ONSITE ENGINEERING INC.
Water, Wastewater and Stormwater Specialists

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Residential Development Wastewater System Evaluation
95 Lawrence Road Development

for

Town of Wellfleet
Wellfleet, Massachusetts

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SECTION 1 – OVERVIEW

1.1 INTRODUCTION

The Town of Wellfleet, in conjunction with the 95 Lawrence Road Task Force (Task Force), solicited proposals for the evaluation of sewage treatment and disposal options for a planned affordable housing development at 95 Lawrence Road in Wellfleet, Massachusetts. Via a Request for Proposal (RFP) process, the Bohler Engineering/Onsite Engineering team (Team) was selected to evaluate enhanced treatment and disposal system options in the form of an Innovative and Alternative (I/A) subsurface sewage disposal system (SSDS) permitted under 310 CMR 15.000, Title 5, and the Town of Wellfleet Board of Health Rules and Regulations; and a larger treatment and disposal system option that would also serve the area surrounding the planned development which would be permitted under 314 CMR 5.00, Groundwater Discharge Permit Program.

The Town of Wellfleet, via creation of the Task Force, have undertaken planning efforts to develop 6 acres of a 9.26 acre Town-owned parcel into forty six (46) affordable housing units, resulting in up to 90 new bedrooms. Funding for the project is provided by the Department of Housing and Community Development's District Local Technical Assistance program through the Cape Cod Commission. The project site, located at 95 Lawrence Road, in its current state consists of a combination of undisturbed land, a baseball field and an elevated water storage tower. The site is located to the northeast of the Wellfleet Elementary School and east of the Wellfleet Police and Fire Department Headquarters, with access to Route 6 (Grand Army of Republic Highway) Road to the south from Lawrence Road. Based on previously prepared conceptual layouts for the development of the site, the proposed affordable house complexes, in general, would be located to the northwest of the baseball field's outfield and to the south of the water storage tank's access drive.

As noted in the RFP, the project site is located within the Duck Creek sub-watershed, which ultimately conveys groundwater to Wellfleet Harbor. According to the Massachusetts Estuaries Project (MEP) March 2017 report, a significant reduction in nitrogen loading is required to achieve MEP threshold nitrogen concentrations for compliance with the Clean Water Act (CWA) in this watershed. In response to this study's findings, the Town of Wellfleet and the Task Force acknowledge the importance of maintaining the environmental health of Wellfleet Harbor and its significance to the Town's residents and therefore commissioned this study to understand the costs and benefits of including enhanced nitrogen removal in addition to the septic system that would be required if this site were to be developed.

Given the Town's intent to evaluate nitrogen reduction capabilities for sewage treatment and disposal for the planned development, the purpose of this report is to assess and present treatment and disposal options, first and foremost, for the planned affordable housing development. Additionally, this study reviews the feasibility and cost of providing a larger decentralized sewage treatment and disposal options for serving other Town-owned facilities adjacent to the planned development, as well as the feasibility of and costs associated with connecting nearby residential parcels to a larger decentralized system.

SECTION 2 – SITE REVIEW

2.1 OVERVIEW

As an initial task of this evaluation, the Team focused their efforts on gathering available information related to the site and surrounding area, as well as site constraints and/or environmentally regulated areas that could affect the siting of sewage treatment and disposal infrastructure. Included as part of this information reconnaissance were a file review of available information from the Town of Wellfleet Board of Health, available data layers from the MassGIS and Town of Wellfleet websites, and information available from MassDEP. The following sections describe the information obtained from these sources, as well as includes figures showing the MassGIS mapping associated with environmental receptors and/or regulated areas in the vicinity of 95 Lawrence Road.

2.2 SITE DESCRIPTION

The project site, located at 95 Lawrence Road, is listed as parcel 13-2-1 on the Town of Wellfleet Assessor data base and has a total land area of 9.26 acres. The parcel in its current state consists of a combination of undisturbed land, a baseball field and an elevated water storage tower. The site is located to the northeast of the Wellfleet Elementary School and east of the Wellfleet Police and Fire Department Headquarters, with access to Route 6 (Grand Army of Republic Highway) to the south. Please refer to Figure 1 for the Assessor Lot layout with corresponding street number for the parcel and area surrounding 95 Lawrence Road.

2.3 SOILS REVIEW

According to MassGIS data, the north, northwest, and northeast portions of 95 Lawrence Road are mapped as a Carver coarse sand material, with the previously disturbed portions of the site being mapped as Udipsamments. According to National Resource Conservation Service (NRCS) survey, a Carver series soil consists of very deep, excessively drained sandy soils formed in glaciofluvial deposits of coarse and very coarse sand. Please refer to Figure 2 for the MassGIS mapping information showing the soil mapping for the area surrounding 95 Lawrence Road.

In order to correlate the above-mentioned soil mapping conditions with actual field conditions, the Team requested and obtained record design drawings and soil information from the Wellfleet Board of Health associated with the subsurface sewage disposal systems located on and adjacent to the project site. In total, we obtained and reviewed thirty seven (37) drawings/soil information associated with the adjacent subsurface sewage disposal system. Of the information reviewed, in each case the soil observation logs indicated a medium sand parent material, percolation rates of less than 2 minutes per inch, and groundwater not encountered in any deep observation hole with the excavation depths ranging from 10 feet to 24 feet.

Based on information ascertained by the Massachusetts Estuaries Project report dated March 2017, groundwater flow direction from the site is cited to be to the south towards Duck Creek, which ultimately discharges to Wellfleet Harbor.

