WASTEWATER TREATMENT
Preliminary Engineering Report

Fort Wright Sewer Service Area

Fishers Island, Suffolk County, New York

Project executed for:
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Funded by a grant from:
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1.0 EXECUTIVE SUMMARY

This report discusses the upgrade of an existing community wastewater treatment and disposal system on Fishers Island in the Town of Southold, Suffolk County, NY. The existing treatment system provides primary treatment through septic tanks, which achieves negligible nitrogen removal. The system operates in compliance with the current SPDES permit requirements. The Town of Southold is considering a voluntary upgrade of the treatment system to further reduce nitrogen concentrations in effluent. This upgrade would enhance water quality by reducing nitrogen levels in groundwater, which is the sole source of drinking water, and nearby surface waters which lie within the Long Island Sound Estuary, an estuary of national importance.

Peconic Green Growth, Inc. and Natural Systems Utilities, Inc. have developed alternatives for upgrading the treatment system. The system is designed to treat domestic wastewater at a design flow of 30,000 gallons per day. Two alternatives were examined with different levels of treatment. Alternative 1 proposes a system that obtains treatment levels of 20 mg/l for Total Nitrogen (TN). These levels are not as stringent as other treatment facilities but provide a significant improvement over the current system. Alternative 2 proposes a treatment system that would meet the more stringent requirements of a regulated wastewater treatment plant of 10 mg/l of TN.

The treatment system upgrade utilizes vegetated recirculating gravity filters (VRGFs) to achieve the desired level of treatment. This new facility would be constructed adjacent to the existing system and reuse components where possible. The increased effluent target of 20 mg/l total nitrogen for Alternative 1 allows for the nitrification and denitrification process steps to be removed from the system design thereby resulting in reduced cost. In addition, Alternative 1 proposes reusing the existing septic tanks which will further reduce construction costs.

The cost of the WWTP improvements are estimated at $1.1 million for Alternative 1 and $1.5 million for Alternative 2. Cost estimates are within 25% accuracy.

2.0 INTRODUCTION

Applied Water Management, Inc. (AWM) has prepared this report in support of a wastewater treatment system to update the current Fishers Island wastewater disposal system. The existing system, consisting of a pump station, septic tanks, and leaching trenches, was built approximately 30 years ago to replace an outfall into Long Island Sound. While this eliminated the direct discharge to the ocean, the septic tank system provides only primary treatment and creates the potential for adverse impacts to the island's groundwater quality, particularly from elevated levels of nitrogen.

The existing system was evaluated as a voluntary, Town-initiated study to determine how nitrogen levels can be reduced. A cost effective approach was developed to significantly improve effluent quality to a total nitrogen (TN) level of <20 mg/L on a year round basis and lower levels during the warmer months, which is also when loads are significantly higher due to the large percentage of seasonal home owners. It is assumed that the current SPDES permit for the disposal system would remain relevant to the system upgrade. The current SPDES permit for this facility does not have a nitrogen limit. Typical SPDES requirements dictate that an effluent TN of 10 mg/L is required for a community sewer system. A second wastewater treatment system alternative has been provided to meet this standard.

Included in this report are descriptions and discussions of the site, expected wastewater flows, influent and effluent wastewater characteristics, wastewater treatment unit processes, and an engineer's cost estimate for Alternative 1 and Alternative 2. Alternative 1 includes vertical flow vegetated, recirculating gravel filters (VRGF) to provide treatment of the wastewater. Alternative 2 includes additional nitrification and denitrification steps to further reduce nitrogen levels. A full description of Alternative 1 can be found in Sections 3.0 to 8.0 of this report; Alternative 2 is discussed in Section 9.0 of this report.

3.0 EXISTING SYSTEM

The existing treatment and disposal system was constructed in the mid 1980's to replace a direct outfall to Long Island Sound. A large portion of the original sewage collection for the Fort Wright military installation is still being used although some mains have been abandoned. The existing system is actually composed of three separate systems, one large system serving the majority of the buildings in the sewer service area and two smaller systems serving individual buildings or groups of buildings. A further description of the existing treatment process is provided in Section 2.3 of this report.

3.1 WWTP Location

The project site is located on the western end of Fishers Island in Long Island Sound approximately 7 miles southeast of the town of New London, Connecticut. The island is a part of Suffolk County, New York and is administered by the Town of Southold. The area in question, known as Fort Wright, is a former military installation and is the only area on the island served by a sewage collection system. The primary wastewater disposal system serving the Fort Wright sewer service area is located to the south of Whistler Avenue across from the school as shown in Appendix B on the Aerial Photograph and Proposed System Layout. The coordinates of the existing WWTP are Latitude 41° 15' 17" N and Longitude 72° 1' 54" W (WGS84), on a parcel identified as District 1000, Section 12, Block 1, Lot 18 on the county tax map. As mentioned previously, there are two smaller on-site sewage disposal systems, one serving the cinema on Whistler Avenue and one serving a group of cottages on Reservoir Road. As per the Town of Southold Engineering Department, the school is also served by its own on-site disposal system. The first three systems are described further in Section 2.3.

3.2 Contributing Uses

The existing system serves a mixture of both seasonal and year-round residences, a community center, and several offices. A portion of the collection system is comprised of combined sewers. It is anticipated that prior to the construction of a new sewage treatment system, some of the older piping will be repaired or replaced as needed to eliminate all combined sewers. Buildings currently not served by the community system would be connected.

3.3 Existing Process Description

The following description of the existing system is based on information in a report titled "Operations and Maintenance Manual for the Fishers Island Wastewater Facilities" prepared by A.R. Lombardi, Inc. in September 1986 and on a major upgrade in 2008.

The sewage collection system discharges to a pump station located on Fox Lane near the abandoned outfall in the northwest section of the service area. The pump station consists of a valve pit, a 25 kW emergency generator, above ground propane tank, control panel, and a wet well containing two submersible pumps designed to deliver 180 gpm at 40' of total dynamic head (TDH). The pump station conveys the wastewater through a 6" force main to the septic tanks and leaching galleys on Whistler Avenue across from the school. The existing disposal system was designed for a summer average flow of 20,000 gpd and a winter average flow of 7,500 gpd with a peak hour estimated flow of 80,000 gpd.

The disposal system consists of three septic tanks, each with a 10,000 gallon capacity. Flow from the force main is split equally to each septic tank through a distribution box. The septic tanks remove most of the settleable solids and floating scum. Effluent from the three septic tanks flows into a large distribution box from which it is split to three smaller distribution boxes and then to a total of fourteen (14) leaching galleys consisting of long trenches for discharge into the ground.

The cinema on Whistler Avenue is served by its own sewage disposal system located adjacent to the building. This system consists of a 1,500 gallon septic tank and two galley trenches.

There are three cottages on Reservoir Road that are served by a separate sewage disposal system consisting of a 2,000 gallon septic tank and four leaching pools.

4.0 PROJECTED FLOWS

The proposed wastewater treatment system upgrade will be located adjacent to the current disposal system on Lot 18, Block 1. The two community systems serving the cinema and cottages as described in Section 2.3 will be abandoned and the buildings will be tied into the existing collection piping to be processed by the proposed treatment system.

4.1 Sewer Service Area

The boundaries of the Fort Wright service area were delineated by the Town of Southold Engineering Department and are shown on the Fishers Island Sewer District Map in Appendix A. This service area is expected to generate a wastewater flow of 27,981 gallons per day (gpd) at full buildout. Further information on projected sewer flows is provided in Section 4.2 and Appendix A.

4.2 Sanitary Determination & Projected Flows

The treatment system will receive both domestic and commercial wastewater from the Fort Wright sewer service area delineated on the map entitled “Fishers Island Sewer District” found in Appendix A. Estimated flows were calculated based on existing uses and future expansion. Flow estimates were determined using hydraulic load unit flow criteria provided in the “Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences” issued by the Suffolk County Department of Health Services (SCDHS). Flow calculations can be found in Appendix A of this report.

Hydraulic Loading & Sanitary Flow Rate

Using the Hydraulic Loading criteria and tax parcel use data, the total estimated wastewater flow for current uses was determined to be 25,881 gallons per day (gpd). If the seven (7) currently vacant parcels are developed with one single-family residence each, the flow will increase to 27,981 gpd. To accommodate the projected flow at full buildout, a design flow of 30,000 gpd will be used.

Fishers Island has a significant population fluctuation between summer and winter seasons. The flows provided above and in Appendix A are considered to be the theoretical flows during the summer months when all residences are occupied and recreational opportunities such as the community center and cinema are in full use. Flows during winter months have not been estimated but are expected to be significantly lower than average summer flows due to seasonal variation in population on the island.

<u>Peak Hourly Flow Calculation</u>

The total peak summer population served by the wastewater treatment system is estimated at 400 persons based on the following:

- 30,000 gpd / 75 gpd per capita = 400 persons

Peak hourly flow was determined using the following formula[1]:

$$P = \frac{Population}{1000} = 0.40$$

$$Q_{PeakingFactor} = \frac{QPeakHourly}{QDesignAve} = \frac{18+\sqrt{P}}{4+\sqrt{P}} = \frac{18+\sqrt{0.4}}{4+\sqrt{0.4}} = 4.02$$

Based on a population of 400, the calculated peaking factor is 4.02. This equates to a peak hourly flow of 4.02 x 30,000 gpd / 1,440 minutes per day, or approximately 84 gpm.

5.0 SITE EVALUATION

The proposed treatment system upgrades will be located adjacent to the current disposal system on Whistler Avenue primarily in the area designated as the current system's reserve area as shown on the Site Plan in Appendix B. The vegetated recirculating gravel filters cells will be east of the existing disposal trenches. The existing pump station in the northwest of the Fort Wright area will continue to transport the wastewater from the collection system through the existing force main. Some existing concrete foundations in the area of the proposed wetland cells will need to be removed.

The locations of all proposed structures were selected in order to minimize interference with the existing disposal system operation and existing utilities. Some of the existing disposal trenches will be disturbed during construction but these will be restored after the tanks have been installed.

[1] Formula taken from the GLUMRB - Recommended Standards for Wastewater Facility. 2004 Edition.

The location for the proposed treatment system was chosen to minimize tree clearing and site improvement costs. The 100 foot setback to habitable buildings is accepted and practiced in other applications within the United States and is more than adequate for these systems.

The existing system has a setback of approximately 25 feet from the property line and 100 feet from the nearest habitable building. The proposed system (Alternative 1 and Alternative 2) provides the same setback distances between the property line and the nearest habitable building.

5.1 Hydrogeological Site Analysis

Fishers Island is part of an end moraine deposit formed as the last Pleistocene ice sheets retreated. The result was numerous hills composed of till, sand and gravel. Information on the bedrock geology is limited but there is no evidence of bedrock outcrops on the island. Supported by past well drilling on the island, bedrock is assumed to be at a depth greater than 200 feet.

The area proposed for the wastewater treatment system is currently used for wastewater disposal. Limited soil borings or test pits exist for this site but those available generally show soils suitable for wastewater disposal. Based on the test pits overseen by AR Lombardi Associates, Inc. in December 1983, groundwater is at least 9 feet below ground elevation. SP soils are found at the bottom of most test pits although the total depth of the SP soils is not known since the test pits do not extend beyond 9-11 feet below ground. Further soil testing will be performed in the future prior to final design.

6.0 INFLUENT CHARACTERISTICS

The SCDHS recommended design influent characteristics as summarized in Table 1 were used for this project.

Table 1: Design Influent Characteristics

Characteristic	Units	Design Influent Concentration
Biochemical Oxygen Demand (BOD_5)	mg/l	272
Total Nitrogen (TN)[1]	mg/l	65
Total Suspended Solids (TSS)	mg/l	300

1. For the purpose of this evaluation, it is assumed that there are no nitrites and nitrates in the influent and that TN is equal to Total Kjeldahl Nitrogen (TKN).

7.0 TREATED EFFLUENT QUALITY

According to Wastewater Engineering: Treatment and Reuse 5th Edition by Metcalf & Eddy, septic tank treatment provides a 30% reduction in influent BOD, 30% reduction in TSS, and a 10% reduction in influent total nitrogen (TN). Therefore, the typical effluent quality that is discharged by the existing system can be estimated, assuming the influent quality as noted in Table 2 is present.

Through treatment system enhancements, a higher quality effluent can be achieved. Table 2 provides a comparison between the existing effluent quality versus that achieved under Alternative 1 and Alternative 2 design concepts. This demonstrates the benefit of the proposed upgrades on reducing effluent concentrations.

Table 2: Design Effluent Characteristics

Characteristic	Existing System Effluent Concentration	Design Effluent Concentration Alternative 1	Design Effluent Concentration Alternative 2
Biochemical Oxygen Demand (BOD_5)	190 mg/L*	<30 mg/L	<20 mg/L
Total Nitrogen (TN)	58 mg/L* (14.5 lbs/d) (5,297 lbs/yr)	<20 mg/L (5.0 lbs/d) (1,826 lbs/yr)	<10 mg/L (2.5 lbs/d) (913 lbs/yr)
Total Suspended Solids (TSS)	210 mg/L*	<20 mg/L	<10 mg/L
pH	6 - 8.5	6 - 8.5	6 - 8.5

*Assumes a 30% reduction of BOD, 30% reduction of TSS and 10% nitrogen removal rate through the existing treatment system

Alternative 1 and Alternative 2 reduce total nitrogen in the effluent by 9.5 lbs/day and 12.0 lbs/day, or 3,471 lbs/yr and 4,384 lbs/yr, respectively. This equates to a removal rate of 65% for Alternative 1 and 83% for Alternative 2. These nitrogen removal values are based on 100% capacity at theoretical removal rates. Under current flows with seasonal use, the estimated nitrogen removal rate may be reduced by 35% during 8 months of the year (total reduction of 23% for the year).

8.0 ALTERNATIVE 1 WWTP CONCEPT

Alternative 1 is a 30,000 GPD wastewater treatment system and disposal system that will be installed adjacent to the existing WWTP and disposal system. The location was chosen because it is at the terminus of the wastewater force main and the area is already used for wastewater disposal. As such, cost savings for this treatment plant will be realized by eliminating the need for an influent pump station. Additional cost savings may be applied by using the existing disposal system and septic tanks, which are assumed to be in adequate condition for continued use.

