ 966,000	$ 387,000
Grant Funding	$ -	$ 966,000	$ 1,933,000	$ 2,899,000	$ 3,479,000
Annual User Costs at with local share funded - 2% 20 years	$ 315,579	$ 256,443	$ 197,366	$ 138,227	$ 102,818
Annual User Costs at with local share funded - 2% 30 years	$ 251,765	$ 208,590	$ 165,458	$ 122,282	$ 96,430

Implementation Plan – Schedule and Financing

The project is proposed to be implemented as a Town facility.

The following near term milestones schedule is:

Engineering Report Presentation to Town Board	December 14, 2021
Town Review	December – January 2022
Submission to NYSDEC for permitting	December 20, 2021
Design of Recommended Alternative	February – April 2022
Grant Funding Application	March - July 2022

INTRODUCTION

This Engineering Report addresses development of a municipal wastewater treatment system for the municipal properties in the Center Area of Shelter Island.

This Engineering Report follows the NYS Environmental Facilities Corporation (EFC) and Department of Environmental Conservation (DEC) Engineering Report Outline for New York State Wastewater Infrastructure Projects to ensure project eligibility for EFC/DEC funding. https://efc.ny.gov/system/files/documents/2021/11/11122021_er_outline_ffy2022.pdf

This Engineering Report consists of the following sections:

Executive Summary
Project Background and History
1. Site Information
2. Ownership and Service Area
3. Existing Facilities and Present Condition
4. Definition of the Problem / Needs Definition

Alternatives Analysis
1. Description
2. Cost Estimates
3. Non-Monetary Factors
4. Recommended Alternative

with appropriate Maps, Figures and Tables.

Engineering Report Certification

During the preparation of this Engineering Report, I have studied and evaluated the cost and effectiveness of the processes, materials, techniques, and technologies for carrying out the proposed project or activity for which assistance is being sought from the New York State Clean Water State Revolving Fund. In my professional opinion, I have recommended for selection, to the maximum extent practicable, a project or activity that maximizes the potential for efficient water use, reuse, recapture, and conservation, and energy conservation, taking into account the cost of constructing the project or activity, the cost of operating and maintaining the project or activity over the life of the project or activity, and the cost of replacing the project and activity.

Title of Engineering Report: Shelter Island Center Municipal Wastewater System Engineering Report

Date of Report: December 13, 2021
Professional Engineer's Name: Pio S. Lombardo, NYS PE # 056900

Signature:

Date: December 13, 2021

1. PROJECT BACKGROUND AND HISTORY

1.1 Ownership and Service Area

The project location map is presented on Figure 1-1. Table 1-1 lists the Study Area parcels, addresses and ownerships. Figure 1-2 is an aerial photograph and tax map of the parcels to be served.

Table 1-1 Study Area Parcels and Ownership

Shelter Island Center Municipal Wastewater Treatment Project - Parcels to be Served				
Parcel #	**Parcel Use**	**SCTM**	**Street Address**	**Owner**
1	Public Library	700-15-2-34	37 N. Ferry Road	Library Society
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7	Justice Court Building	700-15-3-29	46 N Ferry Rd	Town
8	High School	700-15-3-58.1	33 N Ferry Rd	School District

1.2 Existing Wastewater Facilities and Present Condition

The existing wastewater facilities are estimated to consist primarily of cesspools with some parcels possibly having a septic tank prior to a leaching pool. The existing property Suffolk County Department of Health Services (SCDHS) permits and associated drawings have been requested by FOIL from SCDHS. Due to Covid impacts, SCDHS states that it expects to provide any documents by December 29, 2021.

Table 1-2 presents the current wastewater design flows for each parcel and summaries of 4,215 gpd for the municipal buildings and 6,195 gpd if School is included.

As the Assessors records do not have date of when buildings were constructed, it is estimated that the age of the existing wastewater systems is > 60 years.

While the functioning of the wastewater systems appears sufficient, their wastewater purification ability for nitrogen removal, in particular, is inadequate as evidenced by the groundwater contamination as described in Section 1.4.

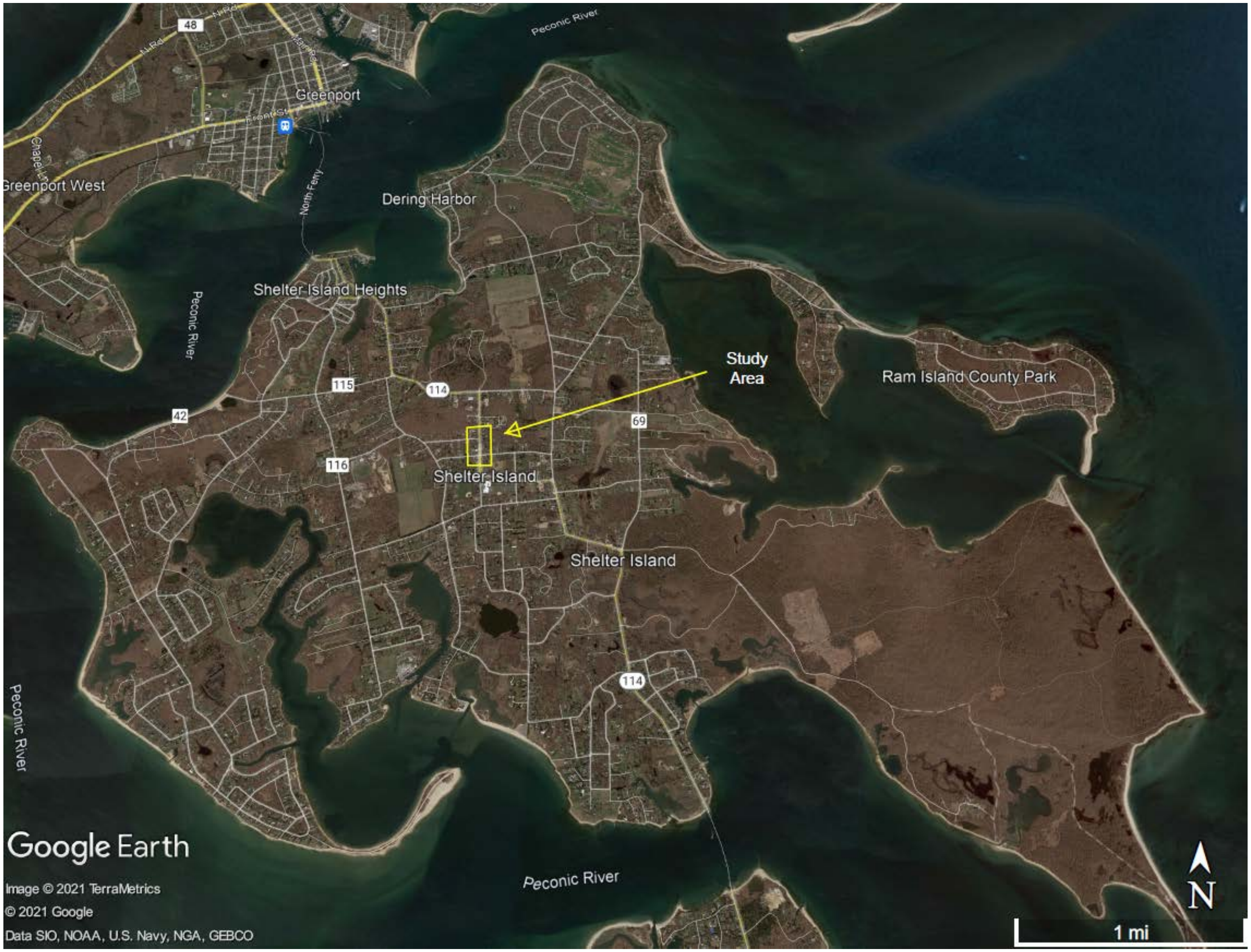

Figure 1-1 Study Area Location Map

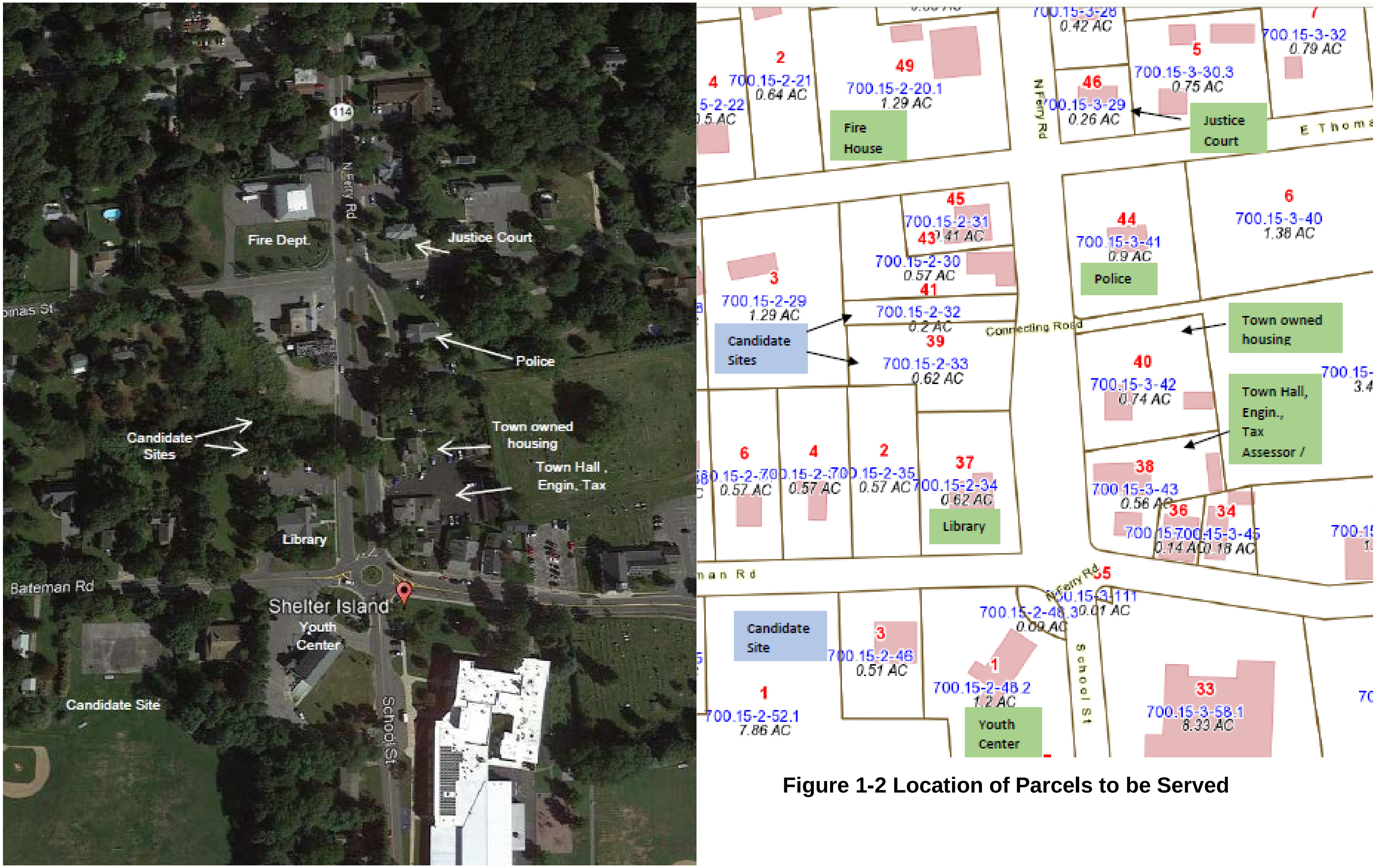

Figure 1-2 Location of Parcels to be Served

Table 1-2 Parcel Wastewater Design Flows

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7	Justice Court Building	1,270	1,270		2,540		0.06	0.06		152
								SubTotal		4,215
School	Students & Staff	Code flow	7.5	gpd/person						1,980
								Grand Total		6,195

	No. Bar Seats	Flow (gpd) / Bar Seat	No. Restaurant Seats	Flow (gpd) / Rest. Seat	Auditorium Area (sf)	Auditorium Flow/sf	# of participants / day	Flow (gpd) / part.	Total Flow (gpd)
Town Youth Center / American Legion Hall (one facility with multiple purposes)	10	15	60	35	4,697	0.03	60	2.5	2,541
							Cronin's estimate		2,538

1.3 Geology

Figure 1-3 illustrates the geologic cross section through Shelter Island and North & South Forks. The uppermost unit underlying Shelter Island consists of the surficial deposits that comprise the Upper Glacial formation. This layer is encountered throughout Shelter Island at the land surface, which ranges from 180 feet above sea level (asl) at the bluffs along the western part of Shelter Island to approximately 40 feet below sea level (bsl) in isolated depressions encountered across the Island. The thickness of the Upper Glacial formation ranges from 120 to 360 feet. These deposits consist primarily of stratified and unstratified sand and gravel interspersed with clay and isolated beds of clay. Shelter Island's water supply is contained entirely within the Upper Glacial aquifer which floats atop the denser saline waters contained in the lower and surrounding Upper Glacial aquifer and deeper geologic deposits. (NPV, 2014)

1.4 Groundwater Hydrogeology & Quality

The major water-bearing units beneath Shelter Island are of geologic origin and include the Upper Glacial aquifer, the Magothy aquifer, and the Lloyd aquifer. Fresh groundwater used for water supply purposes is derived from water contained within the upper part of the Upper Glacial aquifer.

Figure 1-4 (NPV, 2014) presents the Shelter Island groundwater elevations with Figure 1-5 (from Misut et al, 2021) illustrating the groundwater Subwatersheds boundaries and Figure 1-6 (from SCDHS, 2020) illustrating the groundwater travel times to surface waters (SCDHS, 2020). Table 1-3 (from Misut et al, 2021) presents the groundwater watersheds and their respective groundwater flows to estuaries. Figure 1-7 is the USGS Figure *(from Irene Fischer June 2019 presentation)* that illustrates the modeled Shelter Island elevated groundwater nitrate-N levels and includes USGS 2016 – 2018 data.