Base Map / Assessors Map

95 Lawrence Road Study

Figure 1

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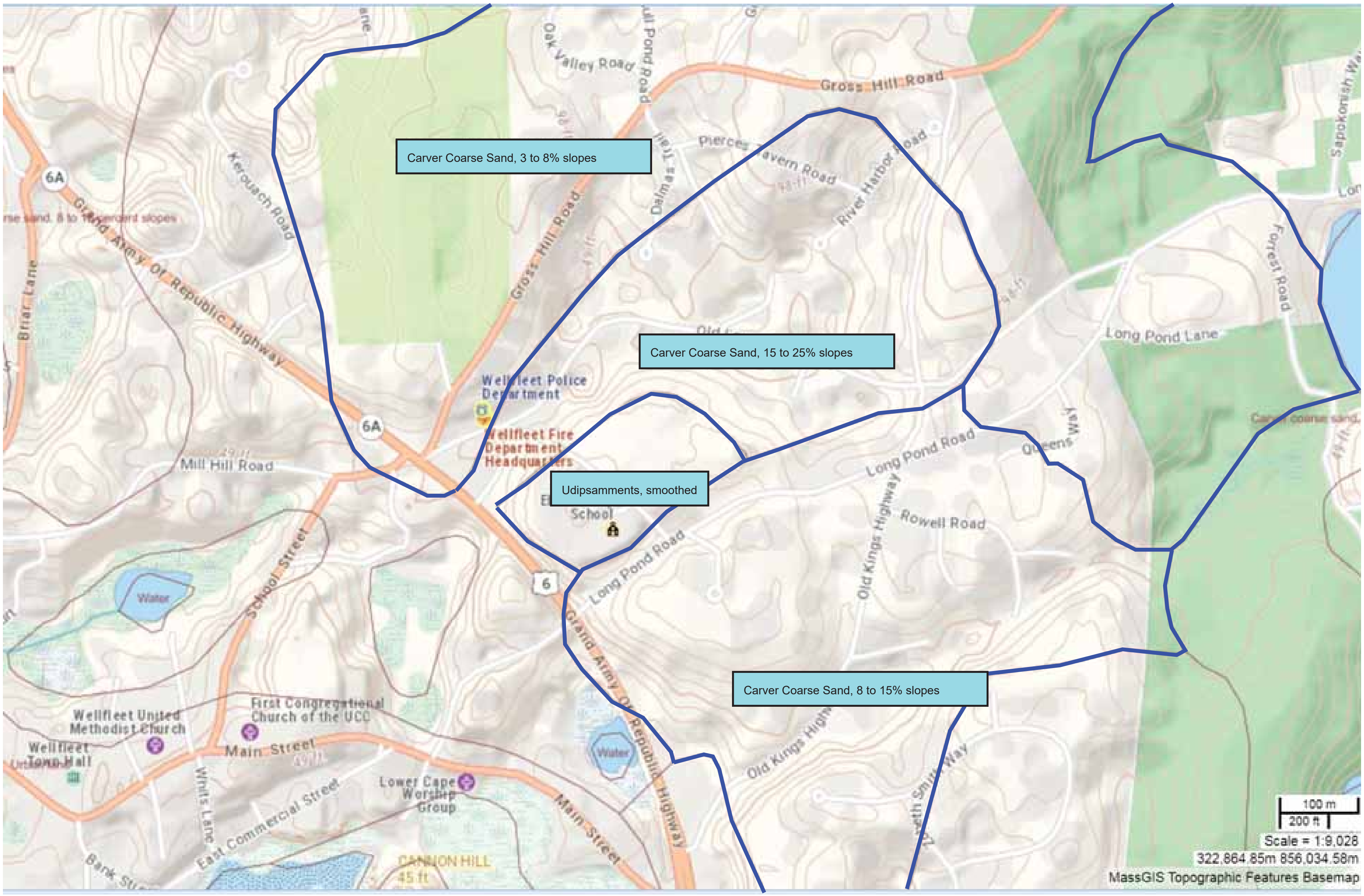