Proposed WWTP structures include the following:

- Three (3) 10,000 gallon septic tanks (30,000 gal capacity) will be installed in parallel with the three (3) existing 10,000 gallon septic tanks. The piping for the existing septic tanks will be reconfigured to make these operate in series rather than their current parallel operation. This will form two parallel trains each with three (3) septic tanks each for a total septic tank capacity of 60,000 gallons. The third tank in each series shall be fitted with a commercial septic tank filter.
- One (1) 10,000 gal precast concrete recirculation tank w/baffle wall will be provided.
- Four (4) 2,025 SF vegetated recirculating gravel filters (VRGF) at four-foot treatment depth using ¾" pea gravel underlain by 1 foot of drainfield rock
- A 200 SF prefabricated control building to house the following:
    - Control System
    - Laboratory/Restroom
    - Chemical Feed System (Supplemental Carbon)
    - Odor Control System
    - HVAC Equipment
- A precast concrete effluent meter chamber will be provided on the discharge line prior to the disposal system.
- Any trenches disturbed during construction will be restored. Based on the *Operations and Maintenance Manual for the Fishers Island Wastewater Facilities – September 1986,* each 64' – 100' trench (14 total) provides approximately 1,500-3,000 gpd of disposal capacity. Thus, assuming the existing trenches are in proper working order they should be able to provide full disposal capacity for the system.
- A stand-by generator is excluded from this alternative. In the event of a power failure, septic tank discharge will be directed to the disposal system via gravity through an overflow pipe installed on the recirculation tank.

A process flow schematic and conceptual site plan layouts are presented in Appendix B.

The following provides a detailed description of the proposed system components.

Septic Tanks

A total of 60,000 gallons of septic tank capacity will be provided through existing and proposed tankage. Precast concrete septic tanks in two trains of three each in series (a total of 6) will provide primary treatment of the wastewater. A septic solids retainer will be installed at the outlet of the last septic tank in each series.

The septic tanks will be pumped out annually to remove septage. The treatment facility is expected to generate approximately 20,000 gallons per year (or approximately 3,300 dry pounds per year at 2% solids) of septage from the septic tanks. Actual septage generation may vary. A licensed septage hauler will be under contract to pump the tanks as necessary.

Recirculation Tank

Flow from the septic tanks will discharge to the recirculation tank. The recirculation tank will pump flow to the vegetated recirculating gravel filter. Return flow from the VRGFs will flow by gravity back to this tank and mix with the septic tank effluent. The recirculation tank will be a 10,000-gallon pre-cast concrete tank equipped with three submersible pumps which include two (2) VRGF feed pumps and one septic system return pump. The tank will include a baffle wall to achieve redundancy. In the event of a power failure or critical system maintenance, overflow from the recirculation tank will be diverted directly to the dispersal system.

The VRGF feed rate is calculated to be 4 times the forward flow, or 120,000 gpd under normal operation. If one VRGF bed is taken out of service, the recirculation flow can be increased to 7 times the forward flow, or 210,000 gpd to maintain the required level of treatment. The VRGF feed pumps will be sized accordingly and will be operate on timer switches, which can be adjusted by the operator to set the dosing interval and frequency

The VRGF feed pumps are hard-piped into a flow splitter valve box supplying the VRGF cells. Valving will be provided to direct flow to the different cells. There will be small-diameter Schedule 40 PVC perforated distribution laterals in each recirculating gravel filter cell. The perforation diameter, spacing, and lateral size will be designed to have less than a 10% difference in the discharge rate between the orifices in each lateral. Each perforated distribution lateral has a flushing valve at the terminal end.

The nitrified wastewater will have the ability to be returned to the head of the septic tanks so as to provide operational flexibility. The purpose of the recycle is to incorporate denitrification into the system before wastewater flows to the denitrification reactor and as a result limit the required dosage of carbon. This operation is performed by the septic system return pump. The pump rate will be approximately equivalent to the design flow. The pump will operate off a variable frequency drive (VFD) and will be adjusted manually by the operator. A backup pump will be stored in the control building in the event of mechanical failure.

Vegetated Recirculating Gravel Filter (VRGF)

For wastewater treatment, four (4) VRGFs, 2,025 square feet in size (total of 8,100 SF) are proposed. The vegetated recirculating gravel filter consists of a filter bed constructed below grade in a cell lined with 40-mil LLDPE or equivalent impermeable liner.

The treatment media is a 48-inch layer of ¾" pea gravel with a small uniformity coefficient, underlain by a 12-inch drainage layer of drainfield rock. The treatment bed will be insulated on the top with a 6-inch mulch layer to provide odor control, insulation from freezing, and support recirculating gravel filter plants to aid in the treatment process. The mulch material will be peat. The filter will be planted with a variety of facultative wetland/wet meadow species.

On average, wastewater will be recirculated approximately 4 times through the vegetated recirculating gravel filter. The recirculation flow is approximately 120,000 gallons per day. The vegetated recirculating gravel filter has a footprint area of 8,100 square feet. The resulting hydraulic loading of 3.7 gallons per square foot per day (forward flow) is within design guidelines (3.0 to 5.0 gallons per square foot per day) published in the US Environmental Protection Agency's (EPA) Onsite Wastewater Treatment and Disposal Systems Design Manual. With one cell out of service, the hydraulic loading increases to 4.9 gallons per square foot per day.

With septic tank pretreatment, the BOD load on the system is 47.5 pounds per day. This assumes a BOD5 reduction of 30 percent in the septic tanks. The organic loading on the vegetated recirculating gravel filter would be about 0.006 lbs per square foot per day under normal operation. If one cell is taken out of service, the organic loading would increase to approximately 0.008 lbs per square foot per day.

Supplemental Carbon

As discussed above, the recirculation loop that transfers wastewater from the recirculation tank to the septic tanks will serve as a denitrification loop for the process. Based on the performance of similar NWTS facilities, it is expected that a TN of 20 mg/L can be met through this process, however, supplemental carbon may be required to further denitrify wastewater. For purposes of this report, it is assumed that supplemental carbon will be provided in the form of Micro C and will be added at an average rate of 3 lbs/day. Carbon will be injected into the process through a positive displacement feed pump. Pump operation and feed rates will be adjusted by the operator on an as needed basis.

Control Building

A 200 SF masonry block control building will be installed with adequate heating, ventilation and lighting. The building will house electrical panels/equipment. The building will be serviced with a 1-1/2-inch water service that will be protected from cross contamination by a backflow prevention device.

The system will be equipped with an autodialer which will notify the operator of alarm conditions. A telephone line will be provided to the control building to allow remote assessment of alarms and system status. An alarm list is provided as follows:

Alternative 1: Alarm List

1. Septic Tank High level alarm
2. Recirculation Tank High level alarm
3. Recirculation Tank Low level alarm
4. Septic System Return Pump Fail
5. VGRF High Level Alarm
6. Loss of Power

Effluent Meter and Disposal System

Effluent from the treatment system will flow from the recirculation tank to a six foot diameter effluent meter chamber prior to discharging to the existing trench disposal system. An updated survey must be completed in order to confirm that the effluent is able to flow to the disposal system by gravity. In the event a gravity application cannot be implemented, a duplex effluent pump system will be required.

It is anticipated that the entire 30,000 gpd design flow capacity can be handled by the existing trench disposal system. Additional soil data and depth to groundwater measurements will be needed prior to finalizing the design.

8.1 Construction Sequence

The new septic tanks be installed initially, which will may require the removal or disturbance of up to four (4) of the existing disposal trenches. Construction should be completed during the non-peak season when flows are reduced. This will alleviate any concerns regarding disposal system capacity during construction. Once the new infrastructure is in place the existing trenches will be restored and placed on-line.

8.2 Cost Estimate

A cost estimate (Table 3) was prepared based on the conceptual design described in this report. The estimated cost for Alternative 1 is $1,080,800 +/- 25%. This results in a cost of $10,800 per user, assuming that each user produces 300 gpd.

Table 3: Engineer's Cost Estimate for Alternative 1

TREATMENT SYSTEM UPGRADE FISHERS ISLAND, NY ALTERNATIVE 1	
DESCRIPTION	**COST**
Mobilization	$ 50,000
Site Work	$ 60,000
Site Utilities	$ 25,000
Process Tanks/Mechanical	$ 150,000
Vegetated Recirculating Gravel Filters	$ 240,000
Odor Control System	$ 20,000
Disposal System	$ 35,000
Building	$ 70,000
HVAC/Plumbing	$ 30,000
Electrical/Controls	$ 135,000
Miscellaneous/Management	$ 150,000
Construction Subtotal	**$ 965,000**
Engineering (12%)	$ 115,800
Total	**$ 1,080,800**

The estimate provided in Table 3 applies a 10% cost increase to factor in the additional expenses that may arise due to the remote location of the project. For example, shipping cost increases are anticipated since materials must be brought in by ferry. Furthermore, accommodations on the island are limited which would result in an increase travel expenses. The estimates include prevailing wage rates. If prevailing wage were not required, costs could be reduced by $20,000-$50,000. Note that our confidence in the pricing is +/-25% considering the fact that there are very few examples of similar construction on the island to which we can compare unit pricing.

SCDHS regulations require a building be provided at all wastewater treatment facilities. The building shall include a restroom and sink along with adequate lighting. If the restroom can be removed from the scope, a $7,000 cost savings would be realized. The above estimate assumes that no fencing, road improvements, new electrical service, landscaping, or stormwater utility structures will be needed. It also assumes a gravel driveway to access the control building will be provided.

The annual estimated operational cost for Alternative 1 was developed based on the preliminary design described in Section 8.0 of this report. This results in an annual cost of $420 per user, assuming that each user produces 300 gpd. The operational costs are summarized in Table 4 below.

Table 4: Annual Operational Cost Estimate For Alternative 1

TREATMENT SYSTEM UPGRADE FISHERS ISLAND, NY ALTERNATIVE 1	
DESCRIPTION	**ANNUAL COST**
Labor	$ 20,000
Power	$ 6,468
Chemicals	$ 5,475
Sludge	$ 3,360
Maintenance	$ 6,583
TOTAL	**$ 41,886**

Cost Estimate Assumptions:

1. Labor is based on one operator performing site visits at a frequency of 2x/week. Sampling and compliance are included.
2. Power cost is based on a service rate of $0.224/kWh.
3. Chemical cost is based on projected Micro C 1000 addition at a rate of 3 gpd @ $5/gal.
4. Sludge hauling costs are based on four septic tank pump outs/year at 6,000 gallons/pumpout. Sludge hauling cost is estimated at $0.14/gallon.
5. Maintenance cost includes replacement of piping, filter media and equipment, as required. Replacement of structures (i.e. concrete tanks, building, etc) is excluded.

9.0 ALTERNATIVE 2 WWTP CONCEPT

An alternative wastewater treatment system (Alternative 2) solution was also conceptualized. This concept provides an additional level of treatment through added processes for nitrification and dentrification of wastewater as described below. This alternative was considered in order to provide a system that meets typical SPDES permit requirements for other facilities which include a TN of < 10 mg/L.

9.1 WWTP Description

Similar to Alternative 1, Alternative 2 is also a 30,000 GPD wastewater treatment system and disposal system that will be installed adjacent to the existing WWTP and disposal system. It will also be served by the existing pump station and force main and use the existing disposal system. This alternative includes tanks for nitrification and denitrification to further reduce the nitrogen load in the effluent. The control building in Alternative 2 will be larger than in Alternative 1 to accommodate supplemental carbon addition and an aeration system for the nitrification tank. This concept assumes that the existing septic tanks are nearing the end of their useful life and will require replacement.

Proposed WWTP structures include the following:

- Six (6) new 10,000 gallon septic tanks (60,000 gal capacity). Two trains of 3 each in series. The third tank in each series shall be fitted with a commercial septic tank filter. It is assumed that the existing septic tanks will not be reused and will be abandoned in place.
- One (1) 10,000 gal precast concrete recirculation tank w/baffle wall
- Four (4) 2,025 SF vegetated recirculating gravel filters (VRGF) at four-foot treatment depth using ¾" pea gravel underlain by 1 foot of drainfield rock
- One (1) 5,000 gal precast concrete Nitrification & Recycle Tank with baffle wall, including:
    - Four (4) Wedge Wire Screens
    - Bioflow 9 MBBR media
    - Aeration Diffusers and Piping
    - Two (2) Recycle Pumps
- One (1) 15,000 gal precast concrete Denitrification Tank with baffle wall including:
    - Two (2) Mixers
    - Bioflow 9 MBBR media
    - Four (4) Wedge Wire Screens
- A 400 SF prefabricated control building to house the following:
    - Control System
    - Laboratory/restroom
    - A blower package that includes two (2) Nitrification & Recycle Tank Blowers
    - Chemical Feed Systems for supplemental carbon
    - Odor Control System
    - HVAC Equipment
- A precast concrete effluent meter chamber will be provided on the discharge line prior to the disposal system.
- Restoration of existing trench disposal system
- Stand-by Generator

This alternative will also be equipped with an autodialer which will notify the operator of alarm conditions. An alarm list is provided as follows:

Alternative 2: Alarm List

1. Septic tank High level alarm
2. Recirculation Tank High level alarm
3. Recirculation Tank Low level alarm
4. VGRF High Level Alarm
5. Nitrification Tank High Level Alarm
6. Nitrification Tank Low Level Alarm
7. Denitrification Tank High Level Alarm
8. Mixer Fail
9. Loss of Power

A process flow schematic and conceptual site plan layouts are presented in Appendix C.

9.2 Process Enhancements

The process flow will be identical to Alternative 1 with the following additional process enhancements: a nitrification tank and a denitrification tank, which will be located after the gravel filters as shown in the process flow diagram found in Appendix C. The additional process enhancements are described below.

Nitrification Tank

A polishing nitrification reactor will be provided for this wastewater treatment system to ensure that completely nitrified water enters the denitrification reactor. This reactor consists of a precast concrete tank, attached growth media, and a fine bubble diffuser. The tank will be divided in half by a concrete wall to achieve redundancy. An aeration diffuser will be provided in each tank to maintain completely stirred, aerated conditions for nitrification to occur.

Based on data presented in the Water Environment Research Federation's final report, *Investigation of Hybrid Systems for Enhanced Nutrient Control* (2000), nitrification rates occurring on media in aerobic zones are 0.87 g NH_4-N per m^2 of media surface area at 10º C (0.76g NH_4-N per m^2 at 8 º C). With an estimated ammonia loading of 7.30 lbs/day entering the nitrification polishing reactor (assuming 50 percent of influent nitrogen is nitrified in preceding treatment components), approximately 38,550 ft^2 of media surface area is needed for complete nitrification.