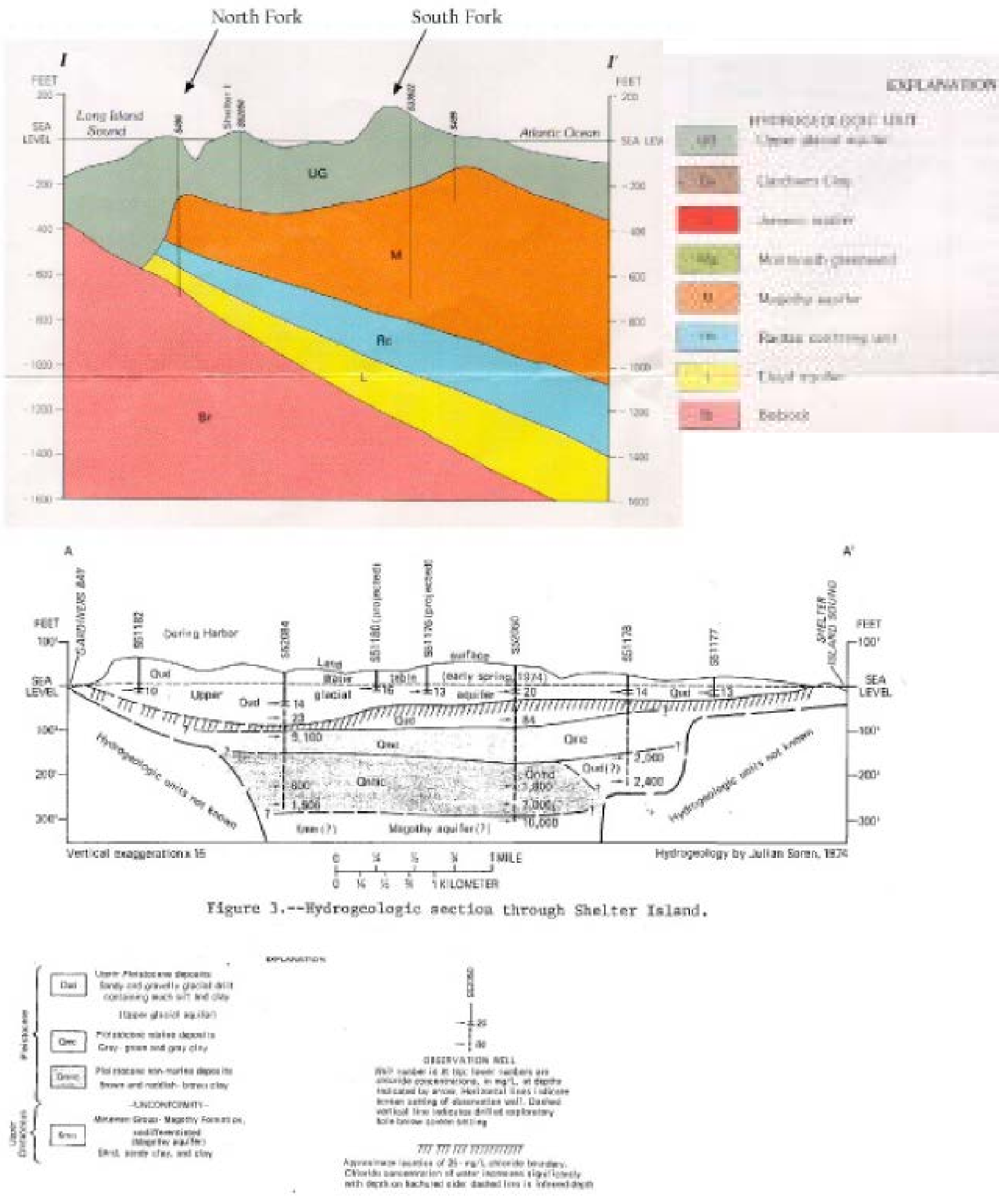


Figure 1-3 Geologic Cross Section through Shelter Island and North & South Forks

Appendix A contains the USGS data which indicates very high levels of nitrate-N is the groundwater near the Study Area. Clearly in the Center area, there is a significant amount of groundwater concentrations in excess of the nitrate-N drinking water quality standard of 10 mg/L.

Depth to groundwater in the Study area is >> 40 feet.

Figure 1-4 Groundwater Elevation Contours

Table 1-3 SI Subwatersheds and Groundwater Flows

Shelter Island Subwatersheds					No. of Receiving Water Bodies (RWB)	Groundwater Discharge to Estuary	
Index #	Priority Waterbody List (PWL)	Name	Marine subsystem	Receiving Estuary		cubic feet per sec	Gallons per Day
178 & 181	1701-0050	Dering Harbor	Dering Harbor	Peconic Estuary	4	1.5	969,408
184	1701-0163	Coecles Harbor	Coecles Harbor	Peconic Estuary	2	1.2	775,526
185	1701-0164	Gardiners Bay and minor tidal tribs	Long Island Sound, Suffolk County, East	Long Island Sound	4	0.3	193,882
161	1701-0170	Shelter Island Sound, North, and tribs	Shelter Island Sound, North, and tribs	Peconic Estuary	1	5.8	3,748,378
191	1701-0242	Dickerson, Menantic, West Neck Creeks	West Neck Harbor	Peconic Estuary	4	0.4	258,509
186	1701-0365	Shelter Island Sound, South, and tribs	Shelter Island Sound, South, and tribs	Peconic Estuary	6	8.5	5,493,312

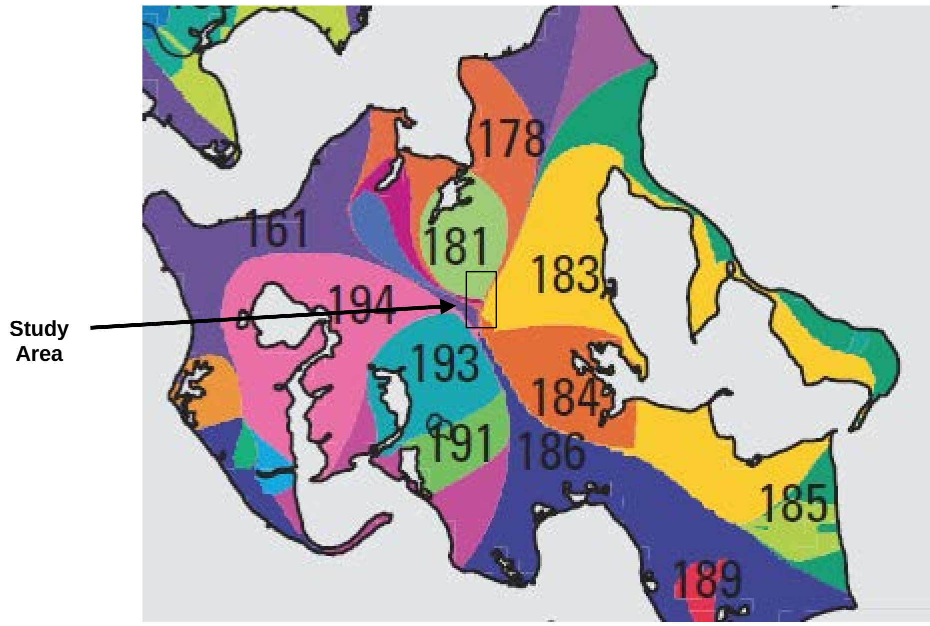


Figure 1-5 Groundwater Subwatersheds Boundaries

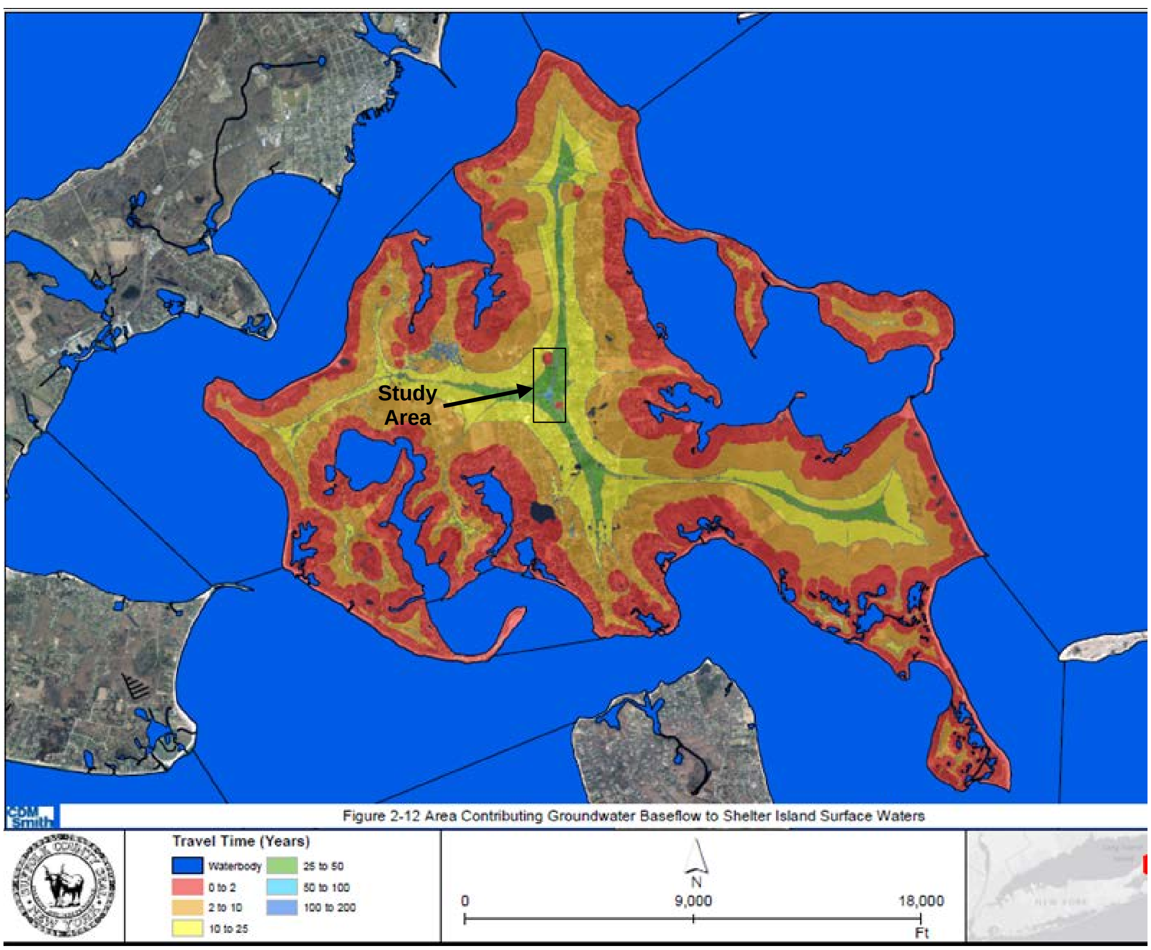


Figure 1-6 Groundwater Travel Time to Surface Waters

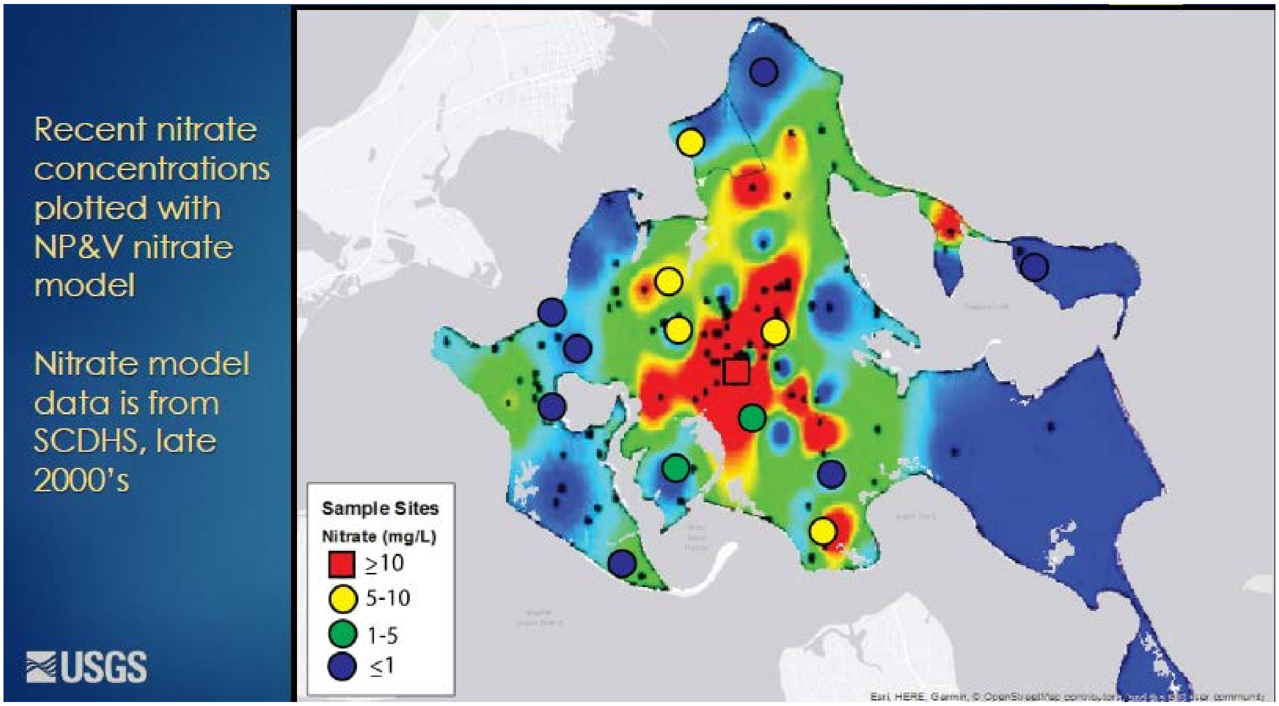


Figure 1-7 Shelter Island Groundwater Nitrate-N Levels

It is important to note that groundwater elevations and watershed boundaries are not static. As the Study Area is essentially on the top of a number of Subwatersheds, any disposal system in the Study Area would be in the aquifer for 25 to 50 years and could travel in a variety of different directions.