Soil Map

95 Lawrence Road Study

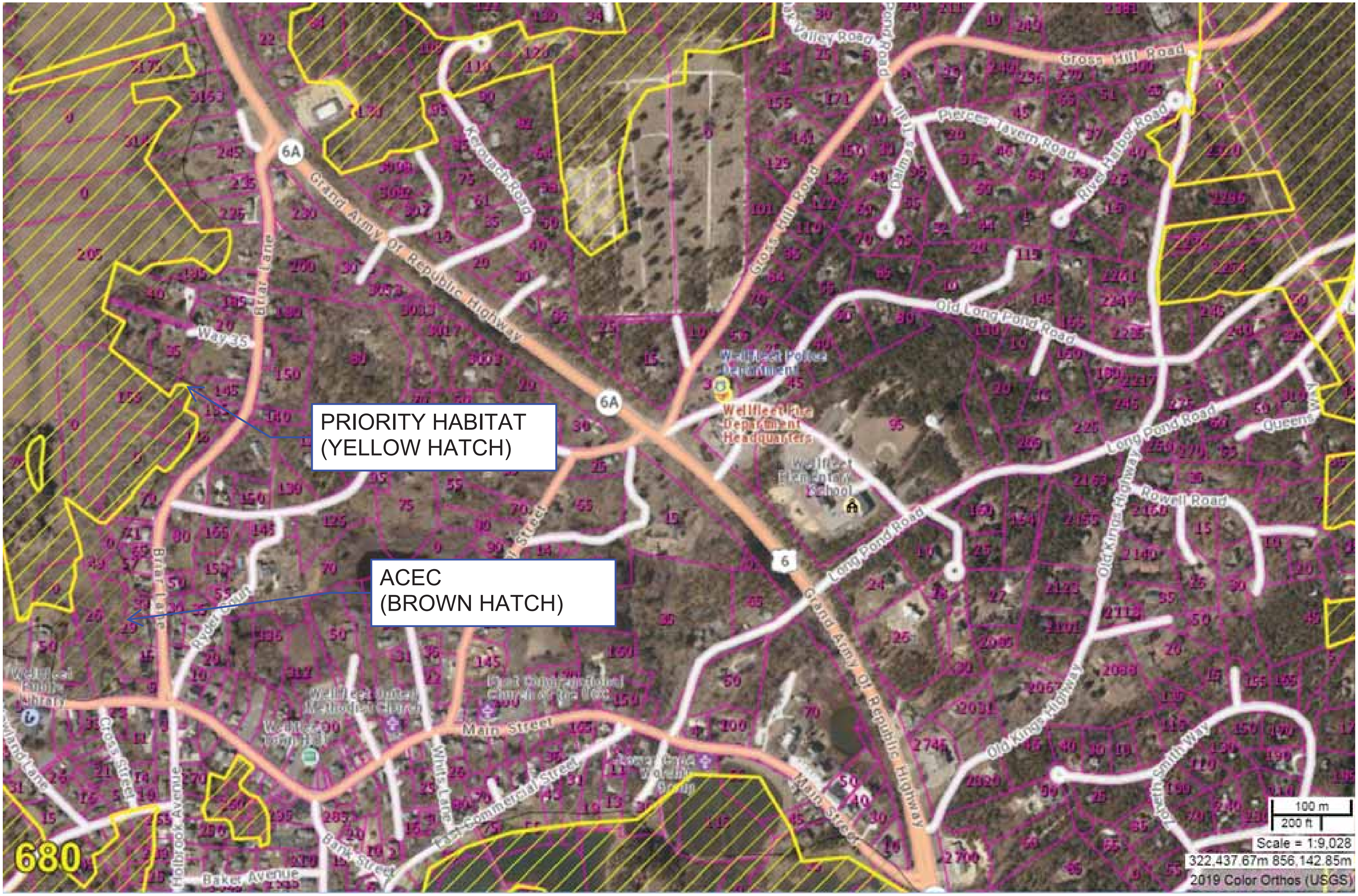
Figure 2

2.4 ENVIRONMENTAL RECEPTOR REVIEW

Using MassGIS data, the Team reviewed information related to areas of environmental concern and/or sensitive environmental receptors that could be affect the siting of a sewage treatment and disposal system at 95 Lawrence Road. As part of these information gathering efforts, we reviewed the MassGIS data layers associated with Outstanding Resource Waters, NHESP Priority Habitats, Areas of Critical Environmental Concern, Water Supply Protection Mapping, Surface Water Supply Protection Mapping, and Title 5 Buffers. As shown on Figures 3 through 5, the project site is not located within a mapped area that would prohibit the citing of a sewage treatment and discharge system.

While the site is not presently located in a designated nitrogen sensitive area or area subject to regulatory restrictions, as previously noted, this area was identified in the Massachusetts Estuaries Project, 2017 update, as an area influencing Wellfleet Harbor and therefore might be subject to Total Maximum Daily Load (TMDL) nitrogen restrictions at some point in the future. Cognizant of this fact, the Team contacted the MassDEP to discuss the findings associated with the Massachusetts Estuaries Project study. During our discussions, it was brought to our attention that there have, in fact, been discussions within MassDEP about designating the contributing area to Duck Creek, and ultimately to Wellfleet Harbor, as a mapped Nitrogen Sensitive area in accordance with 310 CMR 15.215 (2). Under this provision of Title 5, nitrogen sensitive embayments can be designated as a nitrogen sensitive areas, which in turn applies a threshold of the volume of wastewater that can be discharged on a parcel based on the overall footprint of the parcel.

The significance of this designation would be that, in accordance with 310 CMR 15.214, discharges located within nitrogen sensitive areas are limited to 440 gallons/acre with a conventional subsurface sewage disposal system, or in the case of providing a subsurface sewage disposal system with enhanced nitrogen removal, could be increase to 550 gallons/acre (flows greater than 2,000 gallons) to 660 gallons/acre (flows less than 2,000 gallons) depending on the type of MassDEP approved treatment technology. Given the size of the parcel (9.26 acres) and the concept of the planned development, this would result in a site maximum loading of 5,546 gallons if the site is mapped as a nitrogen sensitive area and a sewage disposal system permitted under 310 CMR 15.000 were utilized.



Priority Habitat / ACEC

95 Lawrence Road Study

Figure 3

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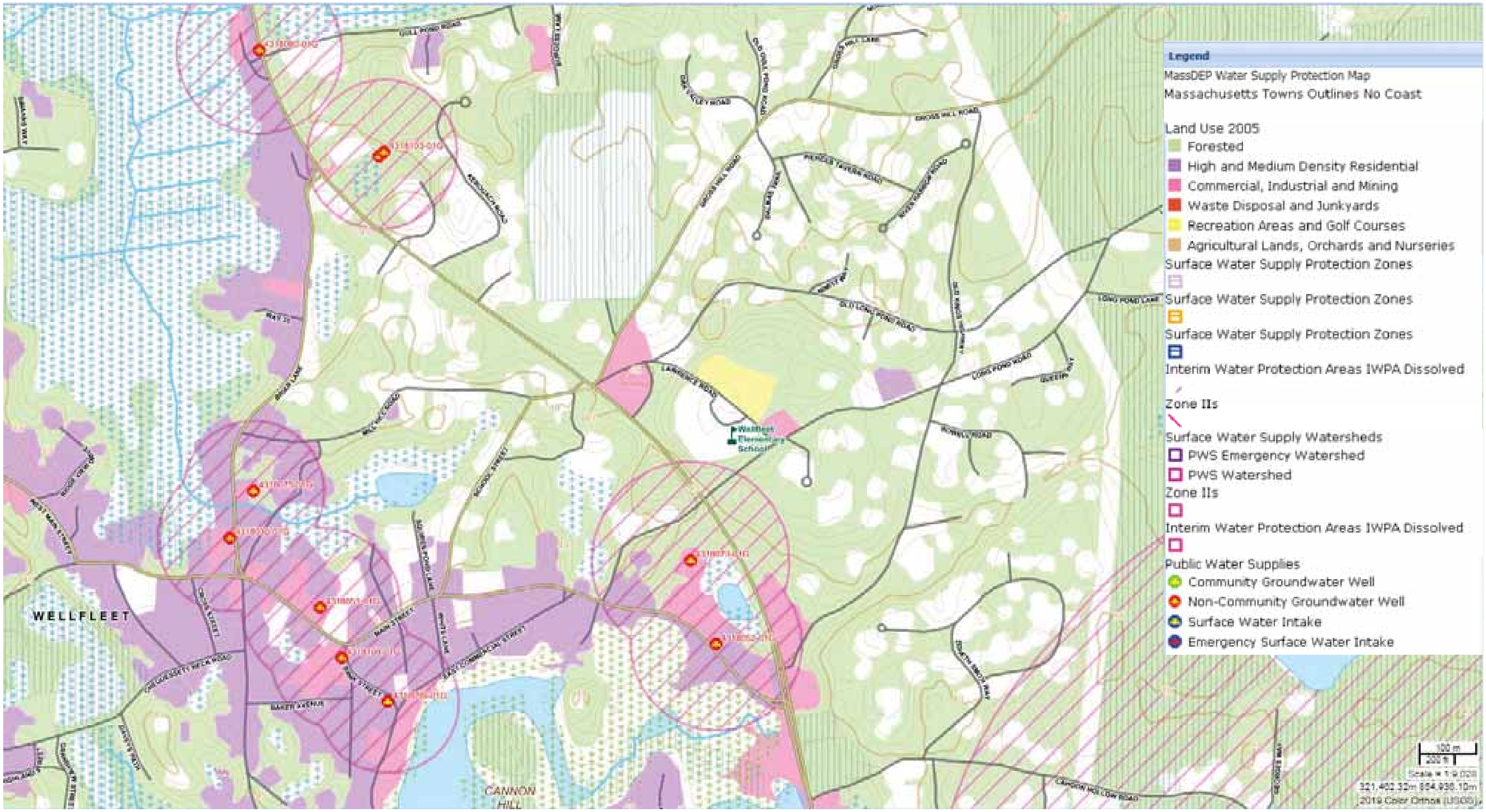