The required volume of media varies from 147 ft^3 up to 279 ft^3, depending on which media is selected. Suitable media would include Bioflow 9 Carrier Media, or equivalent, which has specific surface area of 261 ft^2/ft^3. Calculating the largest tank volume required for adequate mixing, a 5,000-gallon, pre-cast concrete tank has been selected for the nitrification polishing reactor.

A recycle pump chamber will be incorporated into the nitrification polishing reactor. This pump system takes the place of the septic system return pump as described in Alternative 1. The pump chamber will include a duplex pump system. The recycle rate will be approximately equivalent to the design flow. The nitrified wastewater will have the ability to be returned to the head of the septic tanks so as to provide operational flexibility. The purpose of the recycle is to incorporate denitrification into the system before wastewater flows to the denitrification reactor and as a result limit the required dosage of carbon.

Denitrification System

The wastewater must be treated further to meet an effluent limit of 10 mg/L of Total Nitrogen. Wastewater Engineering - Treatment, Disposal, and Reuse, Metcalf and Eddy, Inc., 5th Edition was used to design the denitrification system. For the purposes of denitirifcation system sizing, it is assumed that all ammonia nitrogen will be coverted to nitrate nitrogen by the recirculating gravel filter and nitrifying MBBR. Fully nitrified flow will be recirculated to the septic tank, where influent raw wastewater will provide a carbon source for denitrification. It is anticipated that the septic tank will denitrify 40% of nitrate nitrogen to nitrogen gas in this manner. Based on this, under standard operation, the nitrate load entering the denitrification system will be 8.76 lb/day. However, the denitrifying MBBR will be sized such that it is capable of fully denitrifying 100% of nitrate load (14.59 lb/day), in the instance that the recirculation to the septic tank must be interrupted.

Based on the EPA Nitrogen Control Manual (September 1993), approximately 0.13 g NOx-N is removed per ft^2 of media surface area at 15ºC. The relationship can be extrapolated to 5ºC, at which 0.065 g NOx-N is removed per ft^2 of media surface area. Approximately 101,500 ft^2 of media surface area is needed to remove 14.59 lb/day of nitrate. Again, suitable media would include Bioflow 9 Carrier Media, or equivalent, which has a specific surface area of 261 ft^2/ft^3. Using these areas, approximately 481 ft^3, or a minimum of 3,598 gallons, are needed for the treatment media. Calculating the largest tank volume required for adequate mixing, a 15,000-gallon, pre-cast concrete tank has been selected for the denitrification reactor. This tank will be divided into two (2) chambers for redundancy and will contain the plastic carriers (media) and a submersible mixer to keep carriers suspended.

The proposed carbon source is Micro-C, which will be dosed into the reactor at a 3:1 carbon to nitrogen ratio. Under standard operations, approximately 26.27 lbs/day of carbon will be added to denitrify 8.76 lbs/day of total nitrogen. MicroC has an organic content of 5.5 lbs/gal, therefore approximately 4.8 gallons/day of MicroC will be added to the reactor using an automatic pump.

This equates to a Micro-C application rate of approximately 0.16 gallons of Micro-C per 1,000 gallons of influent wastewater, which is congruent with NSU's experience with these systems elsewhere, where a 10 mg/L TN limit is successfully being achieved.

9.3 Cost Estimate

An engineer's cost estimate (Table 5) was prepared based on the conceptual design described in this report. The estimated cost for Alternative 2 is $1,500,800 +/- 25%. This results in a cost of $15,000 per user (assuming that each user produces 300 gpd).

Table 5: Engineer's Cost Estimate for Alternative 2

TREATMENT SYSTEM UPGRADE FISHERS ISLAND, NY ALTERNATIVE 2	
DESCRIPTION	**COST**
Mobilization	$ 50,000
Site Work	$ 80,000
Site Utilities	$ 35,000
Process Tanks/Mechanical	$ 370,000
Vegetated Recirculating Gravel Filters	$ 240,000
Odor Control System	$ 20,000
Disposal System	$ 50,000
Building	$ 20,000
HVAC/Plumbing	$ 32,000
Electrical/Controls	$ 210,000
Miscellaneous/Management	$ 233,000
Construction Subtotal	**$ 1,340,000**
Engineering (12%)	$ 160,800
Total	**$ 1,500,800**

The above estimate assumes that no fencing, road improvements, new electrical service, landscaping, or stormwater utility structures will be needed. It also assumes a gravel driveway to access the control building will be provided.

The estimate provided in Table 5 applies a 10% cost increase to factor in the additional expenses that may arise due to the remote location of the project. For example, shipping cost increases are anticipated since materials must be brought in by ferry. Furthermore, accommodations on the island are limited which would result in an increase travel expenses. The estimates include prevailing wage rates. If prevailing wage were not required, costs could be reduced by $25,000-$65,000. Note that our confidence in the pricing is +/-25% considering the fact that there are very few examples of similar construction on the island to which we can compare unit pricing.

The annual estimated operational cost for Alternative 2 was developed based on the preliminary design described in Sections 9.0 through 9.2 of this report. This results in an annual cost of $610 per user, assuming that each user produces 300 gpd. The operational costs are summarized in Table 6 below.

Table 6: Annual Operational Cost Estimate For Alternative 2

TREATMENT SYSTEM UPGRADE FISHERS ISLAND, NY ALTERNATIVE 2		
DESCRIPTION	**ANNUAL COST**	
Labor	$	20,000
Power	$	14,153
Chemicals	$	8,760
Sludge	$	2,880
Maintenance	$	15,350
TOTAL	**$**	**61,143**

Cost Estimate Assumptions:

1. Labor is based on one operator performing site visits at a frequency of 2x/week. Sampling and compliance are included.
2. Power cost is based on a service rate of $0.224/kWh.
3. Chemical cost is based on projected Micro C 1000 addition at a rate of 4.8 gpd @ $5/gal.
4. Sludge hauling costs are based on four septic tank pump outs/year at 6,000 gallons/pumpout. Sludge hauling cost is estimated at $0.14/gallon.
5. Maintenance cost includes replacement of piping, filter meida and equipment, as required. Replacement of structures (i.e. concerete tanks) is excluded.

10.0 CONCLUSIONS

The disposed effluent quality generated by the proposed Fort Wright sewer service area can be greatly improved though some cost effective enhancements to the treatment system. Assuming an average daily flow of 30,000 gpd, Alternative 1 and Alternative 2 would result in a reduction of the total amount of nitrogen discharged each year. Alternative 1 and Alternative 2 reduce total nitrogen in effluent by 3,471 lbs/yr and 4,384 lbs/yr, respectively, or 65% and 83%.

* * *

APPENDIX A

FLOW CALCULATIONS
SEWER DISTRICT MAP

Fishers Island Sanitary Sewer Calculations

Tax Parcel	Acreage	Use Code	Use Description	Type of Use	Quantity	Measurement Unit	Density Load Unit Criteria	Kitchen Load	Hydraulic Load Unit Criteria	Total Density Load	Total Hydraulic Load
9.-8-6	0.13	260	Single Family Residence	Seasonal Residences	1	dwelling	300		300	300	300
9.-8-7	0.2	312	Single Family Residence (Proposed)	Residential Vacant Land w/small improvement	1	dwelling	300		300	300	300
9.-9-4	2.53	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-9-5	1.61	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-9-8	0.06	312	Vacant	Residential Vacant Land w/small improvement	1	dwelling	300		300	0	300
9.-9-13	0.7	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-9-14	0.6	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-9-15	0.5	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-9-17	0.56	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-9-18	0.55	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-9-19	0.45	311	Single Family Residence (Proposed)	Residential Vacant Land	1	dwelling	300		300	300	300
9.-9-20	0.59	311	Single Family Residence (Proposed)	Residential Vacant Land	1	dwelling	300		300	300	300
9.-10-1	1.11	311	Single Family Residence (Proposed)	Residential Vacant Land	1	dwelling	300		300	300	300
9.-10-2	0.84	312	Single Family Residence (Proposed)	Residential Vacant Land w/small improvement	1	dwelling	300		300	300	300
9.-10-3	0.46	311	Single Family Residence (Proposed)	Residential Vacant Land	1	dwelling	300		300	300	300
9.-10-4	0.84	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-5	0.3	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-6	0.31	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-7	0.33	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-8	0.37	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-9.1	0.5	280	Used as single family	Residential-Multi-Purpose/Multi-Structure	1	dwelling	300		300	300	300
9.-10-9.2	0.94	280	Apartment Building with 6 apartments	Residential-Multi-Purpose/Multi-Structure	4	Apt > 1200 SF	300		300	1200	1,200
9.-10-9.2	0.94	280	Apartment Building with 6 apartments	Residential-Multi-Purpose/Multi-Structure	2	Apt 600-1200 SF	225		225	450	450
9.-10-10	3.84	612	2 two-family	Residential	2	dwelling	600		600	1200	1,200
9.-10-10	3.84	612	2 single family	Residential	2	dwelling	300		300	600	600
9.-10-11.1	0.28	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-11.2	0.2	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-12	0.63	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-13	0.49	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-14	0.75	281	Apartment Building	Multiple Residences	1	Apt > 1200 SF	300		300	300	300
9.-10-14	0.75	281	Apartment Building	Multiple Residences	5	Apt 600-1200 SF	225		225	1125	1,125
9.-10-15	0.62	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-16	0.47	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-17	0.49	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-18	0.38	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-19	0.41	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-20	0.38	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-22.1	0.19	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
9.-10-22.2	0.15	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
12.-1-1.1	9.57	852	Transfer Station Office	Landfills and Dumps	150	SF	0.06		0.06	25	25
12.-1-1.2	0.75	220	Two Family Residence	Two Family Year-Round Residence	2	dwelling	300		300	600	600
12.-1-2	2.18	480	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
12.-1-2	2.18	480	Apartments	Multiple Use of Multi Purposes	4	Apt < 600 SF	150		150	600	600
12.-1-2	2.18	480	Storage/Contractor Shops	Multiple Use of Multi Purposes	20250	SF	0.04		0.04	810	810
12.-1-3	0.85	449	Offices	Other Storage, Warehouse & Distribution Facilities	1350	SF	0.06		0.06	81	81
12.-1-3	0.85	449	Contracting Shop, Warehouse	Other Storage, Warehouse & Distribution Facilities	8239	SF	0.04		0.04	330	330
12.-1-4.3	0.8	661	Coast Guard Barracks	Army, Navy, Air Force, Marine, Coast Guard, etc.	1	dwelling	300		300	300	300
12.-1-4.4	4.68	440	Ferry District Office	Storage, Warehouse & Distribution Facilities	1150	SF	0.06		0.06	69	69
12.-1-4.4	4.68	440	Ferry District Warehouse	Storage, Warehouse & Distribution Facilities	9259	SF	0.04		0.04	370	370
12.-1-5.1	1.25	480	Community Center (Recreation)	Multiple Use of Multi Purposes	56	parking space	15		15	840	840
12.-1-5.1	1.25	480	Community Center (Cafe)	Multiple Use of Multi Purposes	30	Seats	5	2.5	7.5	150	225
12.-1-5.1	1.25	480	Community Center (Storage)	Multiple Use of Multi Purposes	797	SF	0.04		0.04	32	32
12.-1-5.1	1.25	480	Community Center (Meeting Hall)	Multiple Use of Multi Purposes	83	occupant	5		5	415	415
12.-1-5.1	1.25	480	Community Center (Misc)	Multiple Use of Multi Purposes	4374	SF	0.06		0.06	262	262
12.-1-7.1	0.46	311	Single Family Residence (Proposed)	Residential Vacant Land	1	dwelling	300		300	300	300
12.-1-9	0.28	220	Two Family Residence	Two Family Year-Round Residence	2	dwelling	300		300	600	600
12.-1-10	5.1	448	Ferry District Office	Piers, Wharves, Docks & Related Facilities	524	SF	0.06		0.06	31	31
12.-1-10	5.1	448	Ferry District Office (Warehouse)	Piers, Wharves, Docks & Related Facilities	1007	SF	0.04		0.04	40	40
12.-1-11	0.33	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
12.-1-12	0.35	620	Ecclesiastical Society	Religious	30	seats & occupants	75		75	2250	2,250
12.-1-13.1	0.19	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
12.-1-13.3	0.21	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
12.-1-13.5	0.2	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
12.-1-13.7	0.36	210	Single Family Residence	One Family Year-Round Residence	1	dwelling	300		300	300	300
12.-1-17.1	6.4	612	School, Main Building	Schools	150	occupant	5	2.5	7.5	750	1,125
12.-1-18	178.16	844	Cinema	Air Transportation	500	seat	3		3	1500	1,500
12.-1-18	178.16	844	Police Barracks	Air Transportation	1	dwelling	300		300	300	300
12.-1-19	0.4	449	Single Family Residence (Converted)	Other Storage, Warehouse & Distribution Facilities	1	dwelling	300		300	300	300
						Current Total Flow (GPD)				25,131	25,881
						Future Total Flow (GPD)				27,231	27,981

Note: Future Total Flow assumes vacant parcels will be improved with one single-family dwelling and that none of the other parcels will change from their current use.

Project executed for:
Peconic Green Growth, Inc
651 West Main Street
Riverhead, NY 11901
T: (631) 591-2402
Funded by a grant from:
The Long Island Sound Study/
National Fish and Wildlife
Foundation


Fishers Island Sewer District
District Boundary
Tax Parcels
N
Map Prepared by Town of Southold GIS
February 5, 2013
Aerial Photographs Taken From
Spring 2010 Flight
Suffolk County Real Property Tax Service Agency
Tax Map and AREIS COPYRIGHT 2013, County of Suffolk, N.Y.