1.5 SOILS

From NPV, 2014, the soil survey identifies Shelter Island as lying within an area characterized entirely by Montauk-Haven-Riverhead (MHR) Association soils. This association contains the minor soil groups of Carver, Plymouth, Montauk, Walpole, Atsion and Berryland soils. MHR association soils are characterized as deep, nearly level to strongly sloping, well-drained to moderately well-drained soils, having moderately coarse-textured and medium-textured soils on moraines.

Figure 1-8 is the soils map for the Study Area from Web Soil Survey (WSS), 2021. The soil types in the highlighted Area of Interest and their characteristics from the WSS, 2021 are presented on Table 1-4. https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

1.6 POTABLE WATER

All properties in the Study Area, and nearby surrounding areas, rely on individual water supply wells.

Figure 1-8 Study Area Soils Map

Table 1-4 Study Area Soil Types and Characteristics

Soil Type	Description	% of Area of Interest
HgB	Bridgehamton silt loam, 2 to 6% slopes	2.4%
Bm	Bridgehamton silt loam, graded	0.6%
MkB	Montauk loam, 3 to 8% slopes	95.5%
MkC	Montauk loam, 8 to 15% slopes	1.5%
	Total	100.0%

Soils Characteristics	
Montauk loam	
Typical profile	
	Ap - 0 to 4 inches: loam
	Bw1 - 4 to 26 inches: loam
	Bw2 - 26 to 34 inches: sandy loam
	2Cd - 34 to 72 inches: gravelly loamy sand
Depth to restrictive feature	20 to 39 inches to densic material
Drainage class	Well drained
Hydrologic Soil Group	C
Bridgehampton silt loam	
Typical profile	
	H1 - 0 to 11 inches: silt loam
	H2 - 11 to 56 inches: silt loam
	H3 - 56 to 80 inches: stratified gravelly sand
Depth to restrictive feature	More than 80 inches
Drainage class	Well drained
Hydrologic Soil Group	B

1.7 TOPOGRAPHY

Figure 1-9 is a topographic map of the Study Area which shows that the area is relatively flat at elevation 50 +/- feet. The School ball field is at elevation 33 +/- feet.

Figure 1-9 Study Area Topographic Map

1.8 ZONING

Figure 1-10 illustrates zoning for the study area. The Study Area zones are:

B - Business
B1 - Restricted Business
C - Residential

For these zones, all structures setbacks are:
FY-30'; SY-10'; SY-10'; RY-10'
Lot Coverage-B-70%/75%; B1-50%-75%; C-30%-40%

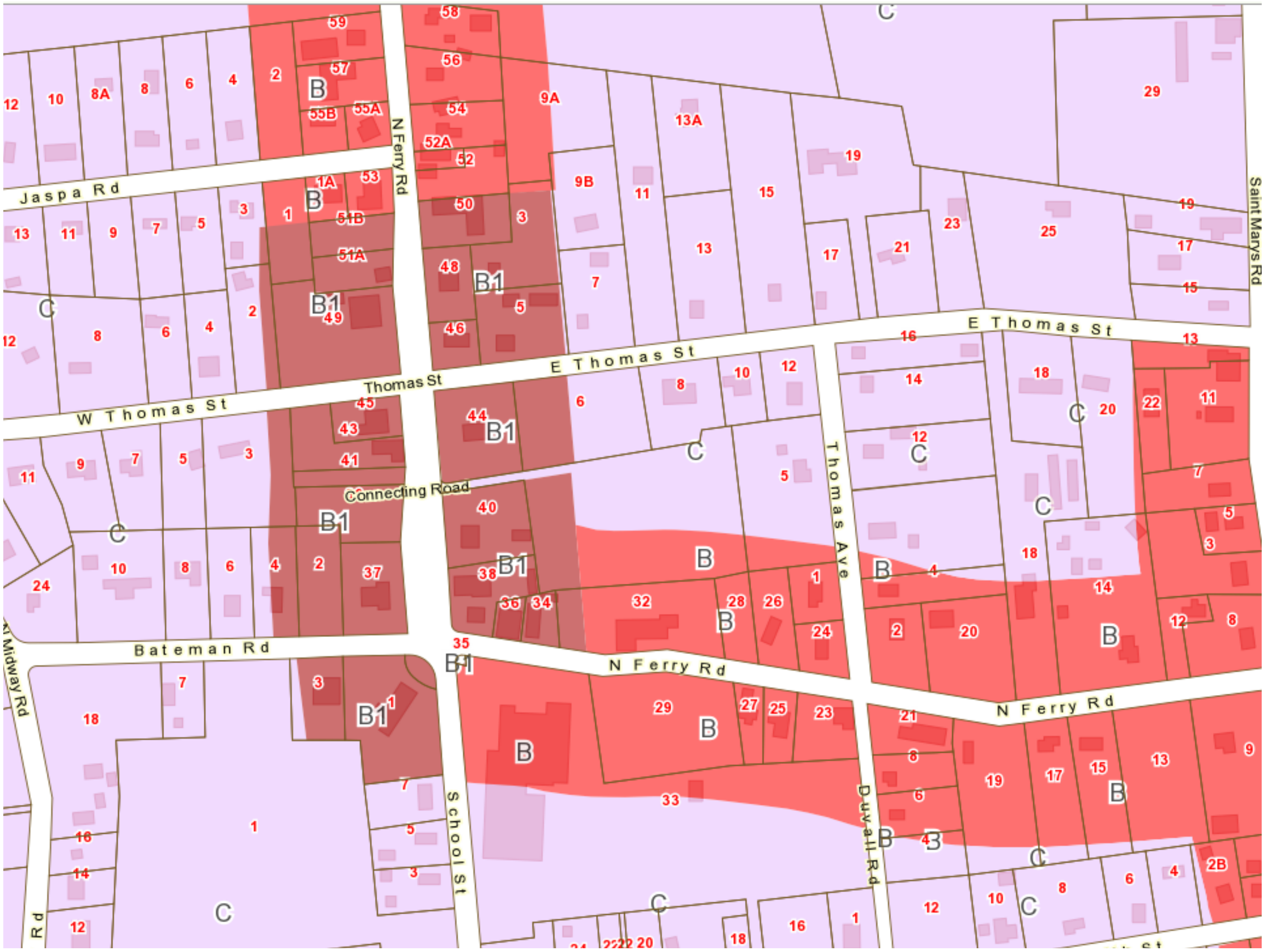


Figure 1-10 Study Area Zoning Map

2. NEEDS ANALYSIS

2.1 NEEDS CATEGORIES

In this Report, a property-by-property Wastewater Management Needs Definition is provided by determining needs in the categories of:

a. **Functional Need Due to Bacterial / Public Health Considerations** – defined as septic systems that are malfunctioning (such as flooded drainfield or breakout, inadequately draining waste fixtures, foul odors, excessive septic pumping, etc.) or have insufficient depth (minimum of 2 feet required) from drainfield bottom to seasonal high groundwater. Functional need / malfunctioning systems are considered a public health threat.

b. **Performance Need** – defined as septic systems not providing sufficient nitrogen, phosphorus and other constituents removal and thereby causing groundwater and/or surface water contamination such that groundwater and/or surface water bodies are not meeting their water quality standards and are therefore impaired. The primary areas of concern are septic impacts on:

   i. Groundwater aquifer, which is the water supply for the study and nearby areas.

c. **Insufficient Space** - lots having inadequate space for a SCDHS code compliant wastewater system in the future for an upgrade or when the current system fails. Properties with insufficient space require an off-site solution or SCDHS variance(s).

The methodologies used for determining the Needs in the various Categories are described in the following Sections that present the data and basis for addressing each Need type. Solution options are addressed in Section 3.

2.2 FUNCTIONAL AND PERFORMANCE NEEDS DETERMINATIONS

There are no known Functional Failures in the Study Area.

There are Performance Needs of the current wastewater management practices, see Section 1.4, as their inadequate nitrogen removal is adversely affecting the quality of the area's groundwater and causing the groundwater to violate the drinking water standard at least for nitrate-nitrogen. As all study area and nearby properties utilize groundwater for their water supply, current wastewater practices are a public health threat. Consequently, the wastewater systems need to be upgraded due to this Performance Need, in particular for nitrogen removal.

2.3 SPACE NEEDS EVALUATION - AVAILABLE AREA ANALYSIS - INDIVIDUAL PROPERTY OPTION

The available area is the area on a parcel that can be used for siting wastewater treatment and disposal facilities without requiring a variance from any SCDHS code setback requirement and/or system siting regulations. The primary factors limiting available area on the Study Area properties is the separation distance between drinking water wells and septic system components. SDCHS regulations require the following setbacks (separation distances):

- 100-ft well to Wastewater Treatment Facilities (WWTF) tanks
- 150-ft well to disposal system
- 10-ft treatment system to commercial / institutional building
- 75-ft treatment system to residential building
- 10-ft property line to WWTF tanks and leaching system setback, commercial / institutional parcel
- 75-ft property line to WWTF tanks setback, residential parcel
- 25-ft property line to leaching system setback, residential parcel

For the Study Area properties, Figure 2-1 presents the locations of:

- Water supply well
- Septic system / cesspool
- Well separation distances of 100 feet (well to WWTF) and 150 feet (well to disposal system)

As can be deduced from Figure 2-1, the Fire Department property and the two (2) privately owned lots to the north of the library parcel, if combined, are the only properties which have area outside the well setbacks.

Figure 2-2 presents the results of the Fire Department site area analysis which indicates approximately 20,000 sf is available for WWTF and 10,000 sf for disposal.

Figure 2-3 presents the available area analysis for the combined two privately owned parcels north of the Library parcel. The combined two parcels north of the Library parcel have approximately 19,500 sf available for WWTF and 12,300 sf for disposal.

The Study Area being at the top of the groundwater watersheds that are water supply sources along with limited areas for wastewater treatment /and disposal is a compelling reason for the area to be sewered and wastewater treatment and discharged in areas with groundwater have a relatively short travel time to surface water bodies.

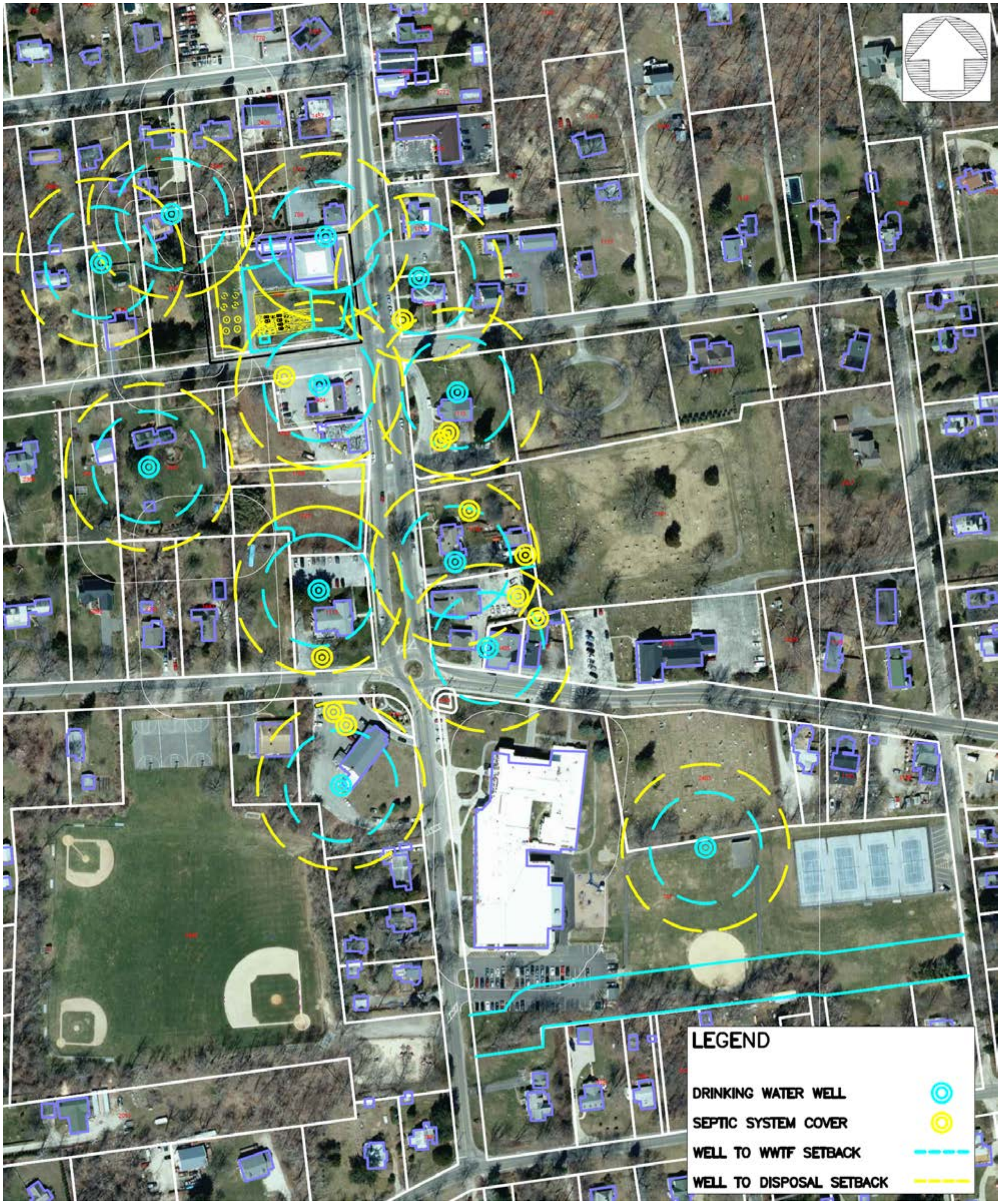


Figure 2-1 Well & Septic Locations & Required Wastewater Upgrades Separation Distances