Water Supply Protection Areas

95 Lawrence Road Study

Figure 4

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IWPA / Zone II

95 Lawrence Road Study

Figure 5

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SECTION 3 – SUBSURFACE SEWAGE DISPOSAL SYSTEM EVALUATION – 95 LAWRENCE ROAD DEVELOPMENT

3.1 INTRODUCTION

As described in Section 1 of this report, the Town of Wellfleet in conjunction with the 95 Lawrence Road Task Force have undertaken planning efforts to develop approximately 6 acres of the Town's 9.26 acre parcel located at 95 Lawrence Road. The proposed development plan is to provide approximately 46 units resulting in 90 bedrooms. Using design flow criteria established in Title 5, 310 CMR 15.203, the proposed project would have a calculated theoretical design flow of 9,900 gallons, therefore would be subject to the requirements of Title 5 as a subsurface sewage disposal system.

Given the Town's concerns regarding adding a large potential source of nitrogen to the Duck Creek and Wellfleet Harbor watershed and ongoing discussions within MassDEP about enhancing nitrogen protections for this watershed and embayment, it appears that providing a nitrogen reducing technology as part of the subsurface sewage disposal system will be an important component of maintaining and possibly improving overall groundwater quality in this area. As such, the Team solicited design information, operation costs, and equipment package costs for MassDEP approved Innovative/Alternative technologies that address nitrogen removal.

The MassDEP, under 310 CMR 15.282 through 15.286, has implemented a program to review treatment system and effluent disposal technologies for their effectiveness in providing levels of protection at least equivalent to that of a standard subsurface sewage disposal system and provide a universal approval process for the use of these systems when permitting a system with the local approving authority (i.e., Board of Health). The MassDEP groups approved systems into four (4) categories; General Use, Piloting Use, Provisional Use, and Remedial Use. For this proposed development, with the focus being nitrogen reduction under the New Construction definition in Title 5, the technologies that were selected for evaluation for the project are required to be approved as General Use and/or Provisional systems.

In general, in order to be approved by MassDEP as a nitrogen reducing system with a design flow less than 10,000 gallons, the technology needs to be capable of producing an effluent with a total nitrogen concentration of 25 mg/l or less, and achieve biochemical oxygen demand and total suspended solids of 30 mg/l or less.

3.2 INNOVATIVE/ALTERNATIVE TECHNOLOGIES OVERVIEW

In concert with the data collection efforts discussed in Section 2, as part of our initial tasks the Team prepared a Request for I/A Treatment System Proposal form that provided a description of the 95 Lawrence Road development project, anticipated flow volumes and influent wastewater strength, and the project's effluent requirements with the goal of obtaining system designs and equipment costs. A copy of the RFP is included in Appendix A.

As part of the technology selection process, the minimum criterion used for the vendor selection were;

1. the technology had to be approved by MassDEP as a nitrogen reducing system under either the General Use or Provisional Category;
2. the system must be capable of achieving an effluent total nitrogen concentration of 25 mg/l or less and;
3. the system must be capable of achieving an effluent biochemical oxygen demand and total suspended solids concentrations of 30 mg/l or less.

These minimum criteria were then reviewed against the MassDEP I/A technology approval letters to determine which technologies met the regulatory requirements noted above. Based on these criteria, RFPs were forwarded to the following vendors: Advantex System by Orenco, Amphidrome System by F.R. Mahony & Associates, Inc., Bioclere by Aquapoint, FAST System by Bio-Microbics, Inc., Nitrex System by Lombardo Associates, and SeptiTech by Bio-Microbics of Maine.

The following paragraphs provide an overview and description of each Innovative/Alternative system and the system's effluent capabilities based on the MassDEP approval letters for use of the system with a design flow less than 10,000 gallons, but more than 2,000 gallons per day.

Advantex System

Description: The system is a multi-pass, packed bed aerobic wastewater treatment system designed to treat residential strength wastewater from facilities with a design flow of less than 10,000 gpd. The System is comprised of a pre-assembled, UV-protected fiberglass reinforced plastic (FRP) module that contains a textile media filter, installed on top of a two compartment Processing Tank. The first compartment receives and separates the raw sewage into three zones: a scum zone, a sludge zone and a clear zone. A flow through port in the tank baffle wall allows effluent from the clear zone to the second compartment of the tank. A Biotube Pump Package installed in the second compartment of the Processing Tank pumps effluent to a pressure distribution manifold located on top of the textile media in the filter module. The effluent is applied at a preset recirculation ratio of between 3:1 to 5:1 controlled by a timer. Timer settings can be recalibrated if flows vary significantly from projected flows.