APPENDIX B

Alternative 1

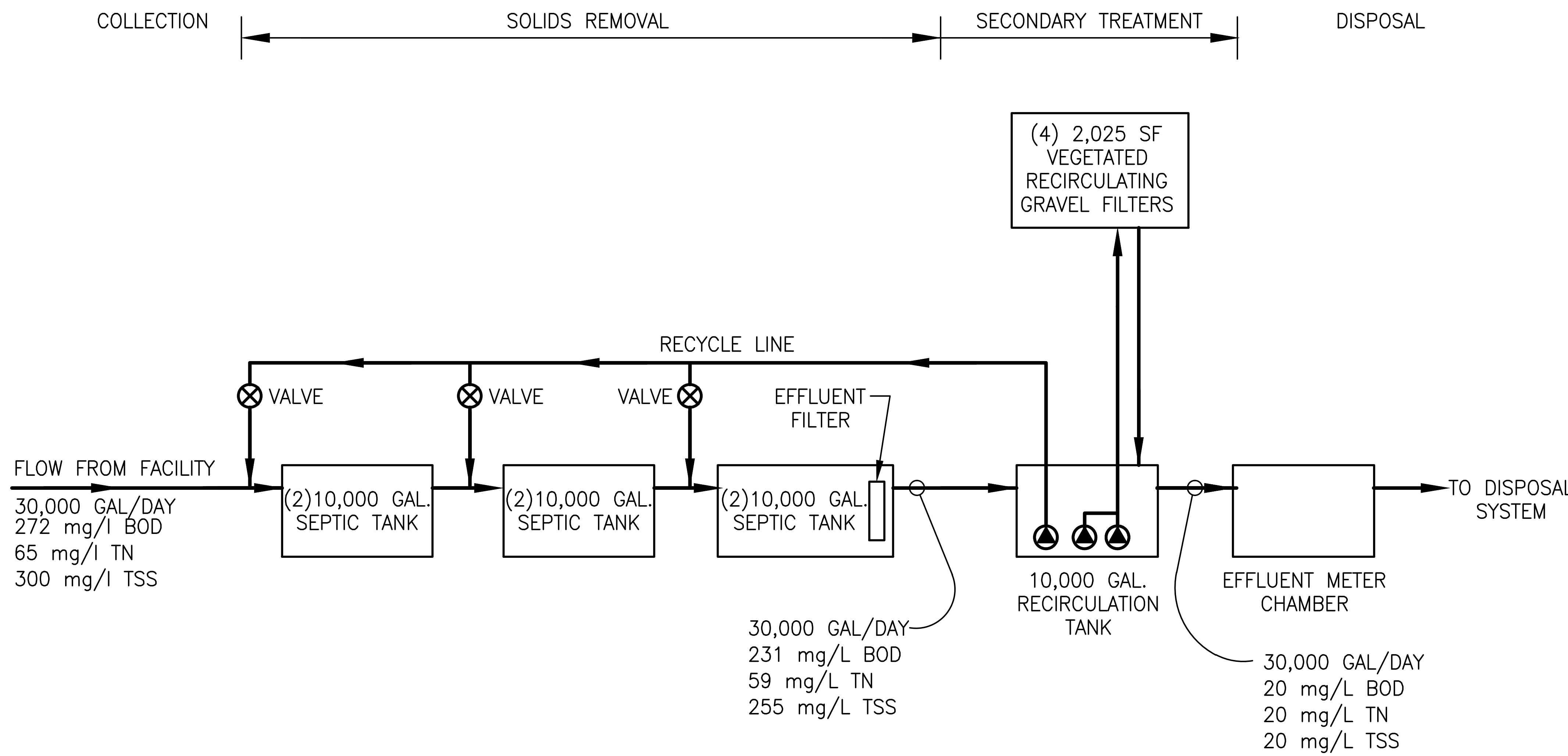
PROCESS FLOW DIAGRAM - ALTERNATIVE 1
PROCESS CALCULATIONS - ALTERNATIVE 1

- **PROCESS KINETICS (4 CELLS)**

MAPPING ALTERNATIVE 1

- **SITE PLAN WITH PROPOSED SYSTEM LAYOUT**
- **AERIAL PHOTOGRAPH WITH PROPOSED SYSTEM LAYOUT**

NWTS CONSTRUCTION DETAILS - ALTERNATIVE 1
PRELIMINARY CONSTRUCTION DETAILS (D1 & D2)



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www.naturalsystemsutilities.com

NATURAL WASTEWATER TREATMENT SYSTEM
PROCESS FLOW DIAGRAM
ALTERNATIVE 1

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. EO1489AA
DATE: 06/10/2013 SHEET 1 OF 1

NATURAL SYSTEMS UTILITIES

Peconic Green Growth
Fisher's Island, Suffolk County, NY

Project E01489AA Peconic Green Growth

Doc Title Treatment kinetics and process sizing calculations (Natural WW Treatment System - TN 20 Flowsheet): 30,000 gpd with recirculation

Completed By	Jens Riedel, P.E.	**Date**	10/29/2013
Checked By	David Smith, P.E.	**Date**	

Section 1 Influent Characteristics and Effluent Targets

Influent Flowrate 30,000 gpd

	Influent concentration	Influent Load
TN	65 mg/L	16.22 lbs/day
BOD	272 mg/L	67.86 lbs/day
TSS	300 mg/L	74.84 lbs/day

	Effluent target	Effluent Load	Required removal	% Removal
TN	20 mg/L	4.99 lbs/day	11.23 lbs/day	69%
BOD	20 mg/L	4.99 lbs/day	62.87 lbs/day	93%
TSS	20 mg/L	4.99 lbs/day	69.85 lbs/day	93%

Section 2 Septic tank treatment performance

	Influent Load	Assumed Septic Tank Removal	Effluent load
TN	16.22 lbs/day	10%	14.59 lbs/day
BOD	67.86 lbs/day	30%	47.50 lbs/day
TSS	74.84 lbs/day	30%	52.39 lbs/day

Section 3 **Vertical Flow Treatment Wetland Sizing**

Percentage of TN assumed to be NH4-N and NOx 100%

	Influent Load	Effluent Requirement	Removal
NH4-N	14.59 lbs/day	4.99 lbs/day	9.60 lbs/day
BOD	47.50 lbs/day	4.99 lbs/day	42.51 lbs/day
TSS	52.39 lbs/day	4.99 lbs/day	47.40 lbs/day

Theoretical oxygen requirement:		Total oxygen requirements:	
1.5 lb/O2	per lb of BOD converted	105.07 lbs/day	47,758 g/day
4.3 lb/o2	per lb of NH4-N converted		

Oxygen transfer per meter of single pass filter with 3-8 mm media	22 g O2/m2.m.day	
Number of passes	4	
Design depth	4 ft	**1.21** m
Area Required	**4,818** ft 2	**448** m2
Number of cells	4	
Cell width	45 ft	
Cell length	45 ft	
Total area	**8,100** ft 2	**753** m2

The treatment area is adequate **TRUE**

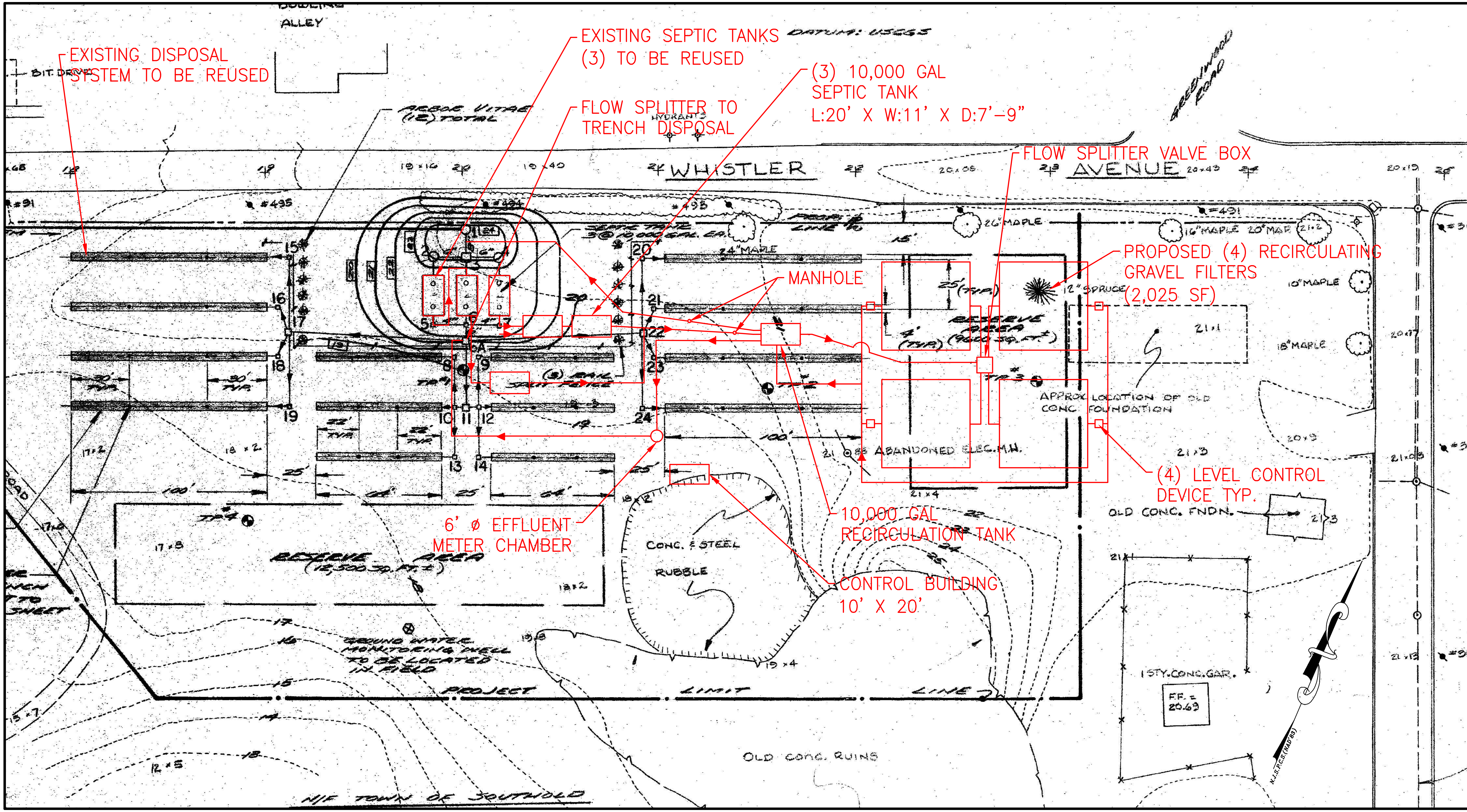
Clogging Check:

Max BOD loading criterion for gravel filter	0.05 lb/ft2/day
Actual loading for this system	47.50 lb
Specific loading for this system	0.00586 lb/ft2/day

The loading area is adequate **TRUE**

Max hydraulic loading criteria	
Single pass filter	1.0 gal/ft2/day
Recirculating filter	5 gal/ft2/day
Actual loading for this system	3.70 gal/ft2/day

The hydraulic load is adequate **TRUE**



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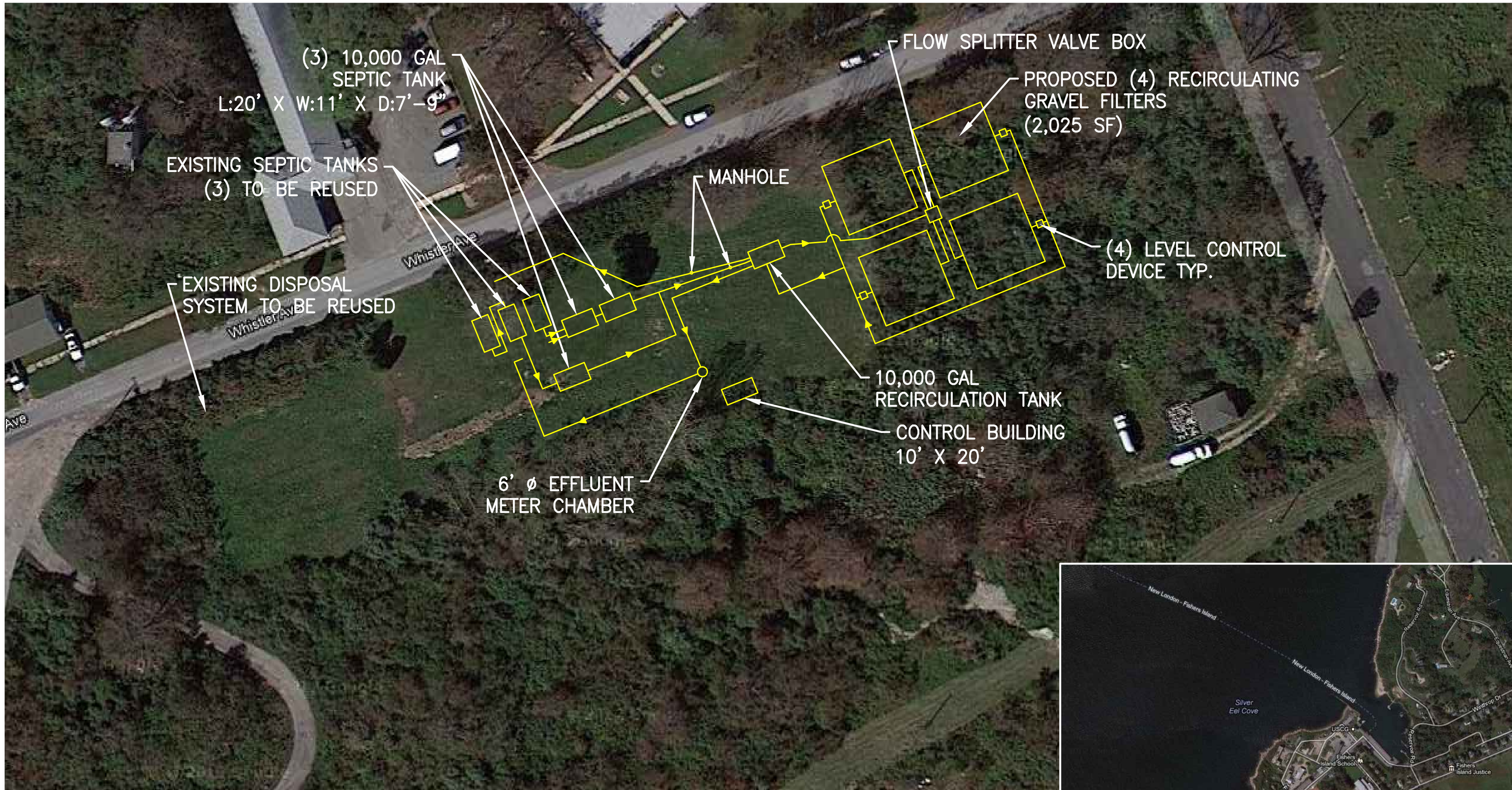
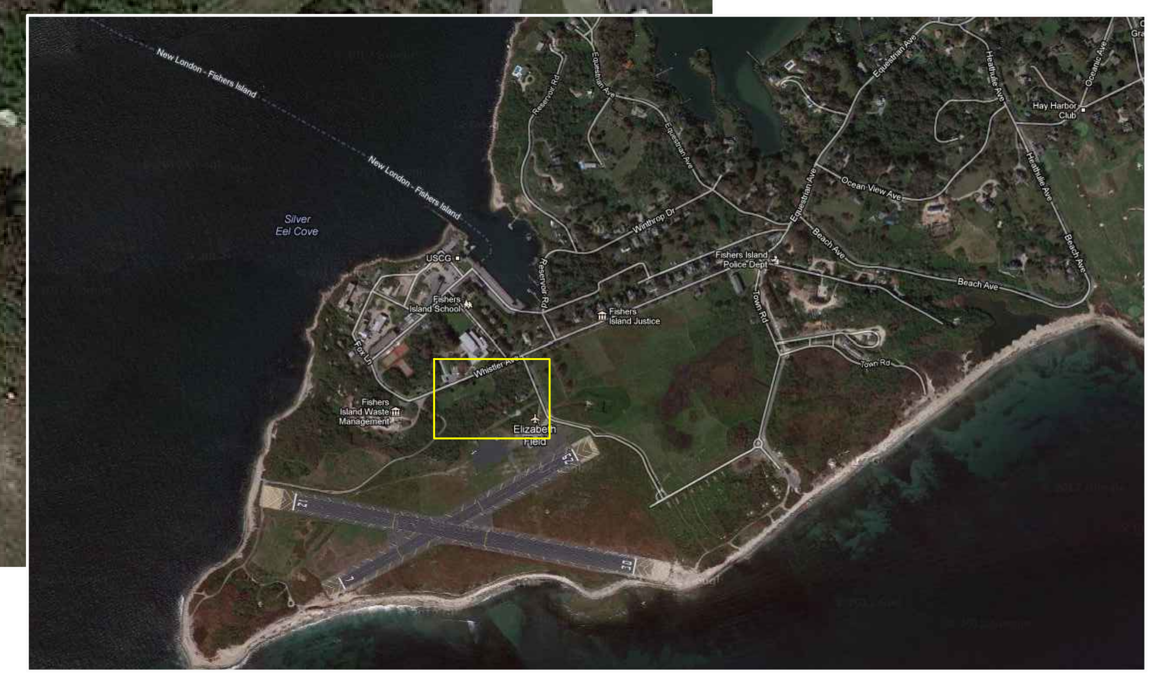
NATURAL WASTEWATER TREATMENT SYSTEM
SITE PLAN
ALTERNATIVE 1