Figure 2-2 Fire Department Site Available Area Analysis

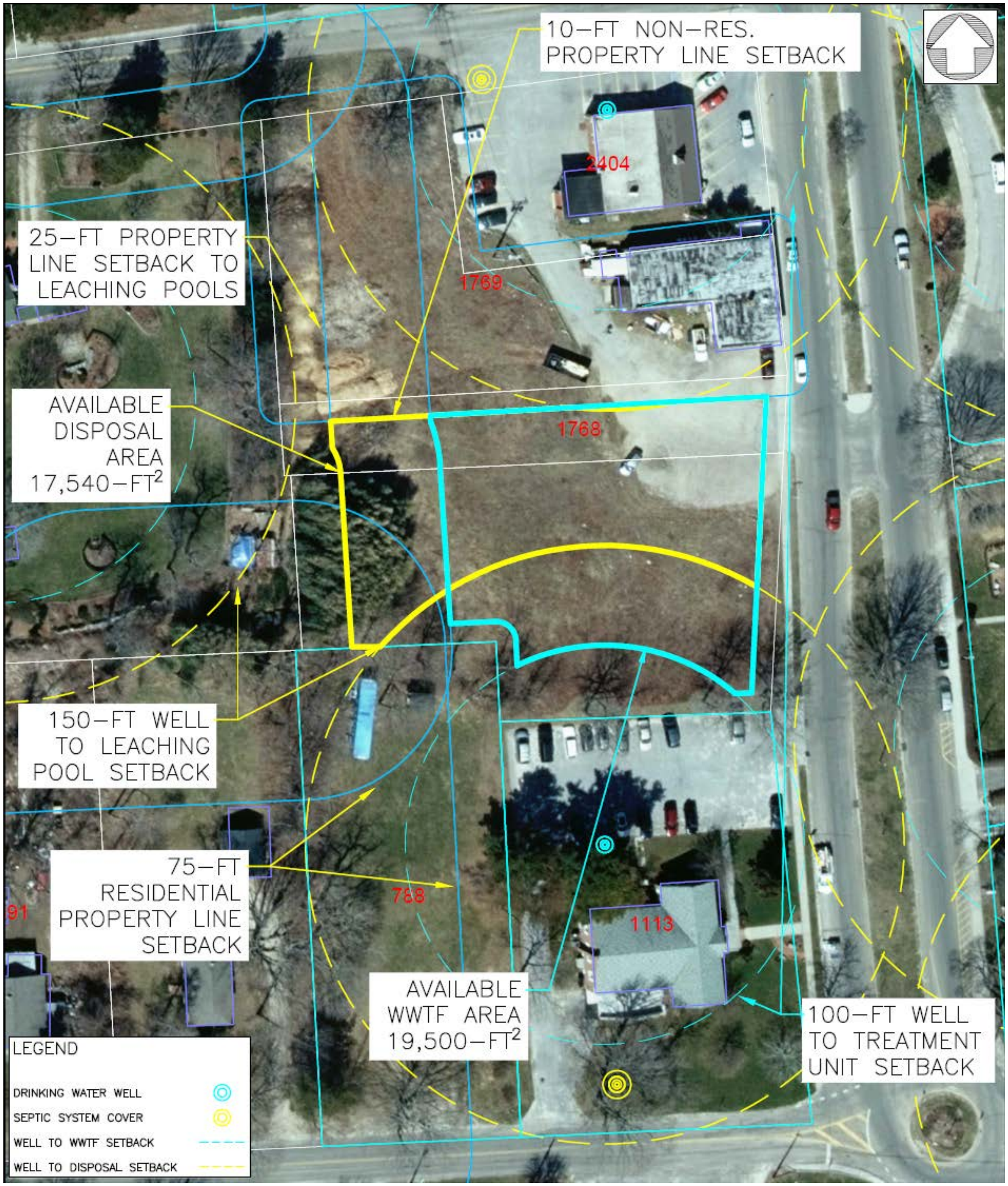


Figure 2-3 Available Area on 2 Parcels North of Library

2.4 NEEDS DEFINITION

As described in this Section:

I. Existing wastewater systems are contaminating the groundwater drinking water supply such that the nitrate-nitrogen drinking water standard of 10 mg/L is being violated.

   While test data does not exist for the PFOA/PFOS family of compounds, concern exists that the groundwater water supply may contain PFOA and/or PFOS levels above the New York State's standard of 10 parts per trillion (ppt). Additionally, the US EPA has announced that it will be issuing drinking water standards for PFOA/PFOS.

II. Only the Fire District has sufficient available space for an upgraded on-site nitrogen removing wastewater technology.

III. For the other Study Area properties, an off-site Study Area wide solution is the only technically viable option. Candidate locations for treatment and disposal are:

   1. Private properties north of Library – would need to be acquired and that cost included
   2. School ballfield area adjacent to cemetery (i.e., well location area) – requires agreement with School Department and school well relocation. Not a desirable area as it consumes recreational space.
   3. Airfield – Town owned property. To avoid the long groundwater aquifer travel times (25 – 50 years), the Town owned Klenawicus Airfield (with < 2-year travel time) was identified as a candidate.

3. TECHNOLOGY ALTERNATIVES ANALYSIS

The components of wastewater management are:

- Collection
- Treatment
- Disposal or reuse

3.1 COLLECTION/SEWER SYSTEMS

Wastewater collection (i.e., sewer) system types are:

1. Total wastewater
    a. Gravity
    b. Pumped in a low-pressure system with grinder pumps (GP) or
    c. Hybrid/combined gravity/pressure system.
    d. Vacuum system in which wastewater moves through the collection system based upon a vacuum created at a central vacuum pump station. A vacuum sewer system consists of vacuum valve at each property and a central vacuum pump station.

2. Septic tank effluent (STE) – whereby septic tanks remain to retain solids and liquid is transported to a treatment plant.
    a. Gravity, referred to as STEG
    b. Pumped in a low-pressure system with septic tank effluent pumps (STEP) or
    c. Hybrid/combined gravity/pressure system.

Based upon an examination of the topography of the study area, a hybrid gravity / pressure system, with pump station(s) is viable. Due to the project's small size, vacuum sewers are not technically feasible nor cost-effective.

Consequently, the technically viable sewer options are:

Total Wastewater
1. Conventional gravity and pump station(s) as needed and grinder pumps.

Septic Tank Effluent (STE)
1. Gravity with pump station(s) as needed and STEP units.

3.2 WASTEWATER TREATMENT OPTIONS

Wastewater treatment technologies fall within one of the following categories:

1. Fixed Film Systems
2. Suspended Growth – Activated Sludge (AS) Systems
3. Integrated Fixed Film and Suspended Growth Systems (IFAS)
4. Active or Passive Carbon Feed with Denitrification Filter after pretreatment by one of the above technologies. While other techniques exist for providing the electron donor needed for denitrification, passive or active carbon feed systems are the simplest and most widely used.

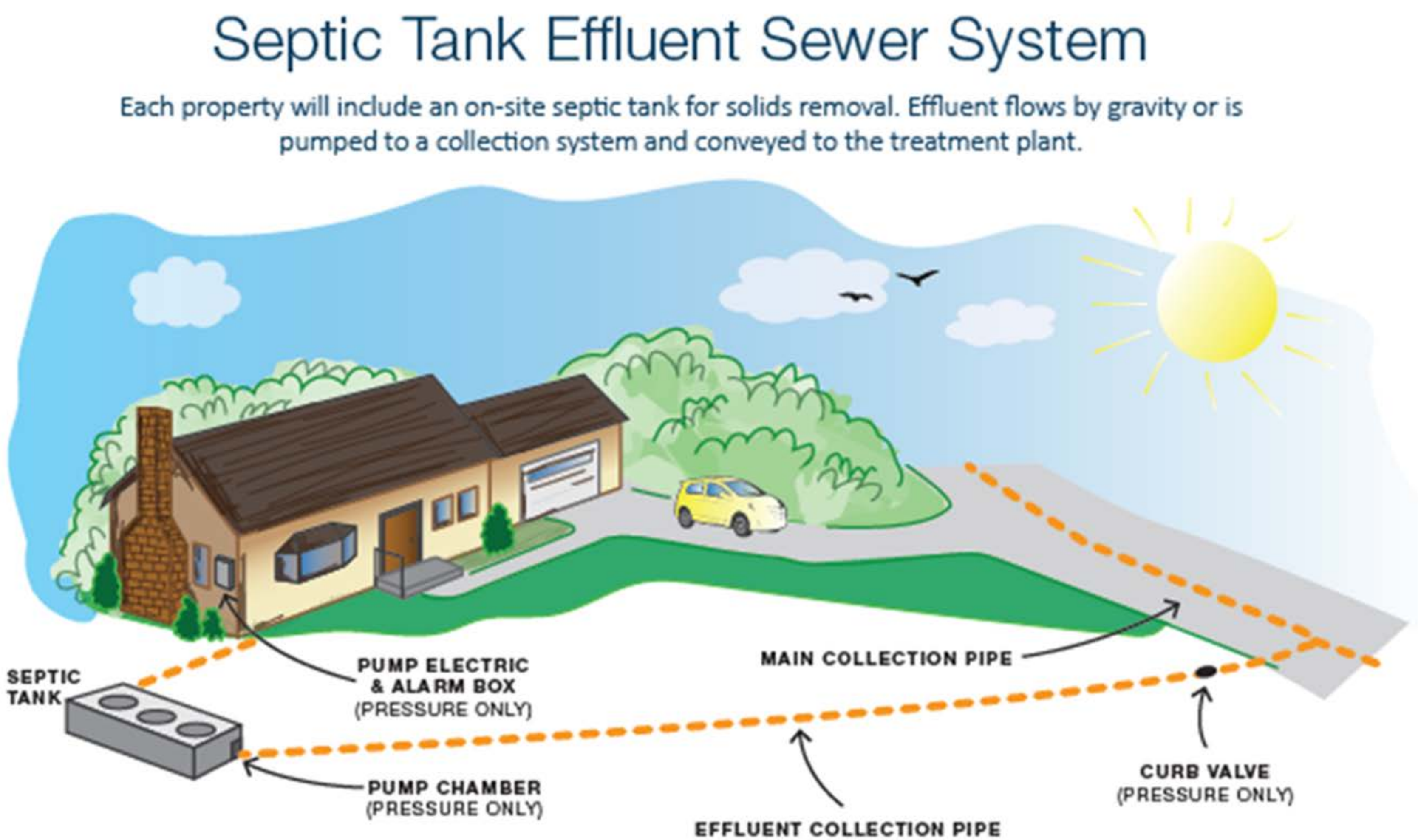


Figure 3-1 STEP – STEG Illustration

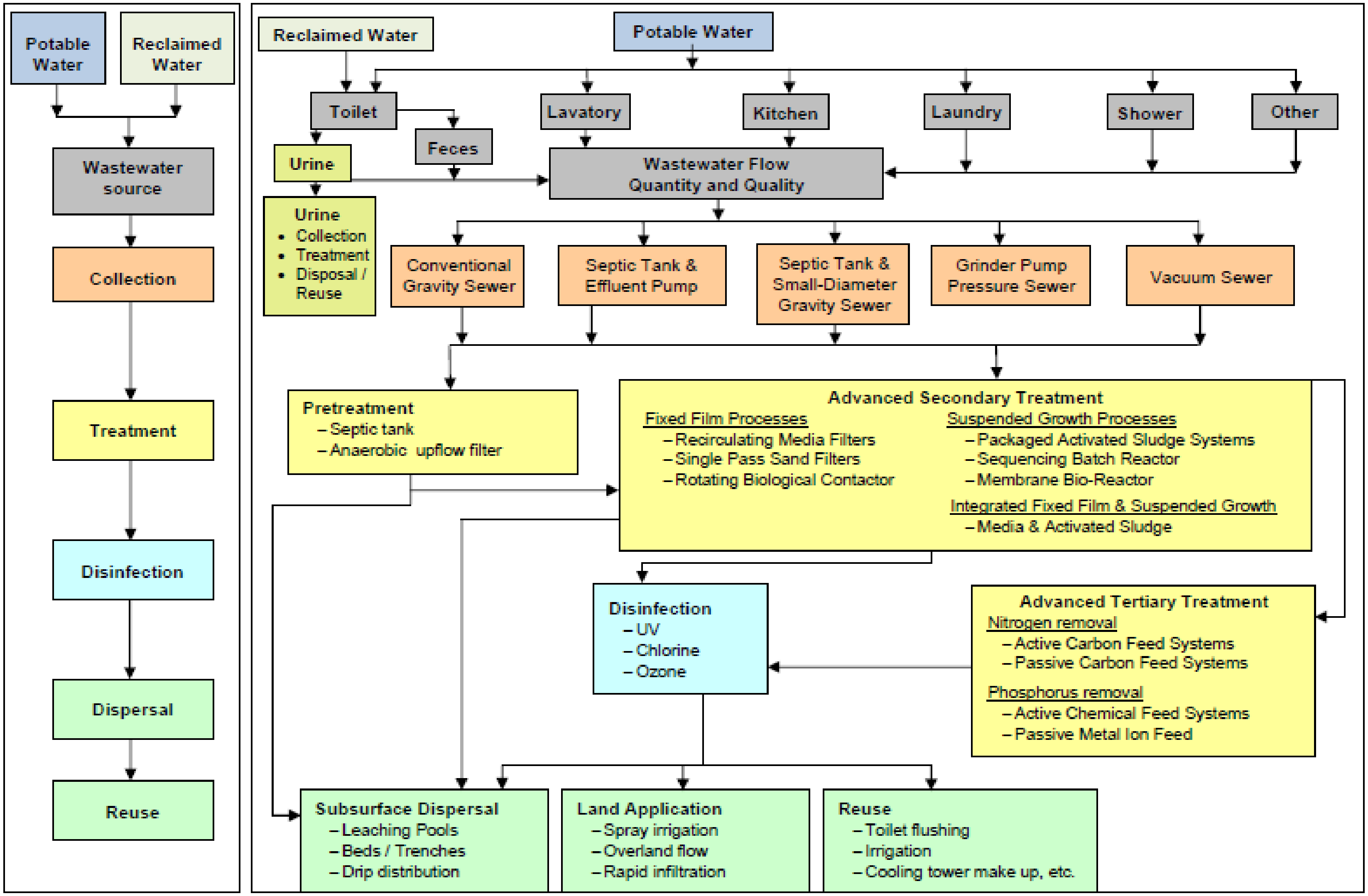


Figure 3-2 Wastewater Management Options

3.3 TREATMENT OPTIONS
Septic Tanks

When the wastewater flows into the tank, the heavy solids settle to the bottom to form a layer of sludge. Lighter materials (grease, fats, small food particles, etc.) float on the surface forming a layer of scum. Between these two layers is a liquid of suspended materials and water-soluble chemicals. Figure 3-3 shows a typical two-compartment septic tank. In Suffolk County, the majority of septic tanks are round in configuration.