Approved Title 5 Loading Capability for Nitrogen Sensitive Areas: 550 gallon/day/acre with Total Nitrogen Limit of 25 mg/l or less.

Required Effluent Limitations for Nitrogen Sensitive Areas:

Biochemical Oxygen Demand:	30 mg/l
Total Suspended Solids:	30 mg/l
Total Nitrogen	25 mg/l
pH	6.0 to 9.0 SU

Amphidrome System

Description: The system is a biological wastewater treatment system that utilizes a Submerged Attached Growth Sequencing Bioreactor (SAGSB). The System consists of an anoxic/equalization tank, a single reactor that alternates between aerobic and anaerobic conditions, and a clear well. Wastewater passes from the anoxic/equalization tank, through a granular biological filter and into the clear well. A pump is then used to reverse the flow back to the anoxic/equalization tank. This cycle is repeated multiple times and the effluent is discharged to the soil absorption system.

Approved Title 5 Loading Capability for Nitrogen Sensitive Areas: 550 gallon/day/acre with Total Nitrogen Limit of 25 mg/l or less.

Required Effluent Limitations for Nitrogen Sensitive Areas:

Biochemical Oxygen Demand:	30 mg/l
Total Suspended Solids:	30 mg/l
Total Nitrogen	25 mg/l
pH	6.0 to 9.0 SU

Bioclere System

Description: The system is a fixed film reactor consisting of a fiberglass tank containing a trickling filter section with inert plastic media, a clarifier and sump, a fan for aeration, and dosing and recirculating pumps. Effluent from the septic tank is sprayed over the plastic media, which then enters the clarifier providing settling, separating the solids from liquid. The liquid effluent is then discharged to the effluent disposal system for final disposal. The system also includes a recycle pump which returns settled solids to the septic tank.

Approved Title 5 Loading Capability for Nitrogen Sensitive Areas: 550 gallon/day/acre with Total Nitrogen Limit of 25 mg/l or less.

Required Effluent Limitations for Nitrogen Sensitive Areas:

Biochemical Oxygen Demand:	30 mg/l
Total Suspended Solids:	30 mg/l
Total Nitrogen	25 mg/l
pH	6.0 to 9.0 SU

FAST System

Description: The FAST® system utilizes a completely submerged fixed film process to treat organics and nitrify, and a passive recycle system for denitrification. Each model contains submerged media specific to the application. Microorganisms grow on the media and remove soluble contaminants from the wastewater, utilizing them as a source of energy for growth and production of new microorganisms. The FAST system insert consists of a liner around the media and an airlift to provide aeration and mixing within the confines of the liner. The area outside the liner in the septic tank remains anoxic for denitrification and a passive recirculation system moves the aerated wastewater to the outside of the liner to obtain denitrification. The aeration and circulation inside the liner are provided by a blower that pumps air into a draft tube that extends down the center of the media. Treated effluent passes out of the aerobic zone of the treatment system through a pipe connected directly to a baffled quiescent area in the liner.

Approved Title 5 Loading Capability for Nitrogen Sensitive Areas: 550 gallon/day/acre with Total Nitrogen Limit of 25 mg/l or less.

Required Effluent Limitations for Nitrogen Sensitive Areas:

Biochemical Oxygen Demand:	30 mg/l
Total Suspended Solids:	30 mg/l
Total Nitrogen	25 mg/l
pH	6.0 to 9.0 SU

Nitrex System

Description: The Nitrex Filter consists of nitrate-reactive media, formulated from wood by-products, contained in a watertight enclosure. Pretreatment is required to nitrify the wastewater. The effluent from pretreatment then percolates through the Nitrex Filter's reactive media. Effluent from the Nitrex Filter is recycled once or multiple times over the media, with the final effluent discharged to the effluent disposal system. For installations indicating wastewater with high strength TKN-nitrogen and low alkalinity, an alkalinity feed system is provided with the Nitrex Filter System.

Approved Title 5 Loading Capability for Nitrogen Sensitive Areas: 550 gallon/day/acre with Total Nitrogen Limit of 25 mg/l or less.

Required Effluent Limitations for Nitrogen Sensitive Areas:

Biochemical Oxygen Demand:	30 mg/l
Total Suspended Solids:	30 mg/l
Total Nitrogen	25 mg/l
pH	6.0 to 9.0 SU

SeptiTech System

Description: The system is an aerobic treatment system that uses an enhanced recirculating biological trickling filter treatment process with anoxic phase to reduce biochemical oxygen demand (BOD5), total suspended solids (TSS) and total nitrogen from sanitary wastewater by biological degradation. The wastewater flows into the first of two tanks consisting of a two compartment primary- anoxic tank where primary settling and partial denitrification occur. The second processor tank contains the trickling filter media and pumps for recirculation within the trickling filter, recirculation back to the anoxic tank and for discharge to the effluent disposal system. In addition to BOD reduction, further nitrification occurs in the mixed-liquor as it passes through the trickling filter with the ammonium in the wastewater converting to nitrate. The system uses a hydrophobic media composed of either polystyrene beads or polystyrene beads with honeycomb shaped solid media, in a two-stage process that allows biological growth within the media pore spaces.

Approved Title 5 Loading Capability for Nitrogen Sensitive Areas: 550 gallon/day/acre with Total Nitrogen Limit of 25 mg/l or less.