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. E001489AA
DATE: 04/15/2013 SHEET 1 OF 2
SCALE: 1" = 50'





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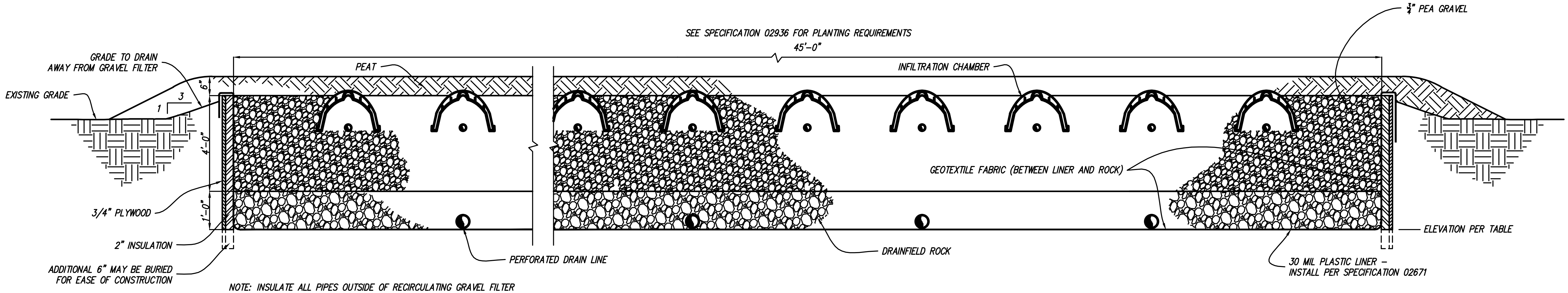
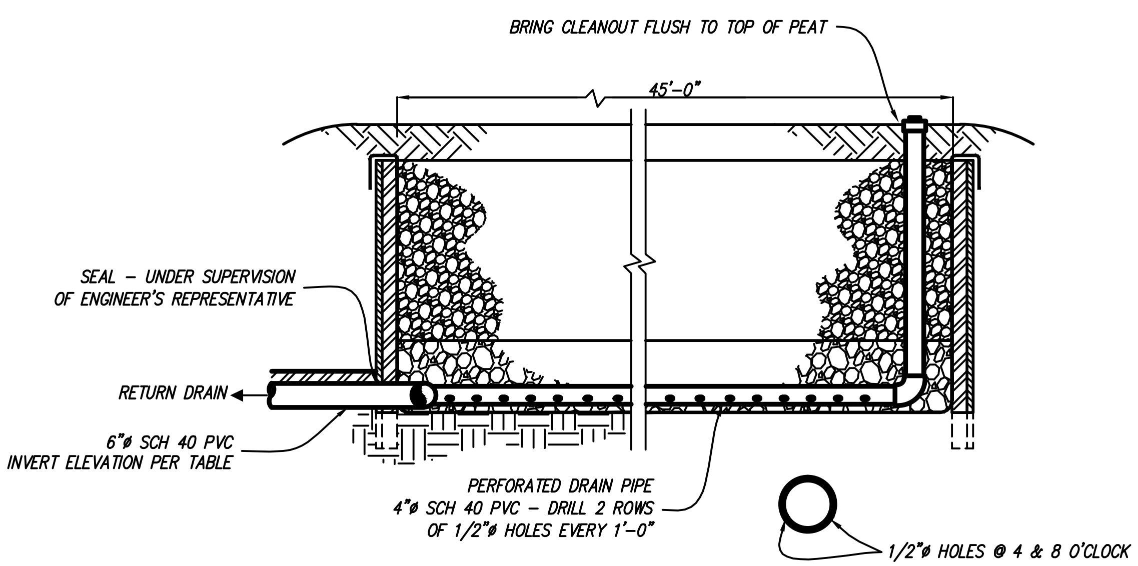
NATURAL WASTEWATER
TREATMENT SYSTEM
AERIAL PHOTO & LAYOUT
ALTERNATIVE I

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT NO. E01489AA
DATE: 04/15/2013 SHEET 2 OF 2
SCALE: 1" = 80'

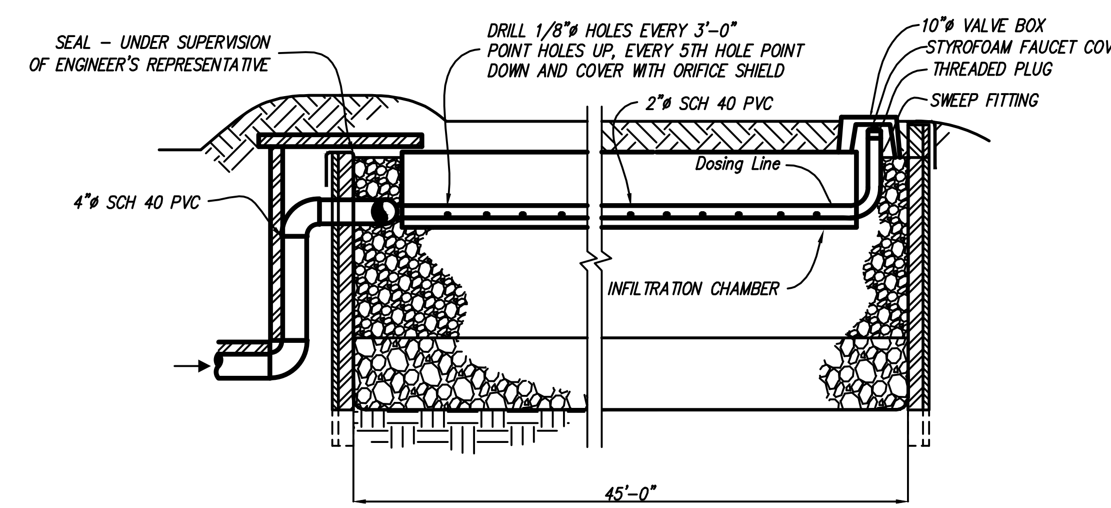


RECIRCULATING GRAVEL FILTER CROSS SECTION

SCALE: NTS



DRAINLINE SECTION



DOSING LINE SECTION

RECIRCULATING GRAVEL FILTER

SCALE: NTS

Project executed for:
Peconic Green Growth, Inc
651 West Main Street
Riverhead, NY 11901
T: (631) 591-2402

Funded by a grant from:
The Long Island Sound Study/National Fish and Wildlife Foundation

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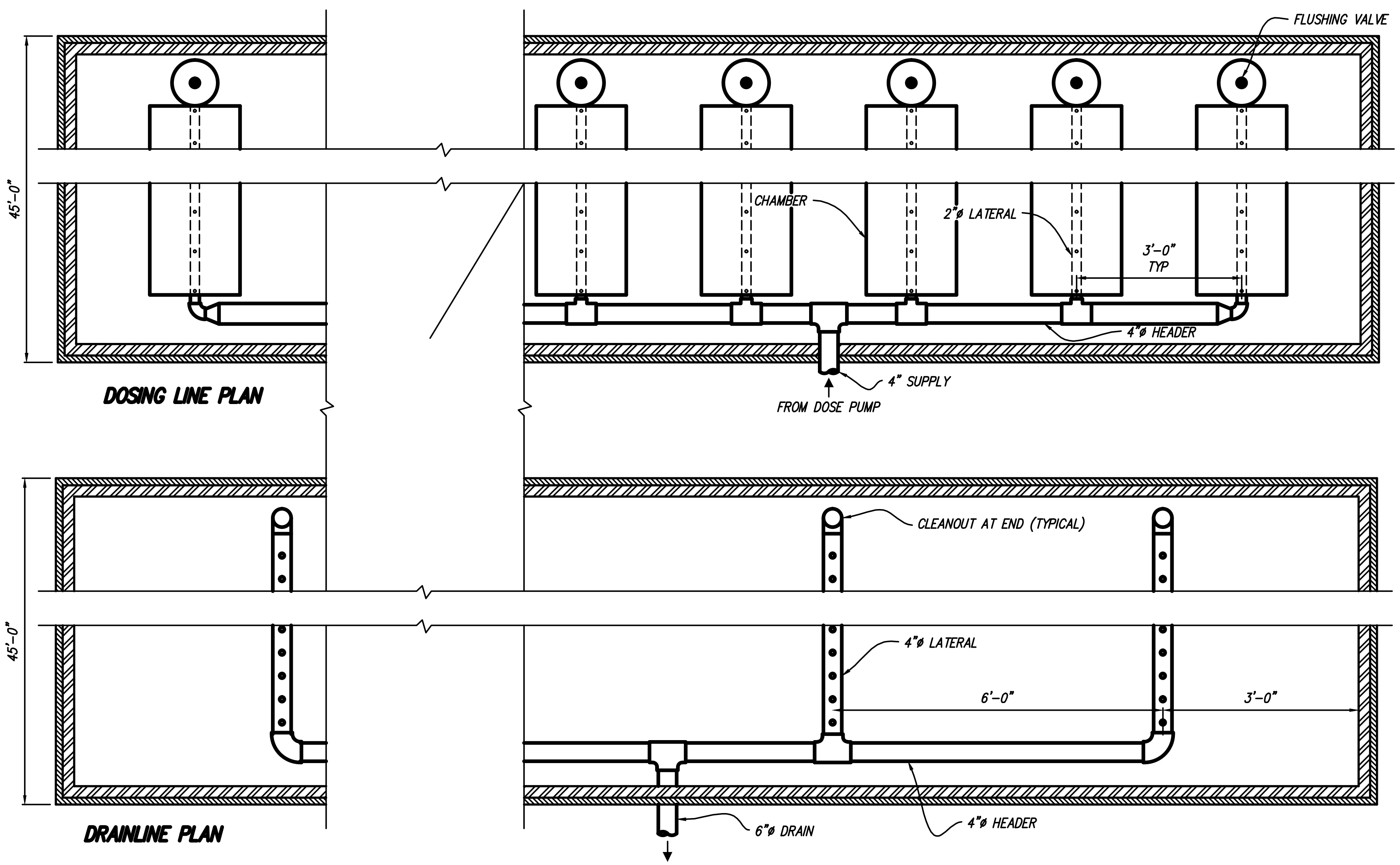
NATURAL WASTEWATER
TREATMENT SYSTEM
DETAIL

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. EO01489AA
DATE: 06/17/2013 SHEET D1 OF 5



RECIRCULATING GRAVEL FILTER PIPING PLANS

SCALE: 3/8" = 1'-0"

Project executed for:
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NATURAL WASTEWATER
TREATMENT SYSTEM
PIPING DETAIL

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. E001489AA
DATE: 06/17/2013 SHEET D2 OF 5