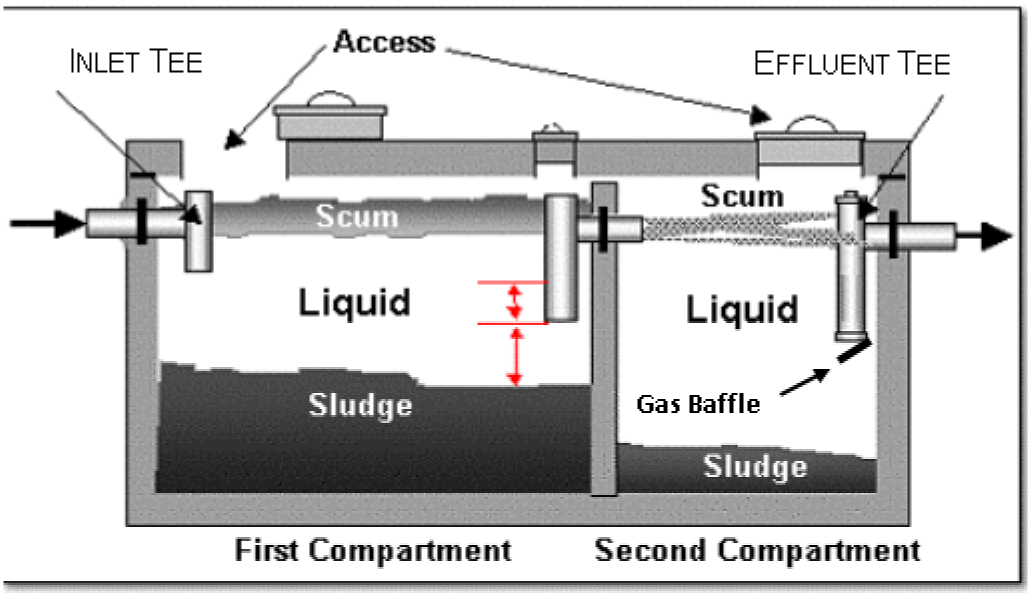


Figure 3-3 Two-Compartment Septic Tank

Fixed Film Systems

Fixed film technologies can be used for both onsite and cluster systems. Fixed film technologies include:

- Single Pass Media Filters
- Recirculating Media Filters (RMF), including Rotating Biological Contactors (RBC)

The media contained within each fixed film system is typically sand, gravel, foam, peat, textile or plastic media. Figure 3-4 is a process flow diagram for a typical RMF system.

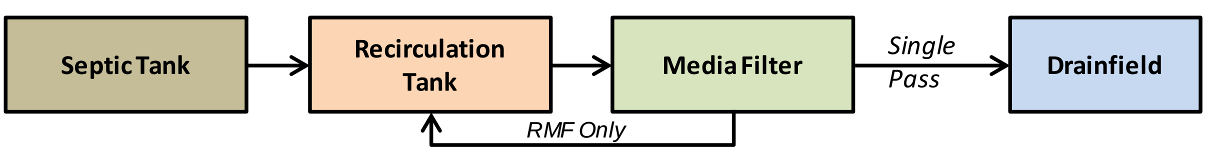


Figure 3-4 Typical Fixed Film Process Flow Diagram

Single pass media filters represent the simplest type of treatment. However, they are very limited when it comes to nitrogen removal. This is because they treat septic tank effluent, which has the solids separated prior to treatment. Separating the sludge prior to treatment results in a carbon-limited system. While these systems excel in nitrification (provided that sufficient alkalinity exists) denitrification is limited by the availability of carbon.

Recirculating Media Filters (RMF) utilize media with a high surface area to volume ratio as a substrate for a biofilm to grow on. Wastewater and air are mixed, using fans and/or spray heads, and contacted with the biofilm that grows on the media. The media effluent is split between recirculating and discharging to the next stage of the treatment process. Recirculation flows are directed to the recirculation tank where some denitrification (typically 50+%) and dilution of the septic tank effluent flow occurs. The primary process control on these systems is the recirculation ratio. Water is pumped in frequent short cycles, with total pump run times typically being less than an hour per day. RBCs use an engineered surface that is rotated half-submerged through the wastewater stream. A biofilm grows on the surface and aerates when the film is not submerged.

Recirculating media filters have the advantage of not needing energy intensive aeration and mixing, as compared to suspended growth systems. Also, secondary clarifiers and return sludge pumps are not necessary. Fixed film processes are also more resistant to varying flows and loads than suspended growth systems. This is due to the stability of the biofilm during periods of varying loading. These systems are more reliable and require less operator involvement than processes that utilize the suspended growth technology.

Sludge production is also much lower for these systems, when compared to systems that utilize suspended growth technology. The result is simplicity and lower O&M costs, along with consistency of treatment results.

Pros of individual fixed film systems include:

- Consistent and typically complete nitrification
- Simple, stable and reliable process
- Low energy use
- Low sludge production

Cons associated with individual fixed film systems include:

- Larger footprint compared to activated sludge systems for larger conventional systems
- Carbon addition needed for complete denitrification
- Alkalinity addition may be needed, very likely needed in Suffolk County due to low alkalinity source water

Suspended Growth – Activated Sludge (AS) Systems

The generic options for suspended growth technologies are applicable to both onsite and cluster systems. Options include:

- Conventional and Modified Activated Sludge Processes
- Sequencing Batch Reactors (SBR), only applicable to cluster systems
- Membrane Bioreactors (MBR), only applicable to cluster systems

Figure 3-5 is a general process flow diagram for a conventional Activated Sludge system.

Suspended growth processes treat wastewater using the same nitrification and denitrification mechanisms as fixed film processes. The difference is that in the activated sludge process, bacteria and solids are maintained in suspension within an aeration tank. These bacteria grow as they absorb nutrients. A secondary clarifier is needed following the aeration tank to settle the biosolids into what is then called activated sludge. Suspended growth systems rely on processes that are typically monitored on a daily or even hourly basis at larger treatment facilities. In larger facilities, sludge is separated into Return Activated Sludge (RAS) and Waste Activated Sludge (WAS). In individual and small cluster systems, this is not typically done, resulting in lower levels of treatment.

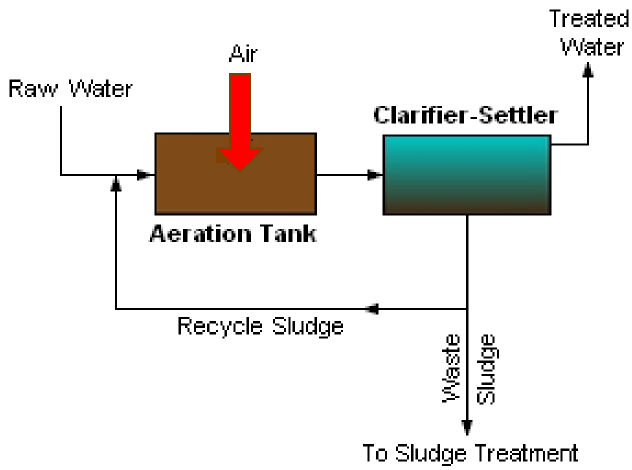


Figure 3-5 General Activated Sludge Process Flow Diagram

By maintaining the sludge within the treatment process, there is sufficient carbon to achieve high levels of denitrification, when properly configured and operated. Factors that are monitored / adjusted at larger treatment facilities include:

- WAS / RAS ratio
- Mixed Liquor Suspended Solids (MLSS)
- Food to Microorganism Ratio (F/M)
- Oxygen / redox levels
- Aeration cycles
- Recirculation ratio
- Sludge Age

All of the above factors affect nitrification (conversion of ammonia to nitrate-N) primarily and also denitrification (conversion of nitrate-N to nitrogen gas). When these factors are adjusted and monitored properly to match influent flows and loads, suspended growth systems are capable of reliably meeting advanced tertiary (< 3-mg/L) standards for nitrogen removal. This process and its many variations are the standard for large-scale wastewater treatment worldwide. However, when these factors are not monitored and / or not even adjustable, as is the case with all OSTDS and many small to medium sized cluster systems, the reliability of the suspended growth process decreases dramatically.

SBRs are unique in that they utilize a batch process to combine treatment stages in a single tank. These units have great treatment potential; however, they are highly reliant on the close supervision of skilled operators. For this reason, they are not recommended for lower flows where full time specialized operations are not required or economically feasible.

MBRs utilize the same suspended growth technology, however replace the secondary clarifiers with membranes within the aeration tank. These processes have a range of treatment options, depending on the type of membranes used. Specialized operations and high life-cycle costs limit the feasibility of MBRs to areas with space constraints and/or a higher required treatment level. These systems operate at a high bacteria concentration, referred to as Mixed Liquor Suspended Solids (MLSS), and a long sludge age, thereby reducing the amount of sludge production and adding stability to the process during varying flows and loads. The major concern with activated sludge processes is washout of the solids in the clarifier. By substituting membranes for the clarifier, MBRs eliminate this mode of failure. However, nitrification performance is still dependent on the same factors as conventional suspended growth systems.

Typical individual suspended growths systems do not have most of the functionality of larger systems and are packaged in a single tank. While this lack of functionality simplifies the system and reduces installation costs, the result is less operator control and generally poor performance compared to the larger centralized systems. The energy use and sludge production are higher than the fixed film systems. The economies of scale must reach a point where the higher O&M costs are offset by the lower construction costs. Typically, flows should exceed 50,000 – 100,000 gpd (depending on the type of suspended growth system) before systems that are properly designed and operated start to become competitive with fixed film systems on a total life cycle cost basis. The reliability of activated sludge systems is highly dependent on the operations staff.

Pros of individual suspended growth systems include:

- Smaller footprint due to single tank configuration
- Lower installation costs

Cons associated with individual suspended growth systems include:

- Many factors affecting performance are not monitored or adjustable
- Relative stability of biological process when faced with varying flows and loads is low
- Reliance on settling of suspended solids introduces possibility of solids carryover to the drainfield
- Inconsistent nitrification and consequently inconsistent denitrification
- Energy intensive process – property owners are able to disconnect electricity
- Higher sludge production
- High dependence on operator attention and skill

Integrated Fixed Film and Suspended Growth – Activated Sludge (IFAS) Systems

Integrated fixed film and suspended growth (IFAS) processes combine the fixed film and suspended growth technologies in one treatment process. This is achieved by adding media to the aeration tank shown on Figure 3-4. By combining both processes, resistance to process upsets is increased over the suspended growth process alone. The addition of a fixed film media to the aeration tank in these processes increases the treatment capacity and reduces the footprint of the aeration tank. This technology has the same dependency on operator attention and skill for applications that require high levels of nitrogen removal.

Pros of individual IFAS systems include:

- Small footprint
- Lower installation costs
- Not carbon-limited
- More stable than traditional suspended growth systems

Cons associated with individual IFAS systems include:

- Many factors affecting performance are not monitored or adjustable
- Less stable and reliable than traditional fixed film processes
- Reliance on settling of suspended solids introduces possibility of solids carryover to the drainfield
- Inconsistent nitrification
- Energy intensive process
- Higher sludge production than fixed film systems

Active Carbon Feed Systems

The primary limitation on nitrogen removal in both fixed film and the simplified suspended growth systems is available carbon for the denitrifying bacteria after nitrification. If the nitrification system fully nitrifies, meaning that ammonia is less than 1 mg/L in the nitrification system, then an anaerobic environment and a carbon source (electron donor) are all that is needed to convert the nitrate to nitrogen gas. Active carbon feed systems use a chemical feed system that stores and doses a chemical carbon source into an anaerobic tank following a nitrification system that achieves complete nitrification. Examples of active carbon feed sources are:

- Methanol
- Micro C
- Glycerin / glycerol

Pros associated with active carbon feed include the following:

- Fast reaction rate minimizes retention time and associated footprint
- Low capital cost for installation if non-toxic/non-hazardous carbon source used

Cons associated with active carbon feed include the following:

- Need for chemical storage, containment
- Hazardous materials storage when methanol is used
- Generates sludge and consumes some treatment plant capacity for backwash treatment
- Requires operator attention and relies on monitoring equipment to prevent overfeed or underfeed
- Ongoing cost of chemicals

Passive Carbon Feed Systems

Passive carbon feed systems use a carbon-rich media to supply carbon for denitrification. The leaching of labile carbon from media used in passive carbon feed systems is biologically mediated. There is neither a concern with overfeeding nor underfeeding, provided the systems are appropriately sized.

The Nitrex™ system is an example of a passive carbon feed system. The Nitrex™ system is an upflow filter that contains a carbon-rich media that slowly releases labile carbon to facilitate denitrification.

Passive systems have the advantage of reliability and simplicity, inconsequential sludge production and minor increase in operator attention beyond that required for the nitrification system. The disadvantages of passive systems are larger footprints and higher construction costs than active feed systems. Passive systems have a 40 +/- year useful life which can make them competitive on a life cycle cost basis.

Pros of passive carbon feed systems include:

- Simple, stable process
- Little/no energy use
- Inconsequential sludge production
- No chemical storage
- No ongoing chemical costs

Cons associated with passive carbon feed systems include:

- Larger footprint
- Higher installation costs
- Media replacement every 40 +/- years

For the Record, LAI is the developer of the Nitrex™ system, which is a passive carbon feed system approved for use in Suffolk County.