Required Effluent Limitations for Nitrogen Sensitive Areas:

Biochemical Oxygen Demand:	30 mg/l
Total Suspended Solids:	30 mg/l
Total Nitrogen	25 mg/l
pH	6.0 to 9.0 SU

3.3 INNOVATIVE/ALTERNATIVE TECHNOLOGY LAYOUTS AND COST EVALUATIONS

As mentioned previously, an I/A technology RFP was forwarded to six vendors to obtain proposals for Innovative/Alternative treatment systems capable of nitrogen reduction. The RFP, included in Appendix A, requested the following information from the vendors, with the vendor proposals submitted to the Team on or about July 29, 2020.

- Budgetary cost of the proposed equipment package;
- Size system components and required layout;
- Compliance data of existing installations relative the 25 mg/l total nitrogen effluent limit;
- Operational costs;
- Maintenance costs.

The following sections summarize each vendor's proposal and details the required size of the system, the necessary infrastructure components based on Title 5 and/or the technology manufacturer's requirements, and the cost of the equipment package. We wish to note that each vendor provided a summary of treatment system performance, which demonstrated compliance with the MassDEP requirement of achieving a minimum effluent Total Nitrogen concentration of 25 mg/l or less. Additionally, while the RFP and MassDEP I/A system approvals only require that the systems achieve a minimum Total Nitrogen effluent limit of 25 mg/l, the majority of vendors provided system performance data that demonstrated that their technology can achieve a higher level of Total Nitrogen removal (at or below 10 mg/l) on a regular basis.

Lastly, we wish to note that given the preliminary nature of the site planning for the development, the layout and costs associated with the sewage collection system has not been included in the layouts and estimated costs. It would be safe to assume that the project will utilize a site wide sewage collection system directed to a centralized sewage pump station. That would lift the sewage to the headworks of the Innovative/Alternative system. Once at the treatment system the flow configuration would be dictated by the requirements of the system, as detailed in each vendor's proposal.

Advantex System

The system proposal submitted by Orenco Systems is based on a two stage Advantex AX 100 system. The proposed layout includes a 20,000 gallon septic tank and a 10,000 gallon septic tank placed in series (to meet the requirements of 310 CMR 15.223) followed by a 7,500 gallon first stage recirculation tank. Sewage from the first stage recirculation tank is then distributed to three (3) AX 100 pods y via a triplex pump system. The effluent from the AX 100 pods then flows by gravity to a 2,500 gallon second stage recirculation tank, which distributes the effluent to two (2) AX 100 pods via a duplex pump system. The effluent from the second stage AX 100 pod system then flows by gravity to a 2,500 gallon post anoxic treatment tank for carbon addition in order to complete the denitrification process. The final treated effluent is then directed to an effluent pump chamber, which then distributes the treated effluent to the effluent disposal system.

Ancillary equipment included in the proposed system includes recirculation pumps from the first stage recirculation tank and second stage to the 20,000 gallon septic tank, a forced air ventilation system for the AX 100 pods, and chemical feed systems for alkalinity adjustment and carbon addition. With this system, a small building (8' x 14') would be required to house the control panel and chemical feed systems. For the equipment package proposed, Orenco Systems estimates a cost range between $177,553.00 and $216,651.00.

As shown on Figure 6, included at the end of this section of the report, the system could be located within the southeast portion of the site in the area in front of the 16 unit proposed building. The majority of the treatment system components could be located underneath the paved parking area, however the AX pods need to be located in a non-traffic area. As shown, we envision that the AX pods, along with the control building, could be located in the lawn area between the parking lot and the baseball field.

Amphidrome System

The system proposal submitted by F.R. Mahony and Associates is based on an Amphidrome Treatment System. The proposed layout of the system would include a 10,000 gallon anoxic/equalization tank followed by a 6 foot by 6 foot Amphidrome Reactor. The primary screened wastewater from the anoxic/equalization tank is filtered through the Amphidrome media and then directed via gravity to a 3,500 gallon Amphidrome clear well. Within the Amphidrome clear well are two sets of duplex pump systems. One set serves as the Amphidrome reverse flow/backwash pumps and the other set is dedicated to effluent discharge. The Amphidrome treatment process is predicated on multiple passes of "batched" wastewater through the Amphidrome Reactor, with the intermittent application of air combined with quiescent filtering and recirculation of wastewater back to the anoxic/equalization tank to facilitate aerobic and anoxic treatment conditions. The final treated effluent is then directed to a dedicated effluent pump chamber, which then distributes the treated effluent to the effluent disposal system.

Ancillary equipment included in the proposed system includes an aeration blower package and an alkalinity adjustment chemical feed system. With this system, a small building (10' x 20') would be required to house the control panel, blowers, and chemical feed system. For the proposed equipment package, F.R. Mahony estimates a cost of $128,700.00.

As shown on Figure 7, included at the end of this section of the report, the system could be located within the southeast portion of the site in the area in front of the 16 unit proposed building. The treatment system could be located underneath the paved parking area with the control building located in the adjacent lawn area. We wish to note that the MassDEP I/A approval for Amphidrome System includes a waiver from 310 CMR 15.223, which requires two septic tanks in series.

Bioclere System

The system proposal submitted by Aquapoint is based on a Bioclere treatment system. The proposed layout of the system would include a 20,000 gallon septic tank and a 10,000 gallon septic tank placed in series (to meet the requirements of 310 CMR 15.223) followed by a 5,000 gallon flow equalization tank. The primary screened wastewater in the flow equalization tank is then lifted to the first of two (2) Bioclere 30/24 units arranged in series. Within each Bioclere unit is a dosing pump, which distributes the wastewater over the Bioclere media, and a recycle pump that returns partially treated wastewater and accumulated biological solids to the 20,000 gallon septic tank. The wastewater distributed over the media is collected in the bottom of the unit and then flows by gravity to the downstream components. The final treated effluent from the second Bioclere unit is directed to an effluent pump chamber, which then distributes the treated effluent to the effluent disposal system.

Ancillary equipment included in the proposed system includes alkalinity adjustment and supplemental carbon chemical feed systems. With this system, a small building (8' x 14') would be required to house the control panel and the chemical feed systems. For the proposed equipment package, Aquapoint estimates a cost of $95,000.00.