APPENDIX C

Alternative 2

PROCESS FLOW DIAGRAM - ALTERNATIVE 2
PROCESS CALCULATIONS - ALTERNATIVE 2

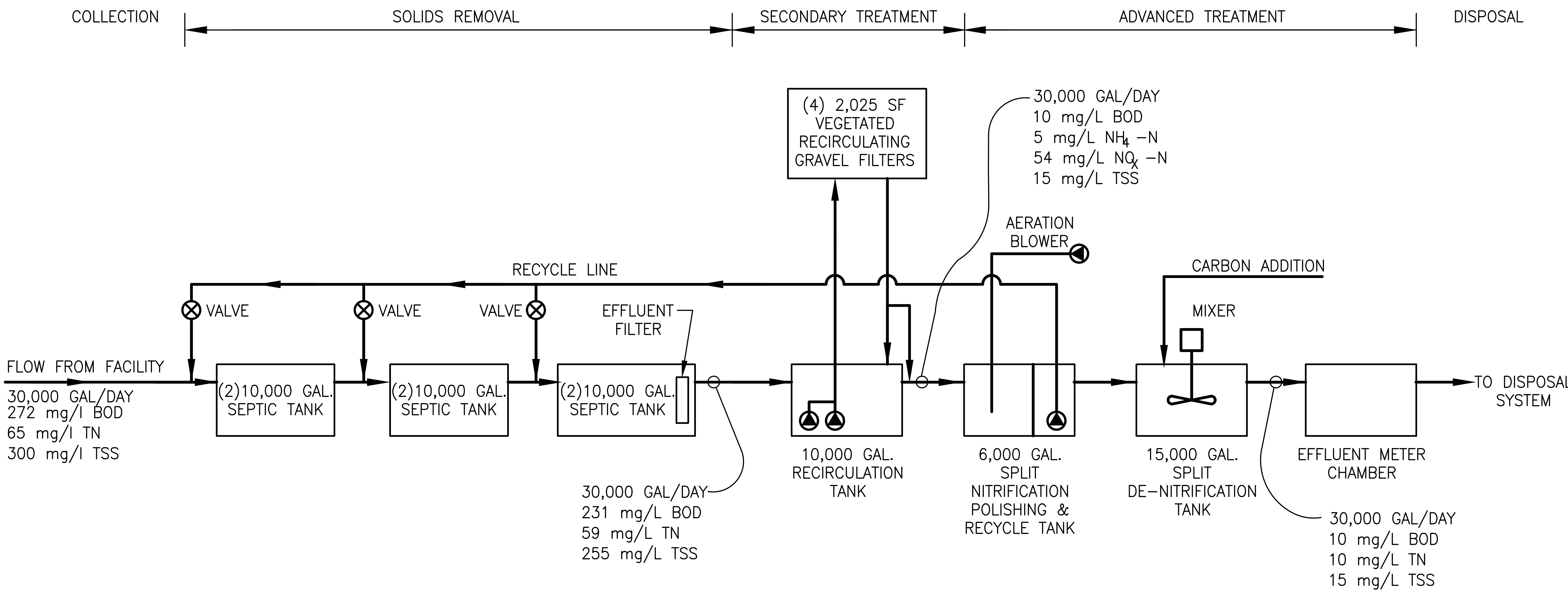
- **PROCESS KINETICS (4 CELLS)**

MAPPING - ALTERNATIVE 2

- **SITE PLAN WITH PROPOSED SYSTEM LAYOUT**
- **AERIAL PHOTOGRAPH WITH PROPOSED SYSTEM LAYOUT**

PRELIMINARY CONSTRUCTION DETAILS (D3, D4, & D5)

- **SEE APPENDIX B FOR D1 & D2**



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NATURAL WASTEWATER TREATMENT SYSTEM
PROCESS FLOW DIAGRAM
ALTERNATIVE 2

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. EO1489AA
DATE: 04/15/2013 SHEET 1 OF 1

NATURAL SYSTEMS UTILITIES

Peconic Green Growth
Fishers Island, Suffolk County, NY

Project E01489AA Peconic Green Growth

Doc Title Treatment kinetics and process sizing calculations (Natural WW Treatment System - standard TN 10 Flowsheet): 30,000 gpd with recirculation

Completed By Jens Riedel, P.E. **Date** 10/29/2013
Checked By David Smith, P.E. **Date**

Section 1 Influent Characteristics and Effluent Targets

Influent Flowrate 30,000 gpd

	Influent concentration	Influent Load
TN	65 mg/L	16.22 lbs/day
BOD	272 mg/L	67.86 lbs/day
TSS	300 mg/L	74.84 lbs/day

	Effluent target	Effluent Load	Required removal	% Removal
TN	10 mg/L	2.49 lbs/day	13.72 lbs/day	85%
BOD	10 mg/L	2.49 lbs/day	65.36 lbs/day	96%
TSS	10 mg/L	2.49 lbs/day	72.35 lbs/day	97%

Section 2 Septic tank treatment performance

	Influent Load	Assumed Septic Tank Removal	Effluent load
TN	16.22 lbs/day	10%	14.59 lbs/day
BOD	67.86 lbs/day	30%	47.50 lbs/day
TSS	74.84 lbs/day	30%	52.39 lbs/day

Section 3 **Vertical Flow Treatment Wetland Sizing**

Percentage of TN assumed to be NH4-N and NOx 100%

	Influent Load	Effluent Requirement	Removal
NH4-N	14.59 lbs/day	2.49 lbs/day	12.10 lbs/day
BOD	47.50 lbs/day	2.49 lbs/day	45.01 lbs/day
TSS	52.39 lbs/day	2.49 lbs/day	49.90 lbs/day

Theoretical oxygen requirement: **Total oxygen requirements:**

1.5 lb/O2	per lb of BOD converted	119.54 lbs/day	54,336 g/day
4.3 lb/o2	per lb of NH4-N converted		

Oxygen transfer per meter of single pass filter with 3-8 mm media	22 g O2/m2.m.day	
Number of passes	4	
Design depth	4 ft	**1.21** m
Area Required	**5,481** ft 2	**509** m2
Number of cells	4	
Cell width	45 ft	
Cell length	45 ft	
Total area	**8,100** ft 2	**753** m2

The treatment area is adequate **TRUE**

Clogging Check:

Max BOD loading criterion for gravel filter	0.05 lb/ft2/day
Actual loading for this system	47.50 lb
Specific loading for this system	0.00586 lb/ft2/day

The loading area is adequate **TRUE**

Max hydraulic loading criteria	
Single pass filter	1.0 gal/ft2/day
Recirculating filter	5 gal/ft2/day
Actual loading for this system	3.70 gal/ft2/day

The hydraulic load is adequate **TRUE**

Peconic Green Growth
Fishers Island, Suffolk County, NY

Section 4 **Nitrification Redundancy System - MBBR Sizing**

Nitrification Redundancy Required in Addition to VFTW 50%

	Influent Load	Effluent Requirement	Removal
NH4-N	7.30 lbs/day	2.49 lbs/day	4.80 lbs/day
			2.16 kg/d

Design loading	0.87	g NH4/ m^2·d
Wastewater minimum temperature	8.00	o C
Temperature correction coefficient Θ	1.07	
Temperature correction factor, Θ(T-10)	0.87	
Corrected design loading	0.76	g NH4/ m2·d
Design surface area	2,844	m^2
Design surface area	30,601	ft^2
Design Safety Factor	1.25	

MBBR Carrier Media Selection Bioflow 9

		Media Name	Hydroxyl Pac	Bee Cell 2000	Bioflow 9	BioFAS B-585	**Choice**	
		Manufacturer	Hydroxyl	WMT	Rauschert	BioProcess H20	Bioflow 9	
		Year of data	2009	2006	Apr-13	Apr-13		
4		Specific Cost ($/ft3)	$ 50.00	$ 42.00	$ 28.50	$ 23.00	**29**	$/ft3
		Specific Surface Area (m2)	450	650	855	515	**855**	m2
		Specific Surface Area (ft2)	137	198	261	157	**261**	ft2
		Required Media Volume (ft3)	279	193	147	244	**147**	ft3
		Required Media Volume (gallons)	2,086	1,444	1,098	1,823	**1,098**	gallons
		Recommended Min Fill	20%	20%	20%	20%	**20%**	
		Recommended Max Fill	45%	30%	25%	30%	**25%**	
		Maximum Tank Volume (gallons)	10,429	7,220	5,489	9,113	**5,489**	gallons
		Minimum Tank Volume (gallons)	4,635	4,814	4,391	6,075	**4,391**	gallons
		Total Media Cost ($)	$ 13,944	$ 8,109	$ 4,183	$ 5,605	**4,183**	

Selected Tank Size	5,000	gallons
Effective fill volume	22%	
Tank size is sufficient	**TRUE**	
Tank Hydraulic Retention Time	0.17	days

Section 5 **Denitrification System Sizing**

Percentage of influent ammonia assumed to go to NOx					100%		
Recirculation to septic					TRUE		
Assumed denitrification achieved in septic tank					40%		
HSSF Influent		HSSF Effluent Requirement				Amount removed	
NOx	14.59 lbs/day	NOx	100%			14.59	lbs/day
						6,634	g/day
	59 mg/L					0	mg/L
Carbon Requirement							
BOD	30,845 g/day	BOD/TOC ratio	2.00	TOC		15,422	g/day
						33.93	lbs/day
Total NOx	14.59 lbs/day			Target C:N ratio		3	:1
	6634 g/day						
Assumed conversion of TOC by denit	52%			Carbon required		19,902	g/day
Additional carbon required based on recirculation strategy				11,941 g/day		26.27	lb/day
Additional NOx load to be removed in denitrification system under std ops				3,980 g/day		8.76	lbs/day
Maximum Design Nox load to be removed in denitrification tank				6,634 g/day		14.59	lbs/day
Biofilm Area required for complete denitrification							
Reference temperature					15	degrees C	
Design loading for fixed film denitrification at reference temperature					1.4	g NOx-N/m2.day	
Design for post tertiary winter reference temperature					5	degrees C	
Arhenius Temperature coefficient					1.07		
Corrected design loading					0.71	g NOx-N/m2.day	
Design biofilm surface area:					9,321	m2	

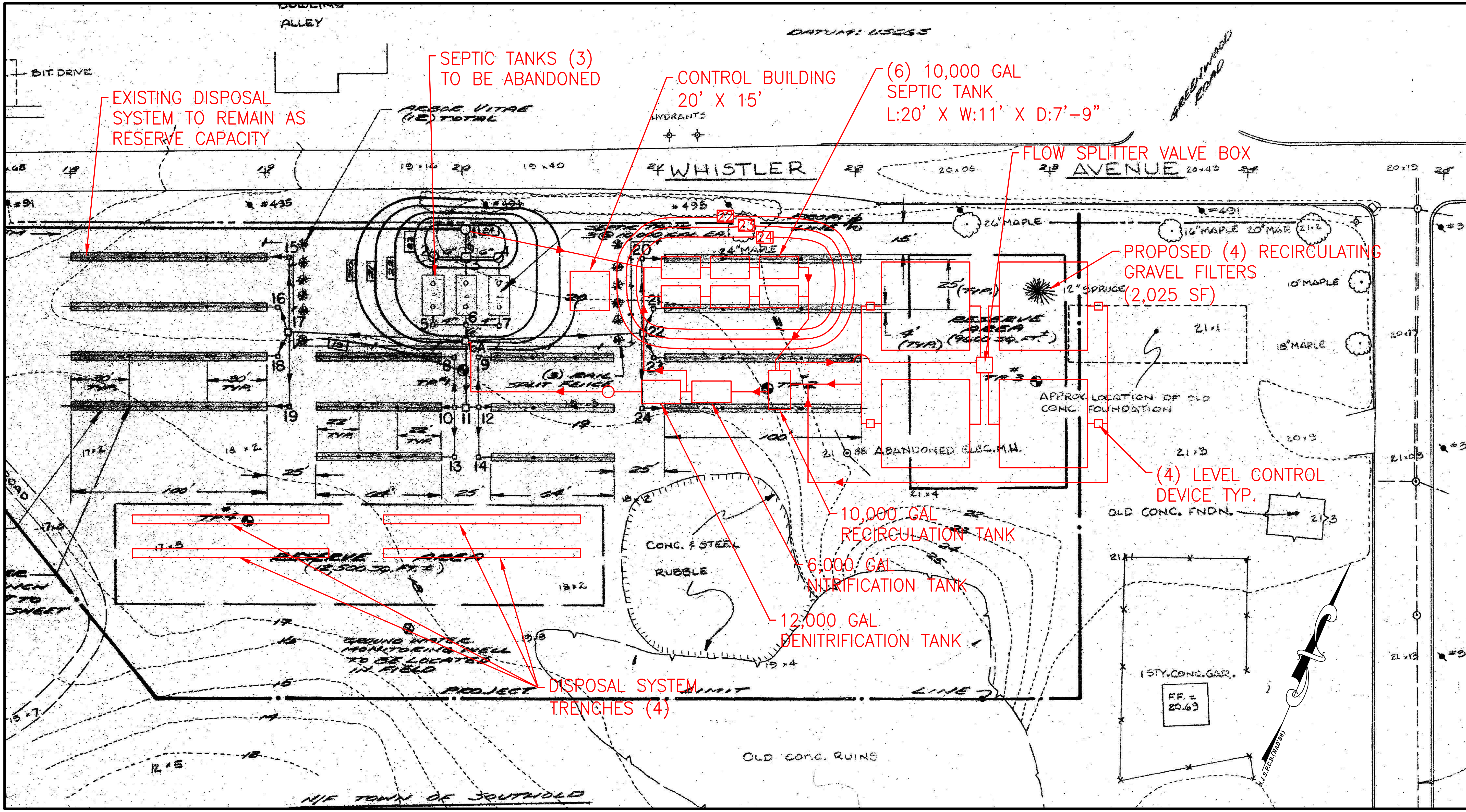
Peconic Green Growth
Fishers Island, Suffolk County, NY

Denitirifcation by MBBR

Proposed carbon source:	MicroC 1000		
Carbon from source:	660,000 mg/L		**5.51** lb/gallon
Daily quantity of carbon source required	**4.8 gallons**		
Design surface area		100,298 ft²	
Design Safety Factor		1.25	
Media selection		Bioflow 9	

Media Name / Manufacturer	Hydroxyl Pac / Hydroxyl	Bee Cell 2000 / WMT	Bioflow 9 / Rauschert	BioFAS B-585 / BioProcess H20	**Choice** / Bioflow 9	
Year of data	2009	2006	Apr-13	Apr-13		
Specific Cost ($/ft3)	$ 50.00	$ 42.00	$ 28.50	$ 23.00	**29**	$/ft3
Specific Surface Area (m2)	450	650	855	515	**855**	m2
Specific Surface Area (ft2)	137	198	261	157	**261**	ft2
Required Media Volume (ft3)	914	633	481	799	**481**	ft3
Required Media Volume (gallons)	6,837	4,733	3,598	5,974	**3,598**	gallons
Recommended Min Fill	20%	20%	20%	20%	**20%**	
Recommended Max Fill	45%	30%	25%	30%	**25%**	
Maximum Tank Volume (gallons)	34,183	23,665	17,991	29,869	**17,991**	gallons
Minimum Tank Volume (gallons)	15,193	15,777	14,393	19,913	**14,393**	gallons
Total Media Cost ($)	$ 45,703	$ 26,578	$ 13,711	$ 18,370	**13,711**	

Selected Tank Size	15,000	gallons
Effective fill volume	24%	
Tank size is sufficient	**TRUE**	