4. SOLUTION ALTERNATIVES ANALYSIS

This Solutions Analysis addresses the technical viability of:

a. Retaining existing systems – No action. As determined in Section 1.4, this is not acceptable due to groundwater contamination

b. On site wastewater treatment & disposal at each individual Study Area parcel. As the soils and depth to groundwater are very conducive to an on-site system, the key factor for evaluating the on-site option is space availability after consideration of SCDHS code setback requirements, of principle concern is well – septic setbacks. As determined in Section 2.3, this is not a viable option.

c. Study areawide sewer, treatment and disposal option. The key issue is determining if there is sufficient available area at potentially available (preferably Town owned) site(s) based upon the treatment and disposal footprint requirement

The alternatives analysis identifies and evaluates:

- Viable treatment and disposal / reuse location candidates
- Treatment and disposal / reuse technology options

Section 2 identified that the Fire District property, the combined two undeveloped private properties north of the Library and the School as Study area candidate locations. To avoid the long groundwater aquifer travel times (25 – 50 years), the Town owned Klenawicus Airfield (with < 2-year travel time) was identified as a candidate.

To evaluate the candidate locations, Section 4.1 computes the Required Area for the flow options of 4,225 and 6,200 gpd.

For analytical purposes the SCDHS an d NYSDEC approved Nitrex technology system is used as the base treatment and disposal system and a septic tank – effluent collection system is used for the sewer system. A process flow diagram of the Nitrex system is presented on Figure 4-1. The septic tank – effluent collection system, as illustrated on Figure 4-2. relies on a septic tank on each individual property for solids settling/removal with effluent being transported by gravity (STEG) or pumped (STEP) to treatment and disposal location. A Nitrex system layout at the Fire Department property is presented on Figure 4-3.

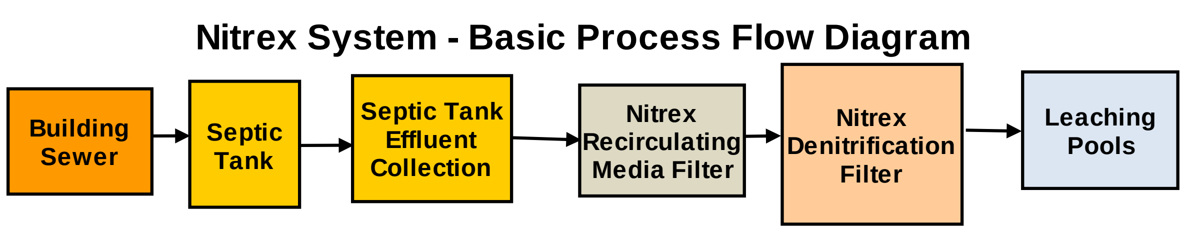


Figure 4-1 Nitrex Wastewater Treatment System – Process Flow Diagram

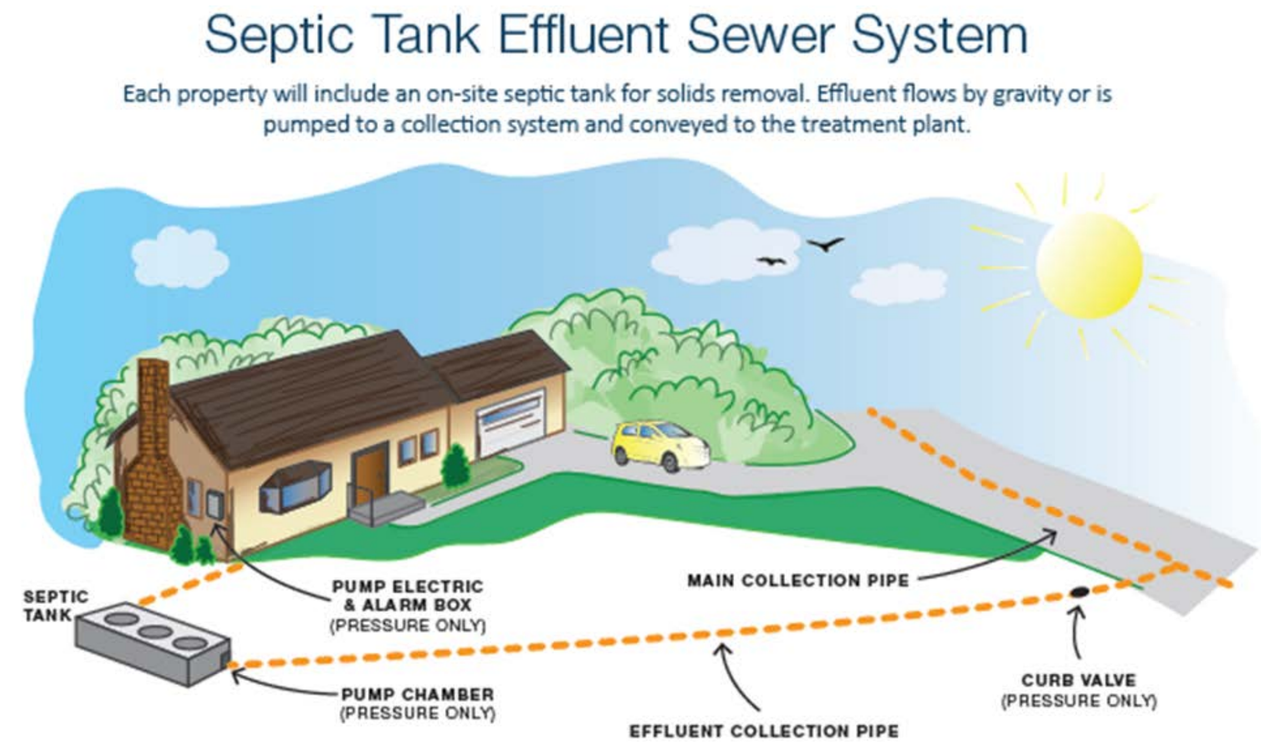


Figure 4-2 Septic Tank – Effluent Collection System Schematic

4.1 REQUIRED AREA ANALYSIS FOR STUDY AREA-WIDE TREATMENT & DISPOSAL

The required area is the minimum footprint required to site the wastewater treatment and disposal components and consists of the following components:

a. Utilizing code wastewater design flows and understood wastewater quality associated with parcel use, treatment processes are sized and layout prepared which defines treatment system required footprint / area.
b. Utilizing site soils, groundwater elevation and flow from a. above, disposal system is sized and its footprint defined
c. Reserve area requirements

High strength wastewater, i.e., high nitrogen content, requires more treatment capacity per gallon of treated wastewater than typical residential wastewater. For the purposes of sizing treatment systems to determine the minimum required area, the following design assumptions apply:

- Design flows of 4,225-gpd and 6,200-gpd
- Septic tank effluent collection system
- Influent total nitrogen concentration of 150-mg/L
- Influent alkalinity 80-mg/L
- Nitrex nitrogen removal wastewater treatment system with leaching pool disposal

4.1.1 4,225-gpd System Required Area

Figures 4-3 and 4-4 present the layout of the 4,225-gpd system, which has a required area of 3,380-ft^2, which includes reserve, at the Fire District and adjacent to Library sites, respectively.

Figure 4-3 4,225-gpd Nitrex System Layout – Fire Department Site

Figure 4-4 4,225-gpd Nitrex System Layout – Library North Site

A 4,225-gpd Nitrex system consists of the following components:

- Flow Equalization Tank: 3,000-galllon tank (below grade)
- Anaerobic Upflow Filter: 2,000-galllon tank (below grade)

- 1st and 2nd Stage Recirculation Tanks: 3,000 & 2,000-galllon tank (below grade)
- 1st and 2nd Stage Nitrex RMFs: (4) 6,000-galllon tanks (below grade)
- 1st and 2nd Stage Nitrex filters: (6) 6,000-galllon tanks (below grade)
- Drainfield Dosing Tank: 4,000-galllon tank (below grade)
- Leaching Pools: (3) 10-ft diameter, 10-ft effective depth
- Operations and Controls Building: 16' x 12' Building

4.1.2 6,200-gpd System Required Area

A 6,200-gpd Nitrex system consists of the following components:

- Flow Equalization Tank: 5,000-galllon tank (below grade)
- Anaerobic Upflow Filter: 3,000-galllon tank (below grade)
- 1st and 2nd Stage Recirculation Tanks: 5,000 & 2,500-galllon tank (below grade)
- 1st and 2nd Stage Nitrex RMFs: (5) 6,000-galllon tanks (below grade)
- 1st and 2nd Stage Nitrex filters: (6) 8,000-galllon tanks (below grade)
- Drainfield Dosing Tank: 6,000-galllon tank (below grade)
- Leaching Pools: (4) 10-ft diameter, 10-ft effective depth
- Operations and Controls Building: 16' x 12' Building

Figures 4-5, 4-6 and 4-7 present the layout of the 6,200-gpd system, which has a required area of 3,860-ft^2, which includes reserve, at the Fire District, adjacent to Library and School sites, respectively. Figures 4-8 presents the sewer layout for connection to the "adjacent to Library" and School sites.

4.2 Sewer Layout Analysis for Study Area

Figure 4-9 presents the sewer layout to the Klenawicus Airfield with the route consisting of:

- Gravity connection of municipal buildings / school to pump station at library
- Low pressure sewer from pump station, north along North ferry Road, right at Manwaring Road; right at St. Mary's Road to Klenawicus Airfield

The sewer route enables future gravity connections for 6 properties north of Justice Hall on the east side of North Ferry Road and pump connections for all other properties along the route. For preliminary engineering analysis, Table 4-1 is a Table of Study Area properties and their wastewater line invert estimated elevations.

Pending field measurements of actual waste line invert elevations, it appears that a Study Area gravity system to the low spot at the library property, with potentially 1-2 individual pumps, is technically feasible.