As shown on Figure 8, included at the end of this section of the report, the system could be located within the southeast portion of the site in the area in front of the 16 unit proposed building. The treatment system concrete tanks could be located underneath the paved parking area, however the Bioclere units need to be sited in a non-traffic area. As shown, we envision that the two Bioclere units along with the control building, could be located in the lawn area between the parking lot and the baseball field.

FAST System

The system proposal submitted by BioMicrobics is based on a MicroFAST and NitraFAST system. The proposed layout of the system would include a 20,000 gallon septic tank and a 10,000 gallon septic tank placed in series (to meet the requirements of 310 CMR 15.223) followed by the FAST system. The screened wastewater from the septic tanks is directed to the MicroFAST 9.0 treatment unit for initial treatment, and then directed via gravity to the NitraFAST 9.0. Once undergoing treatment, the effluent flows to a combination recycle/effluent pump chamber. Within this chamber are two pump systems, one simplex return pump to recycle treated effluent back to the 20,000 gallon septic tank, and a duplex pump system that provides dosing to the effluent disposal system.

Ancillary equipment included in the proposed system includes the aeration blower package and chemical feed systems for alkalinity adjustment and supplemental carbon addition. With this system, a small building (8' x 14') would be required to house the control panel, blowers, and chemical feed systems. For the equipment package proposed, BioMicrobics estimates a cost range between $94,000.00 and $96,000.00.

As shown on Figure 9, included at the end of this section of the report, the system could be located within the southeast portion of the site in the area in front of the 16 unit proposed building. The treatment system could be located underneath the paved parking area with the control building located in the adjacent lawn area between the parking lot and the baseball field.

Nitrex System

The system proposal submitted by Lombardo Associates, Inc. is based on the Nitrex system. The proposed layout of the system would include a 20,000 gallon septic tank and a 10,000 gallon septic tank placed in series (to meet the requirements of 310 CMR 15.223) followed by a flow equalization tank and then the Nitrex system. The Nitrex system would consist of recirculation tank followed by the first stage Nitrix RMF. Screened wastewater in the recirculation tank is directed to the first stage Nitrix RMF. The effluent from the Nitrix RMF then flows by gravity to the RMF effluent tank, which contains two pump systems. The first pump system lifts the wastewater to the Nitrex tank system for final treatment, while the second pump system recycles a portion of the wastewater back to the recirculation tank for additional treatment by the Nitrex RMF. The treated effluent from the Nitrex tanks is directed to the drainfield dosing tank, which also contain two pump systems. The first pump system also recycles a portion of the flow back to the recirculation tank for re-treatment in both Nitrex system, while the other pump system doses the effluent disposal system.

Ancillary equipment included in the proposed system includes a chemical feed system for alkalinity adjustment. With this system, we anticipate that a small building (8' x 14') would be required to house the control panel and chemical feed system. For the proposed equipment package, which includes engineering and permitting services, and the Nitrix system tanks, Lombardo Associates, Inc. estimates a cost of $348,300.00.

As shown on Figure 10, included at the end of this section of the report, the system could be located within the southeast portion of the site in the area in front of the 16 unit proposed building and underneath the paved parking area with the control building located in the adjacent lawn area between the parking lot and the baseball field.

SeptiTech System

The system proposal submitted by BioMicrobics-Maine is based on a SeptiTech system. The proposed layout of the system includes a 20,000 gallon septic tank and a 10,000 gallon septic tank placed in series (to meet the requirements of 310 CMR 15.223) followed by the SeptiTech system. The SeptiTech system consists of three (3) SeptiTech STAAR 13.5 reactors installed in series. The first SeptiTech reactor is a single compartment tank, followed by two (2) three compartment tanks. Within all but one compartment, there are blocks of media, portions of which are submerged with the majority un-submerged. Recirculation pumps in the tanks distribute the wastewater over the media for treatment. In addition, within the media chambers are several recycle pumps, which direct partially treated wastewater back to the 20,000 gallon septic tank for re-treatment. The wastewater flows by gravity from compartment to compartment, and tank to tank until reaching the last compartment of the third tank. Within this last compartment are the effluent dosing pumps, which direct the treated wastewater to the effluent disposal system.

Ancillary equipment included in the proposed system includes a chemical feed system for alkalinity adjustment. With this system, a small building (8' x 14') would be required to house the control panel and chemical feed system. For the equipment package proposed, BioMicrobics estimates a cost range between $88,000.00 and $90,000.00.

As shown on Figure 11, included at the end of this section of the report, the system could be located within the southeast portion of the site in the area in front of the 16 unit proposed building and underneath the paved parking area with the control building located in the adjacent lawn area between the parking lot and the baseball field.

Overall Innovative/Alternative Treatment System Capital Cost Evaluation

The next task associated with our evaluation of these technologies involved using each treatment system configuration and equipment package cost to develop the estimated capital cost associated with furnishing and installing a complete Title 5 compliant system. Utilizing the proposals furnished by each vendor, we compiled the information into four categories which, in general, would influence the overall cost of each system. These categories include;

- the proposed equipment package cost,
- the volume/number of tanks required for each system,
- the required building size (if needed) and,
- The estimate of installation/labor costs required to install each package, which must take into consideration the complexity of system installation and the amount of process piping/equipment labor to complete the installation.

To assist with determining the cost associated with the complexity of system installation and process piping costs category, we consulted with a Cape Cod Contractor that is familiar and experienced with I/A septic systems and has completed multiple I/A systems installations, as well as Groundwater Discharge Permit systems installations, on Cape Cod.