NATURAL SYSTEMS UTILITIES

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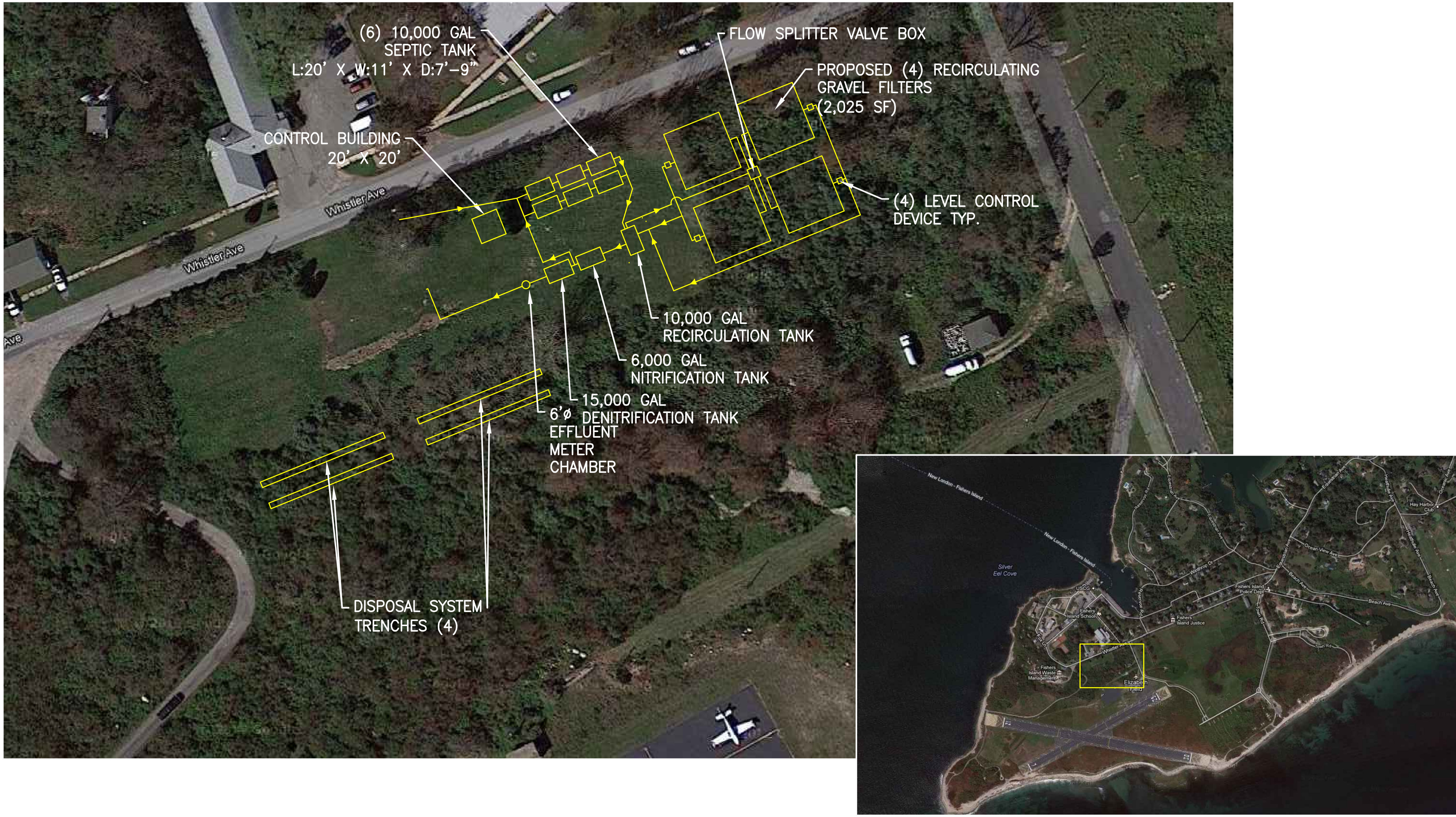
C: 973.534.3464
F: 908.359.5193
www.naturalsystemsutilities.com

NATURAL WASTEWATER
TREATMENT SYSTEM
SITE PLAN
ALTERNATIVE 2

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. E001489AA
DATE: 04/15/2013 SHEET 1 OF 2
SCALE: 1" = 50'



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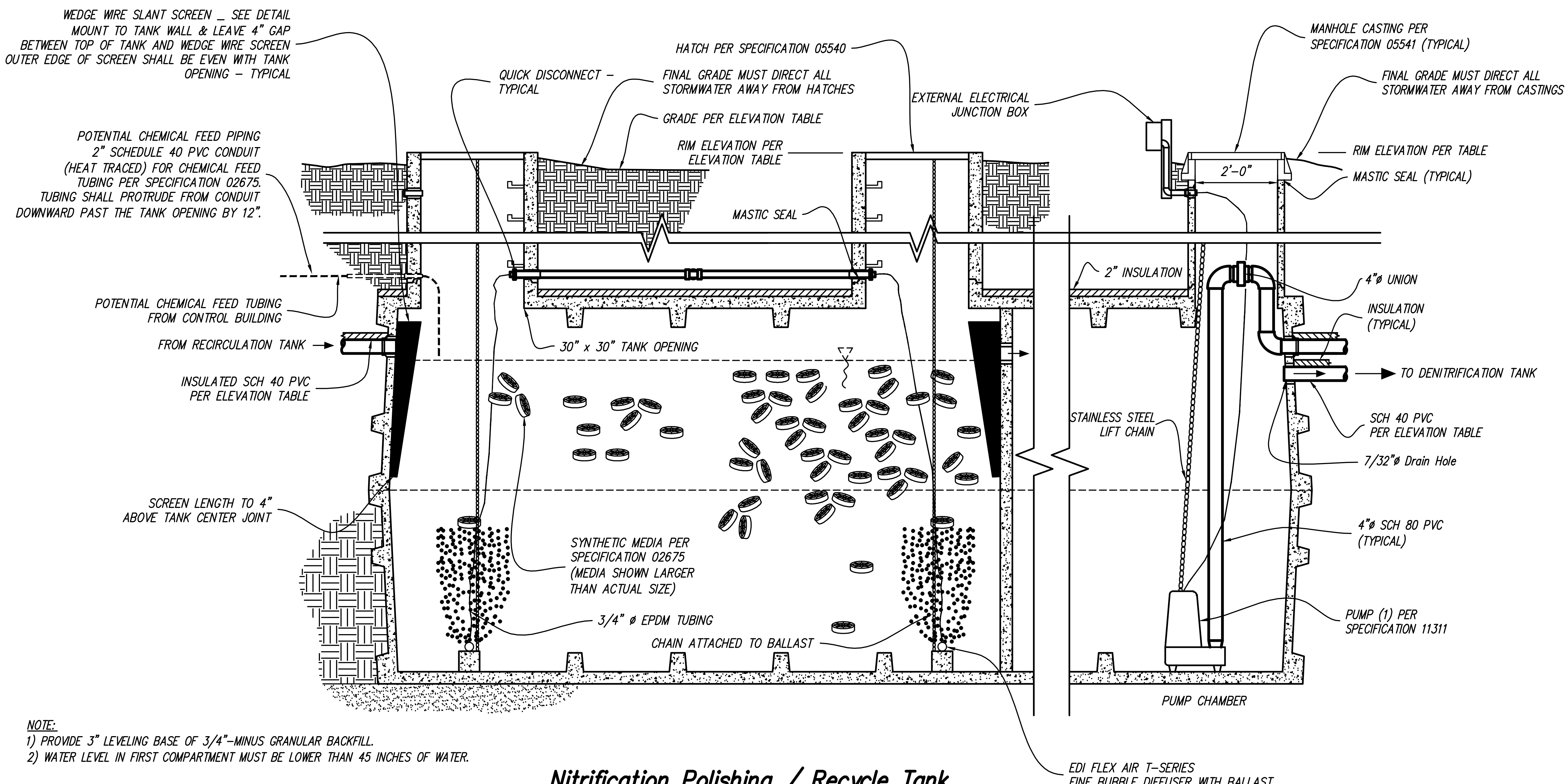
NATURAL WASTEWATER
TREATMENT SYSTEM
AERIAL PHOTO & LAYOUT

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. E001489AA
DATE: 04/15/2013 SHEET 2 OF 2
SCALE: 1" = 80'



NOTE:
1) PROVIDE 3" LEVELING BASE OF 3/4"-MINUS GRANULAR BACKFILL.
2) WATER LEVEL IN FIRST COMPARTMENT MUST BE LOWER THAN 45 INCHES OF WATER.

Nitrification Polishing / Recycle Tank

SCALE: NTS

Project executed for:
Peconic Green Growth, Inc
651 West Main Street
Riverhead, NY 11901
T: (631) 591-2402

Funded by a grant from:
The Long Island Sound Study/National Fish and Wildlife Foundation

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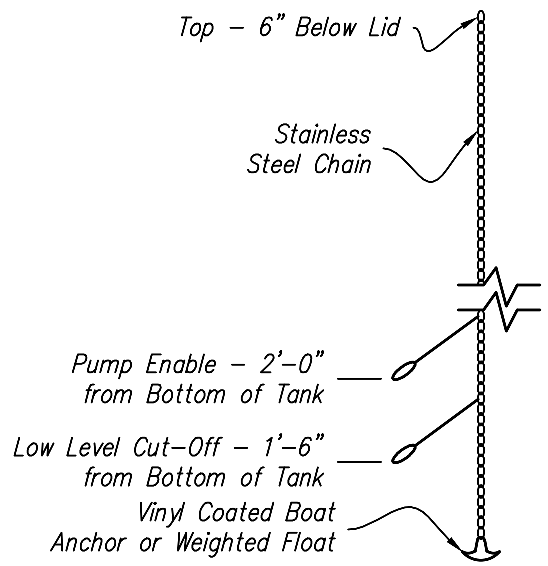
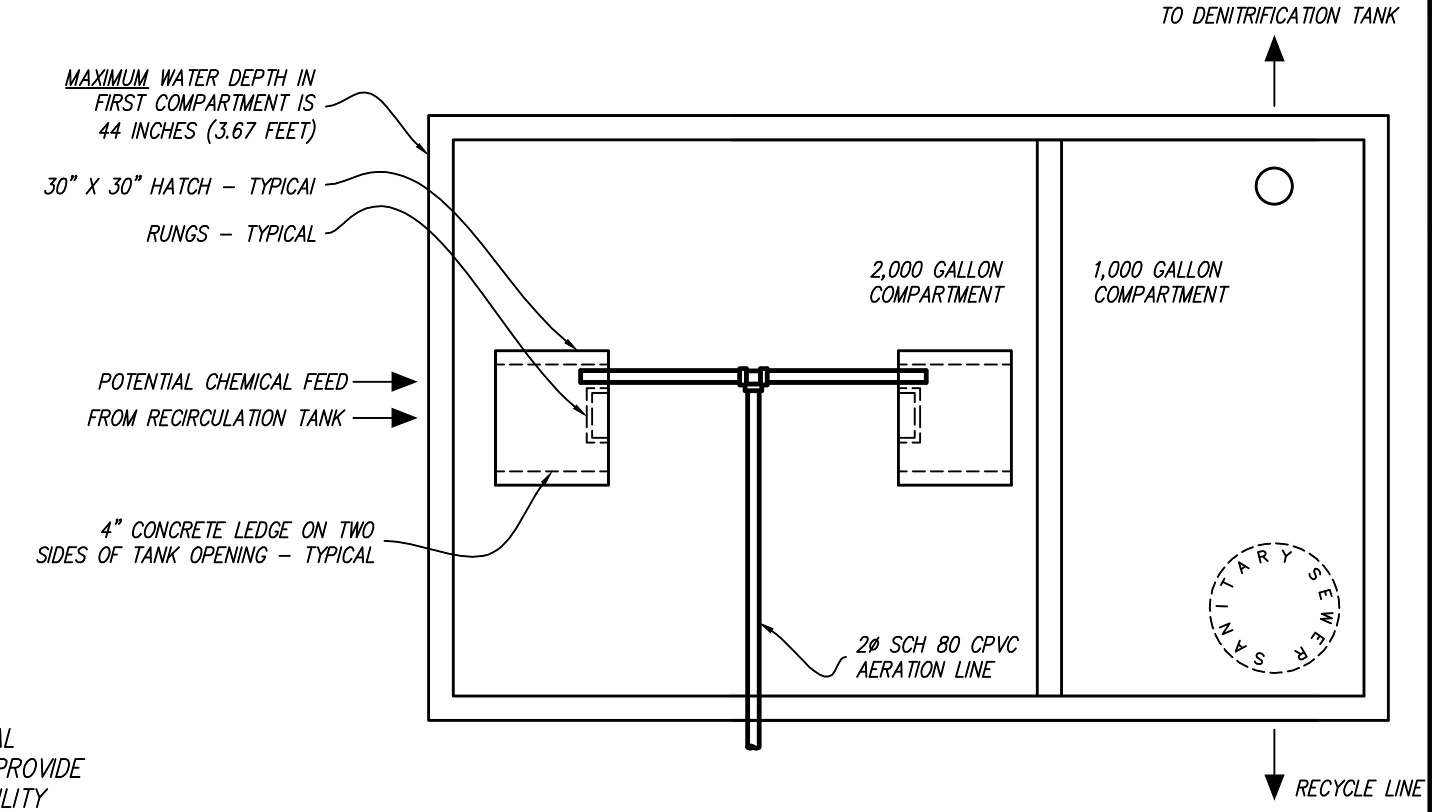
NATURAL WASTEWATER TREATMENT SYSTEM NITRIFICATION DETAIL

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. E001489AA
DATE: 06/17/2013 SHEET D3 OF 5