Figure 4-5 6,200-gpd Nitrex System Layout – School Ballfield Site

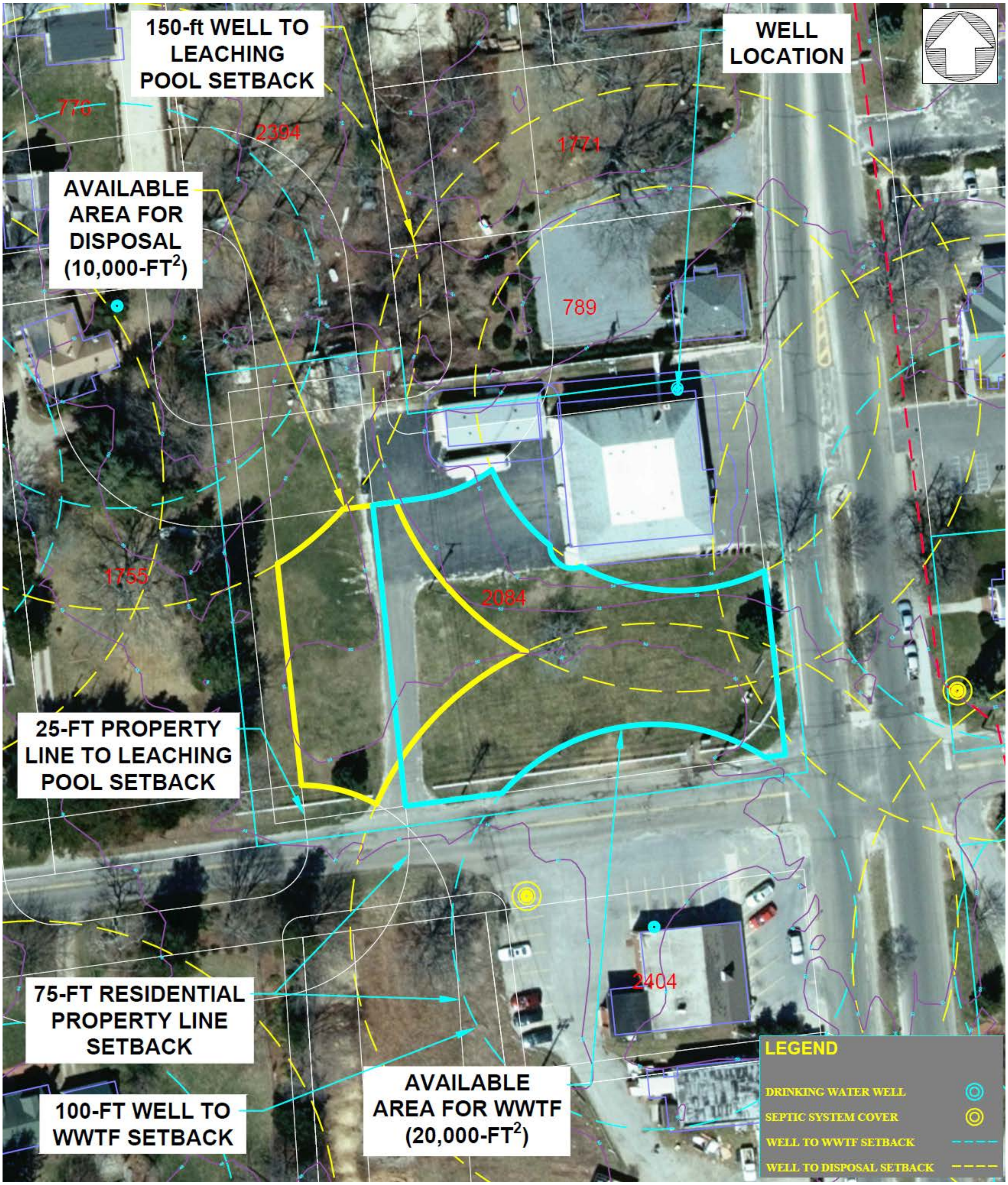


Figure 4-6 6,200-gpd Nitrex System Layout – Fire Department Site

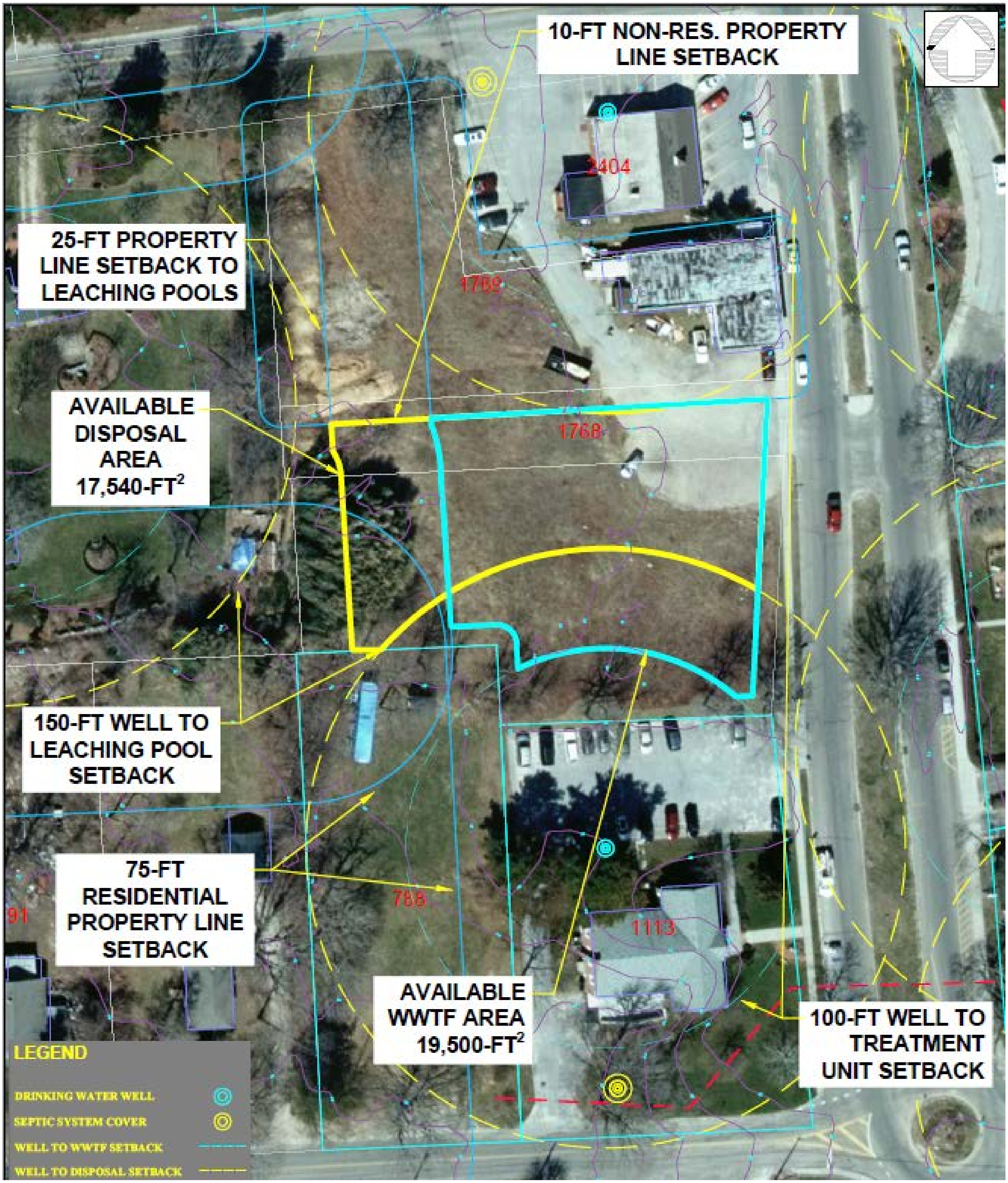


Figure 4-7 6,200-gpd Nitrex System Layout – Library North Site

Figure 4-8 Preliminary Collection System Layout – Library North Site

Table 4-1 Estimated Wasteline Invert Elevation at Foundation Wall

Parcels to be Served + School		Wasteline elevation estimates				Floor Below Ground		Wasteline feet below grade est.
Parcel Count	Parcel Use	Exterior Building Footprint (sf)	No. Floors	Total Gross Floor Area (sf)	Surface Elevation at Bldg Wasteline	(1=Yes, 0=No)	with Bathroom (1=Yes, 0=No)	
1	Public Library	3,346	2	6,692	43	1	?	?
2	Fire Depart Center Fire House	5,000	2	10,000	54	0	0	51.5
3	Town Youth Center / American Legion Hall (one facility with multiple purposes)	4,697	2	9,394	50	1	1	
4	Town Assessors + Tax Receivers Office Bldg.	1,000	1	1,000	50	0	0	47.5
	Town Hall	3,765	1	3,765	50	0	0	47.5
	Building + Engineering Depart. Building	1,511	1	1,511	50	0	0	47.5
5	Town-owned residential housing	2,021	1	2,021	48	0	0	45.5
6	Police Depart. HQ	2,123	2	4,246	49	1	?	?
7	Justice Court Building	1,693	2	3,386	53	1	?	?
	School				49			

4.3 WWTF – Disposal Locations Evaluation

Figures 4-10 and 4-11 illustrate Shelter Island (SI) Town and SI/County Owned Properties, respectively. Table 4-2 lists Town owned properties their screening for use as a wastewater treatment facility (WWTF) site.

Table 4-2 Town Owned Properties Screened for WWTF Site

Town Owned Candidate Sites			
Site #	Description	Evaluation	
1	Klenawicus Airfield	Highly desirable	Short time to surface water; few houses downgradient; property has lots of open space
2	99 N Ferry Rd	Undesirable	Discharge would be in groundwater with long (decades) travel time
3	Goat Hill Golf Course	Undesirable	Public Water Supply Recharge Area
4	N Menantic & Bowditch Roads Area	Undesirable	Former Landfill

As can be seen from an examination of the potential sites on Figure 4-10 and Table 4-2, the Klenawicus site is the most favorable location.

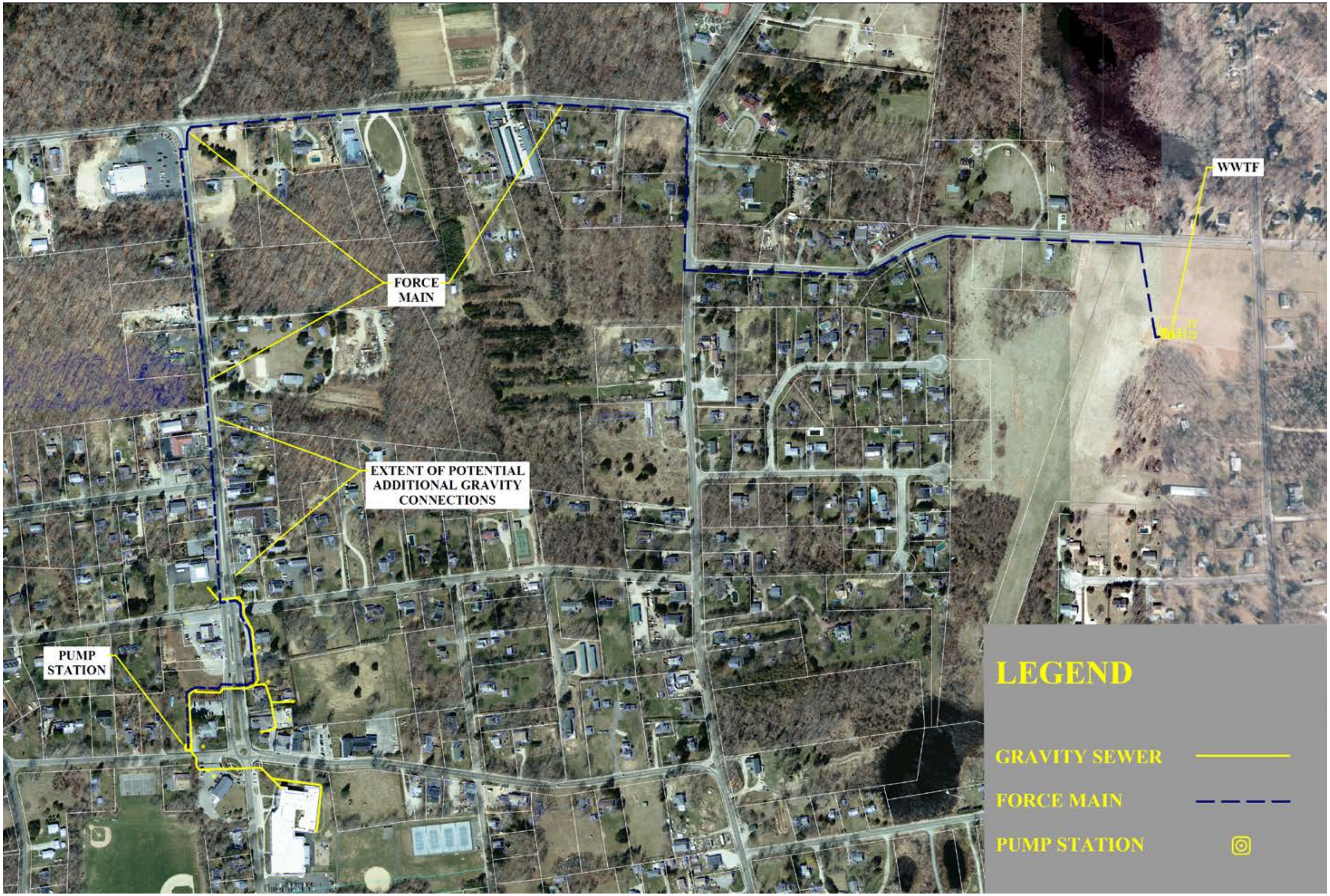


Figure 4-9 Preliminary Collection System Layout – Airfield Site

Figure 4-10 Shelter Island Town Owned Properties

Figure 4-11 Shelter Island Town / County Owned Properties

4.4 RECOMMENDED WASTEWATER SYSTEM TECHNOLOGY AND LOCATION

Collection

The septic tank effluent (STE) collection system is recommended vs. a total wastewater collection system for the following reasons:

1. STE system significantly reduces sludge generation at the WWTF which reduces project costs and odor concerns
2. STEP systems are less costly to build and simpler to operate as compared to grinder pumps
3. STE treatment systems are simpler to operate and maintain

Consequently, the recommended wastewater system consists of:

Collection	Septic tank effluent (STE) gravity (STEG) and pumped (STEP) system
Treatment	Nitrex technology at the Klenawicus Airfield
Disposal	Leaching pools / low pressure shallow drainfield

5. COST ESTIMATES

Table 5-1 presents a summary of LAI's opinion of probable costs for the recommended wastewater collection, treatment and disposal option as described in Section 4.4 and funding levels, along with user charge estimates at various funding levels, using an amortization interest rate of 2% for 20 and 30 years https://www.fmsbonds.com/market-yields/.

Table 5-1 Opinion of Probable Cost for Recommended Wastewater System

WWTF Location	Capital Costs	Annual O&M	Flow		
Airfield	$ 3,817,131	$ 79,150	6,200 gpd		
Local Capital Costs, Grant Funding & User Charges Scenarios					
Grant Funding	**0%**	**25%**	**50%**	**75%**	**90%**
Local Capital Costs	$ 3,817,131	$ 2,863,000	$ 1,909,000	$ 954,000	$ 382,000
Grant Funding	$ -	$ 954,000	$ 1,909,000	$ 2,863,000	$ 3,435,000
Annual User Costs at with local share funded - 2% 20 years	$ 312,593	$ 254,242	$ 195,898	$ 137,494	$ 102,512
Annual User Costs at with local share funded - 2% 30 years	$ 249,585	$ 206,983	$ 164,387	$ 121,746	$ 96,206

Non-Monetary Factors

The primary non-monetary factors are:

1. Discharge location selection with the airfield location providing the least, i.e., minimal impact, on the groundwater aquifer and water supply wells.

2. Aesthetics – with the objective to maximize below ground systems and landscaping to blend treatment system with landscape

3. Treatment Technology has very low Operations and Maintenance requirements and minimal energy use.

6. IMPLEMENTATION PLAN – SCHEDULE AND FINANCING

6.1 LEGAL

The proposed project requires the creation of a District for the proposed sewer system option.

The options are establishment of special districts through New York State enabling legislation in Town Law are:

- ✓ § 190-g Water quality treatment districts;
- ✓ § 190-e Wastewater disposal districts
- ✓ Watershed Protection Improvement Districts
- ✓ Business Improvement Districts

These options are described in Town Law Article 12, 12-A and 12-C. A wastewater disposal district includes the ability to include individual onsite wastewater systems, such as proposed for the Fire Department. For private properties implementing I/A technologies, a wastewater disposal district can be the vehicle to avoid an I/A grant being taxable income. However, the I/A system would need to be owned by the District.

6.2 FINANCING

Once a District is formed, bonding for the local share will be necessary, with authorization by Town.

6.3 SCHEDULE

A Process Flow Diagram for District and Wastewater System Implementation is presented on Figure 6-1.