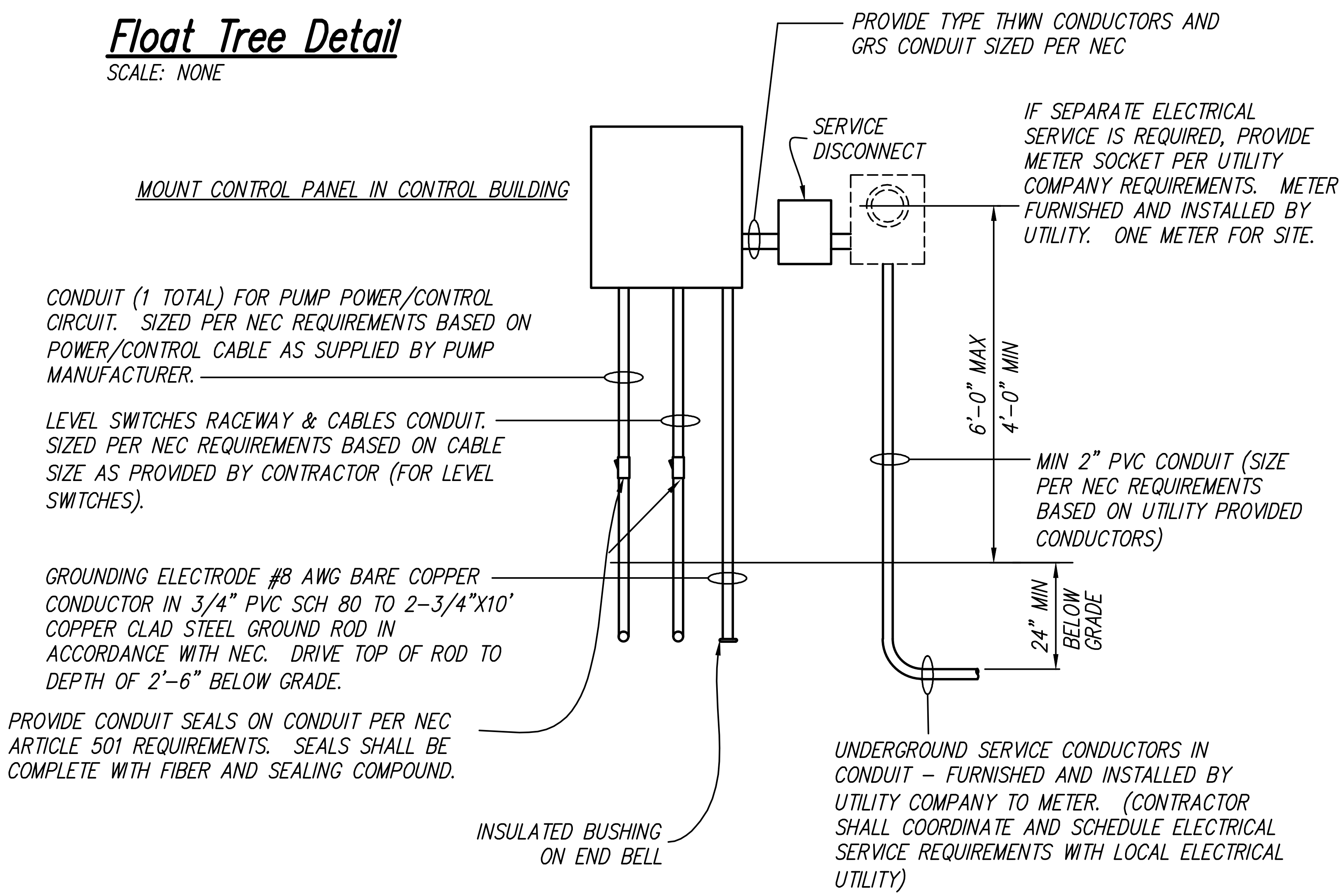
Float Tree Detail

SCALE: NONE



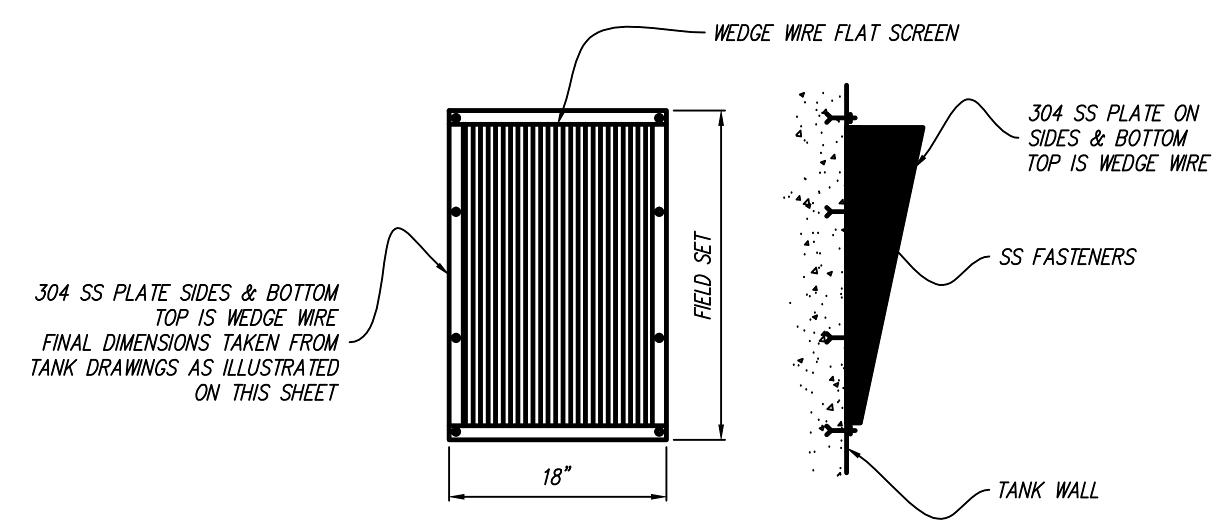
NITRIFICATION POLISHING / RECYCLE TANK PLAN

SCALE: NONE



CONTROL PANEL DETAIL

NTS



WEDGE WIRE SCREEN DETAIL

SCALE: NONE

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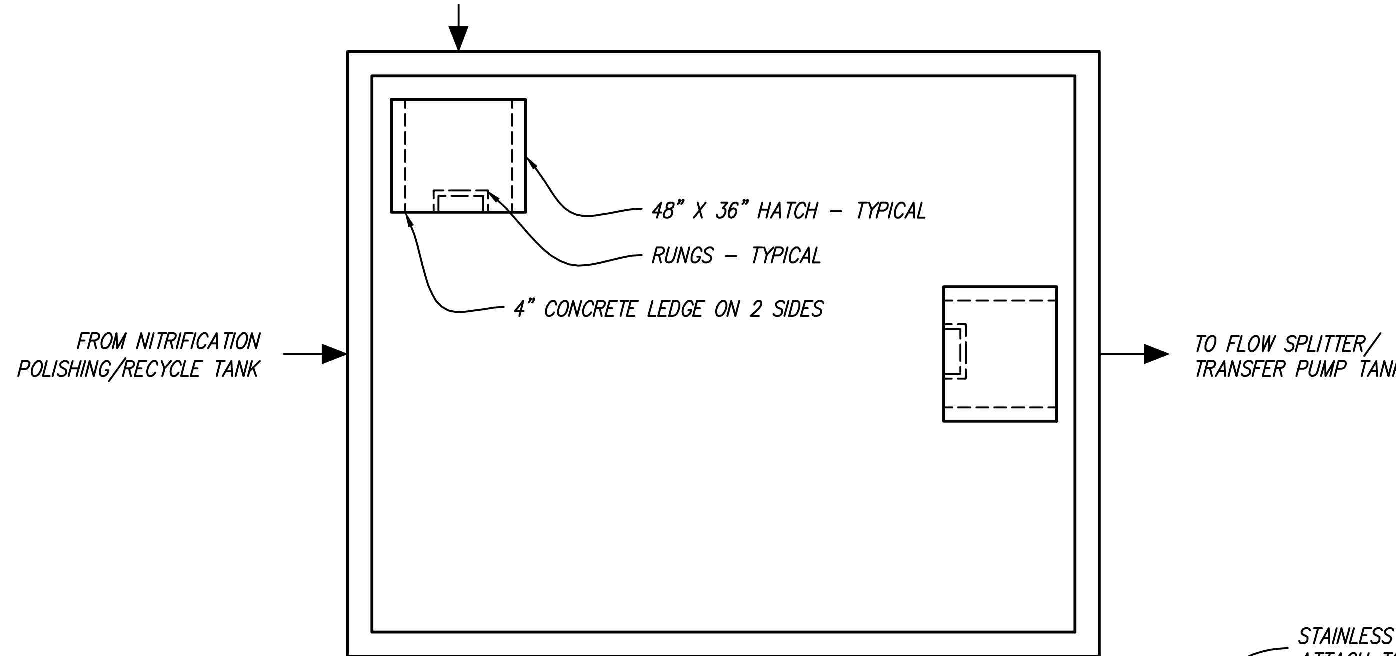
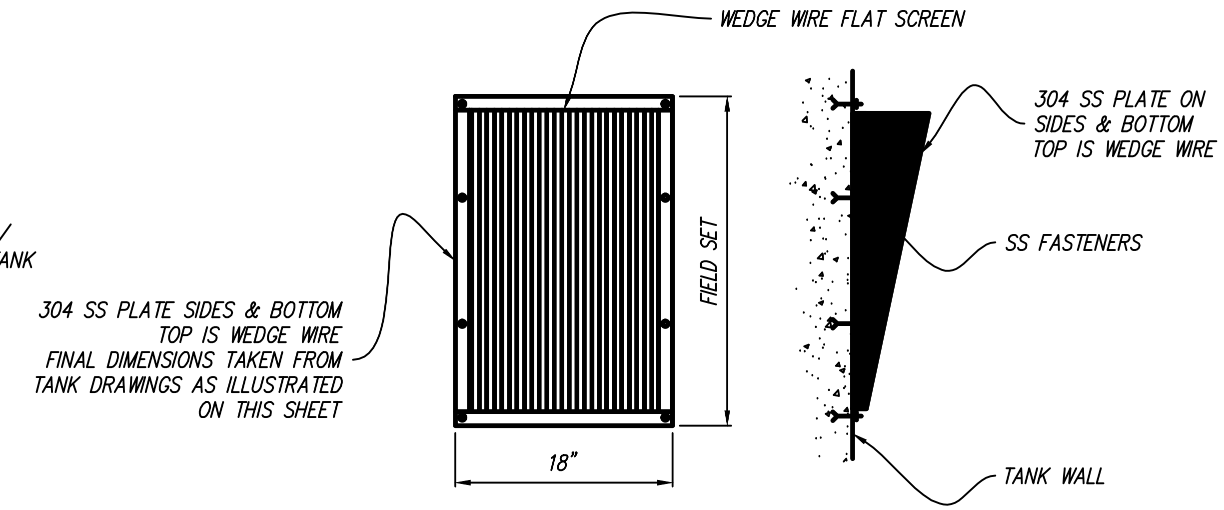
NATURAL WASTEWATER TREATMENT SYSTEM
CONTROL PANEL DETAIL

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. E001489AA
DATE: 06/17/2013 SHEET D4 OF 5



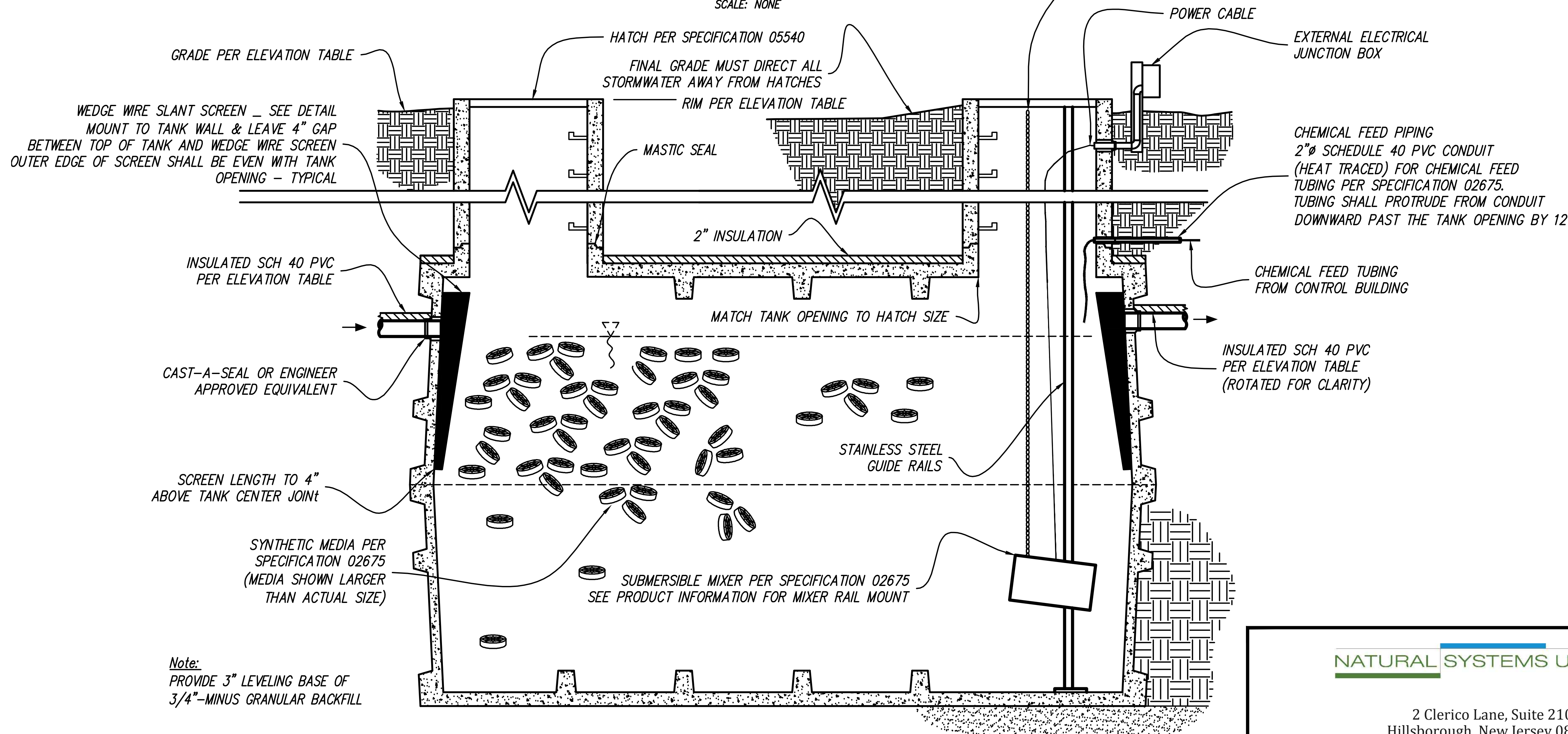
DENITRIFICATION TANK PLAN

SCALE: NONE



WEDGE WIRE SCREEN DETAIL

SCALE: NONE



Note:
PROVIDE 3" LEVELING BASE OF
3/4"-MINUS GRANULAR BACKFILL

DENITRIFICATION TANK

SCALE: NONE

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NATURAL WASTEWATER
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DENITRIFICATION DETAIL

FISHERS ISLAND
SUFFOLK COUNTY, NY
PROJECT No. E001489AA
DATE: 06/17/2013 SHEET D5 OF 5