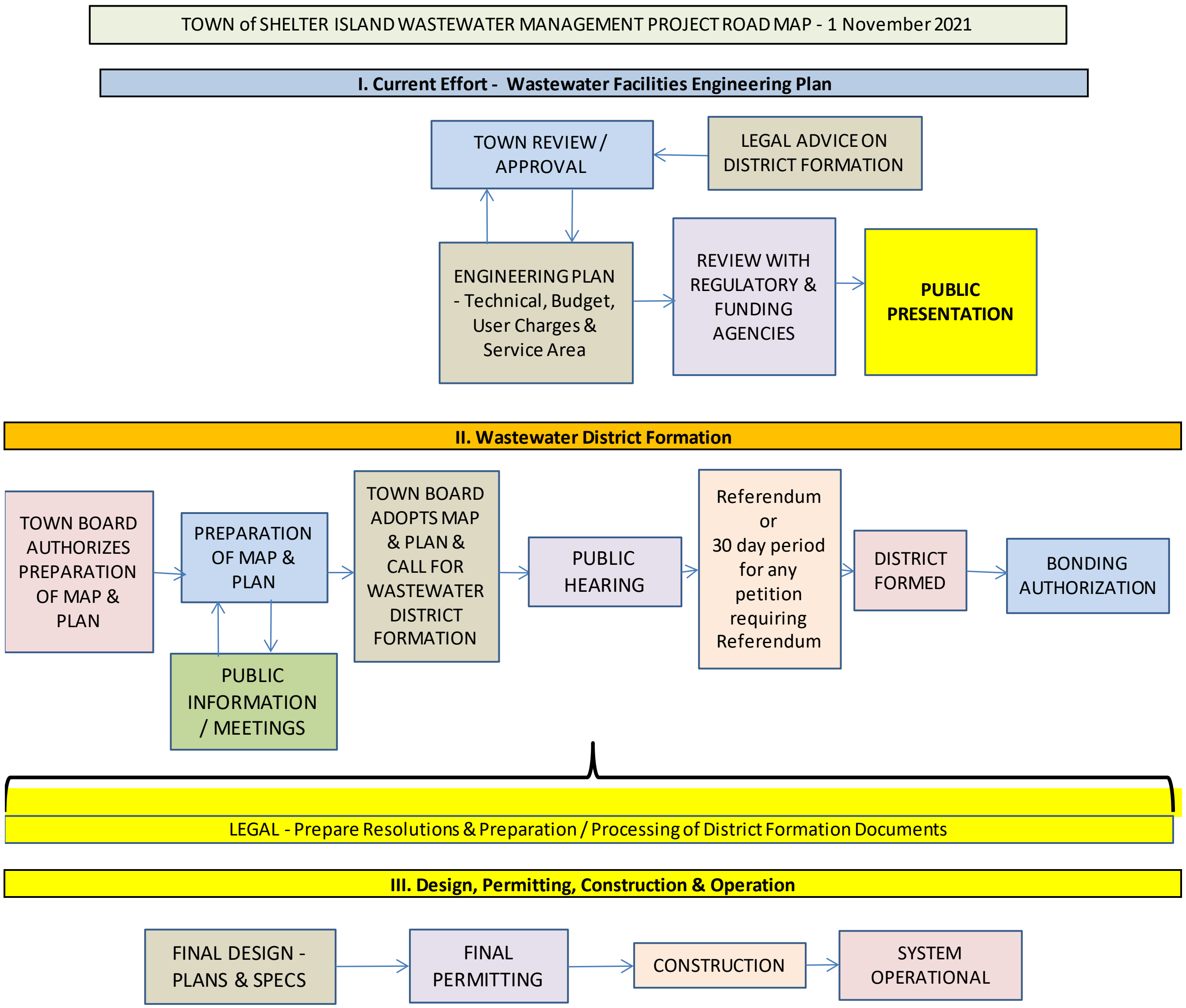
The following near term milestones schedule is:

Engineering Report Presentation to Town Board	December 14, 2021
Town Review	December – January 2022
Design of Recommended Alternative	February – April 2022
Grant Funding Application	July 2022

Legal formation of Wastewater System Ownership

▪ Town Board Authorizes Preparation of Map & Plan	January 2022
▪ Map & Plan Completion & Public Hearings	March 2022
▪ Town Board Adopt Map & Plan & Calls For Wastewater District Formation	April 2022
▪ Referendum or 30-day period for any Referendum petition	May 2022
▪ District formed	June 2022
▪ Bonding Authorization	July – August 2022

Figure 6-1 Process Flow Diagram for District and Wastewater System Implementation



Environmental Engineers/ Consultants
LOMBARDO ASSOCIATES, INC.

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1. Misut, P.E., Casamassina, N.A., and Walter, D.A., 2021, Delineation of areas contributing groundwater and travel times to receiving waters in Kings, Queens, Nassau, and Suffolk Counties, New York: U.S. Geological Survey Scientific Investigations Report 2021–5047, 61 p., https://doi.org/10.3133/ sir20215047.

2. Nelson, Pope & Voorhis (NPV), 2014, Town of Shelter Island Watershed Management Plan.

3. Suffolk County Department of Health Services (SCDHS), 2020, Subwatersheds Wastewater Plan

4. Web Soil Survey (WSS), USDA, Natural Resources Conservation Service (NRCS) https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm, 2021

APPENDIX A USGS WELL WATER QUALITY DATA

Figure A-1 illustrates the location of USGS groundwater monitoring wells for which groundwater quality data was collected for the period 2016 – 2018, with the data presented on Tables A-1 through A-3.

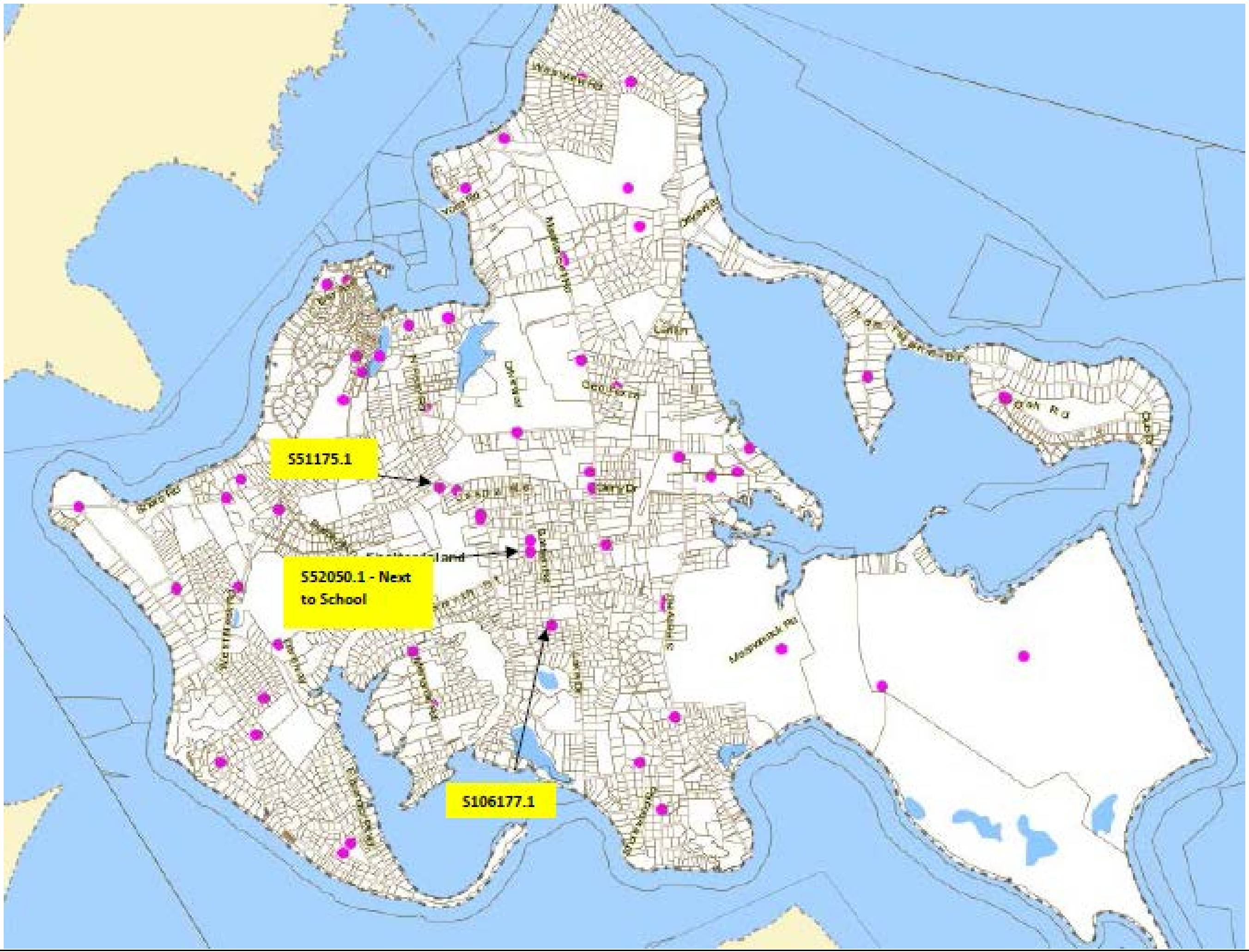

Table A-1 Groundwater Quality USGS Well S106177.1

Ground Water Quality Data - USGS Well			# S106177.1
Latitude 41°03'40", Longitude 72°20'12" NAD27			
Land-surface elevation 30.3 feet above NGVD29			
Well depth is 70 feet below land surface. Hole depth 73 bls			
Location: on ~ 30 Baldwin Road north of Strawberry Lane			
Constituent \ Date	**12/2/2016**	**11/8/2017**	**9/27/2018**
Temp (°C)	12.8	13.0	13.9
Specific Cond (uS/cm)	206	202	189
D.O. (mg/L)	9.0	7.8	6.8
pH	6.6	5.8	5.9
Organic N (mg/L)	0.33	0.09	
Ammonia-N (mg/L)	0.01	0.02	0.02
Nitrite-N + Nitrate-N (mg/L)	5.95	5.36	4.9
Ortho-phosphate-P (mg/L)	0.026	0.031	0.037
Iron (mg/L)	0.0118	<.010	0.0265
screen zone is 55-60 ft below top of the well casing (which is ~ 31). Therefore MW is 24 - 29' into GW			

Table A-2 Groundwater Quality USGS Well S51175.1

Ground Water Quality Data - USGS Well			# S51175.1
Latitude 41°04'16", Longitude 72°20'51" NAD27			
Land-surface elevation 39.5 feet above NGVD29			
Well depth is 60 feet below land surface.			
Location: on ~ Bowditch Road at N. Midway Road			
Constituent \ Date	**11/19/2018**		
Temp (°C)	12.3		
Specific Cond (uS/cm)	470		
D.O. (mg/L)			
pH	6.6		
Organic N (mg/L)	0.34		
Ammonia-N (mg/L)	7.7		
Nitrite-N + Nitrate-N (mg/L)	5.22		
Ortho-phosphate-P (mg/L)	0.018		
Iron (mg/L)	0.200		

Table A-3 Groundwater Quality USGS Well S52050.1

Ground Water Quality Data - USGS Well #			# S52050.1
Latitude 41°03'59", Longitude 72°20'20" NAD27			
Land-surface elevation 44.0 feet above NGVD29			
Well depth is 64 feet below land surface			
Location: 33 N Ferry Rd, School District Well			
Constituent \ Date	**10/12/2016**	**11/17/2003**	
Temp (°C)	15.3	15.1	
Specific Cond (uS/cm)	480	512	
D.O. (mg/L)	6.1		
pH	5.7	5.5	
Organic N (mg/L)	0.71		
Ammonia-N (mg/L)	0.13	<0.04	
Nitrite-N + Nitrate-N (mg/L)	11.2	34.9	
Ortho-phosphate-P (mg/L)	0.004	<0.02	
Iron (mg/L)			

APPENDIX B COST ESTIMATES DETAILS

Table B-1 presents the Capital Cost estimate details for the preferred option. Table B-2 presents the Operations and Maintenance costs for the preferred option.

Table B-1 Capital Cost Estimate Details with School

	Wastewater System Cost Estimates - with School & Force Main to Airfield Site - 6,200 gpd						
On-Prop. Work	Septic Tanks			19,000	gallons	$3.50	$66,500
	Property Connections			8	EA	$2,000.00	$16,000
	Abandon Existing Septic Systems			8	EA	$2,500.00	$20,000
Collection System	Effluent Sewer - Unpaved Area	SDR 35	4" gravity	1,710	LF	$60.00	$102,600
	Effluent Sewer - Paved Area	SDR 35	4" gravity	870	LF	$100.00	$87,000
	Major Highway Crossing - Sewer	SDR 35	4" gravity	320	LF	$200.00	$64,000
	Town Road Crossing - Sewer	SDR 35	4 gravity	160	LF	$150.00	$24,000
	Force Main - In Trench w/Gravlty	SDR 26	3" pressure	1,460	LF	$50.00	$73,000
	Force Main - Cross Country	SDR 26	3" pressure	400	LF	$60.00	$24,000
	Force Main - Road Shoulder	SDR 26	3" pressure	6,000	LF	$150.00	$900,000
	STEP			1	#	$7,500	$7,500
	Pump Station		gpm	1	#	$75,000	$75,000
	Asphalt cut, remove and replace	4	ft wide	600	SY	$50.00	$30,000
	Subtotal - Collection System Construction Costs						***$1,489,600***
	Miscellaneous			8%			$119,200
	Contingency			15%			$223,400
	Engineering & admin			15%			$274,800
	Total Collection System Capital Costs						**$2,107,000**
Treatment & Disp. System	Treatment & Disposal Sytem	6,200 gpd	Nitrex, Below Grade	6,200	gpd	$195	$1,209,000
	Subtotal - Treatment & Disposal System @ Airfield						***$1,209,000***
	Miscellaneous			8%			$96,720
	Contingency			15%			$181,350
	Engineering & admin			15%			$223,061
	Total WWTF & Disposal System Capital Costs						**$1,710,131**
	Total Wastewater System Costs						**$3,817,131**

Table B-2 Annual O&M Cost Estimate Details

6,200-GPD Shelter Island Nitrex System										
Annual O&M Estimate										
								1st Year	Year 2	Year 3+
1	**Contract Operations**	**1st Year**	**Year 2**	**Year 3+**				**$ 28,100**	**$28,100**	**$21,080**
	# hours per visit	3	3	4						
	# visits per year	110	110	62						
	hourly rate	$85	85	$85						
		$28,050	28,050	$21,080						
2	**Sampling**	**1st Year**	**Following Years**					**$ 11,500**	**$ 11,500**	**$ 9,500**
		$11,500	$ 9,500							
3	**Electricity**	**Total Kwhr**	**7,000**	**Cost / kwhr**	**$0.20**	**$0.20**		**$ 1,400**	**$ 1,400**	**$ 1,400**
4	**Sludge Pumping and Disposal**							**$ 700**	**$ 700**	**$ 700**
	Frequency (years)	5								
	Total Gallons	16,875								
	$/gal	$0.20								
	Soda Ash	lbs/month	$/lb	Tax & mark-up	%					
		833	1	1.10	75%			**$ 8,250**	**$ 8,250**	**$ 8,250**
5	**Engineering Oversight / Annual report**							**$ 12,000**	**$ 12,000**	**$ 8,000**
6	**Collection System, Misc. / Contingency**			10%				**$ 6,200**	**$ 6,200**	**$ 4,900**
				Total Typical O&M Costs				**$ 68,150**	**$ 68,150**	**$ 53,830**
7	**Annual Equipment Replacement Budget**							**$ 11,000**	**$ 11,000**	**$ 11,000**
		Total Typical O&M Costs with Repair/replace allowance						**$ 79,150**	**$ 79,150**	**$ 64,830**