Table 1 below presents a summary of these categories and costs for review. We wish to note that the cost information listed in Table 1 is not intended to represent the total cost to build the treatment system, but rather is intended to provide comparisons among the systems based on common aspects of the required infrastructure and the work associated with constructing each system. Specifically, items that would be the same for all systems, such as the collection system and miscellaneous site work, etc. have not been quantified here. It is important to note that the information included in Table 1 is based on the following criteria, conditions and assumptions used by the Team to develop the treatment system comparison:

- The costs for the sewage collection system has not been included in this analysis.
- The cost difference with providing electrical feed and distribution systems for mechanical equipment is assumed to be consistent among all technologies.
- Final site restoration work among the systems is not included, given that the site is not yet designed and it is safe to assume that the final site work would be similar for all systems.
- Building structure costs are estimated based on a $125.00 per square foot.
- The proposal for the Nitrex system did not provide treatment tank volumes, therefore tank volumes from a similar size system design was used to estimate installation costs.
- The Nitrex system proposal includes costs associated engineering and permitting, which are not included by the other vendors. Therefore, the Nitrex package cost was reduced by $10,000.00 to account for this work for the purposes of this analysis.
- The Nitrex's "Tank Furnish & Installation Costs" category was adjusted to reflect that the cost for the system's required tankage is included in their equipment proposal price.

- The inclusion of an equalization tank was accounted for only the proposals that indicated an equalization tank is required.
- We assumed that a standby generator would be provided, therefore providing 24 hours storage in the applicable tanks was not included.
- For each option, an effluent pump chamber with a minimum volume of 6,000 gallons is proposed.
- Proposed equipment costs do not include local sales tax.
- Proposals that provided system package cost as a range were reported as an average of the cost range.

Table 1
Innovative/Alternative System Opinion of Cost
Comparison Summary
95 Lawrence Road
Wellfleet, Massachusetts

Vendor/Technology	Advantex	Amphidrome	Bioclere	FAST	Nitrex	SeptiTech
Equipment Package	$197,104.00	$128,700	$95,000	$95,000	$338,300	$92,000
Building Size (SF)	112	200	112	200	112	112
Required Tankage (gallons)	51,000	20,000	41,000	54,000	99,000	60,000
Process Piping & Installation Cost	$197,000	$141,570	$156,750	$104,500	$67,660	$92,000
Building Cost	$14,000	$25,000	$14,000	$25,000	$14,000	$14,000
Tank Furnish & Installation Costs	$255,000	$100,000	$205,000	$270,000	$322,500	$300,000
Total Opinion of Cost	$663,104	$395,270	$470,750	$494,500	$742,460	$498,000

Innovative/Alternative Treatment System Operations Cost Evaluation

In addition to assessing the capital costs associated with furnishing and installing these systems, as part of our analysis, we compiled and compared the anticipated operational costs associated with the ongoing operation and maintenance of the systems.

To complete this task, the Team requested that each vendor furnish a summary of their estimated annual operational costs associated with their system. As part of this process, we also requested estimated electricity and chemical use as well as anticipated sludge generation and disposal costs.

Table 2 below summarizes the costs for operations and maintenance of each system, as provided by the vendors and includes estimated costs associated with electricity, chemicals, sludge pump, and requirements for operation and oversight.

We wish to note the following criteria used for the operational cost comparison summary:

- Annual sludge pumping is based on a minimum of 30,000 gallons, which accounts for pumping of the system headworks at least once per year.

- Electrical costs are based on a rate of $0.1491 per kilowatt hour.
- Sludge pumping costs are based on a rate of $0.18 per gallon.
- Chemical costs associated with alkalinity adjustment (sodium bicarbonate) and supplemental carbon (Micro-C) are based $0.10/lb. and $8.00/gallon, respectively. Per their proposal, the Nitrex system alkalinity adjustment system is based soda ash at $1.56/lb.
- SeptiTech and Bioclere did not provide estimates for chemical usage, therefore an average usage of 30 lbs./day of alkalinity and 1 gallon of carbon chemicals were assumed.

Table 2
I/A Subsurface Sewage Disposal System
Opinion of Annual Operation Cost Summary
95 Lawrence Road
Wellfleet, Massachusetts

Vendor/Technology	Advantex	Amphidrome	Bioclere	FAST	Nitrex	SeptiTech
Electricity (kWh/day)	72.2	59.4	41.0	132.0	22.0	150.0
Sludge Pumping (gallons)	30,000	36,100	46,832	30,000	30,000	30,000
Chemicals:						
Alkalinity/pH Adjustment (lbs./day)	22.1	43.8	30.0	33.0	3.1	30.0
Supplemental Carbon (gallons/day)	1.3	0.95	1.0	1.0	-	1.0
Estimated Costs						
Electricity Cost	$3,930	$3,233	$2,231	$7,184	$1,197	$8,163
Chemical Cost	$4,602	$4,373	$4,015	$4,125	$1,751	$4,015
Sludge Pumping	$5,400	$6,498	$8,430	$5,400	$5,400	$5,400
Vendor's Estimated Operation Cost	$13,932	$14,104	$14,676	$16,709	$8,348	$17,578
Contract Operations Oversight	$1,200					
Laboratory Testing	$1,600					
Routine Maintenance	$2,500					
Opinion of Overall Annual Operation Cost	**$19,232**	**$19,404**	**$19,976**	**$22,009**	**$13,648**	**$22,878**

FIGURE 6

ADVANTEX SYSTEM

9,900 GALLON INNOVATIVE/ALTERNATIVE SSDS

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 7
AMPHIDROME SYSTEM
9,900 GALLON INNOVATIVE/ALTERNATIVE SSDS

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 8

BIOCLERE SYSTEM
9,900 GALLON INNOVATIVE/ALTERNATIVE SSDS

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 9

FAST SYSTEM

9,900 GALLON INNOVATIVE/ALTERNATIVE SSDS

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 10

NITREX SYSTEM

9,900 GALLON INNOVATIVE/ALTERNATIVE SSDS

95 LAWRENCE ROAD

WELLFLEET, MASSACHUSETTS

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FIGURE 11

SEPTITECH SYSTEM

9,900 GALLON INNOVATIVE/ALTERNATIVE SSDS

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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3.4 TITLE 5 EFFLUENT DISPOSAL SYSTEM EVALUATION

As detailed in Section 2, based on MassGIS and record information available at the Town of Wellfleet Board of Health, the soils in the vicinity of site are indicative of a sand parent material with seasonal high groundwater at a depth of greater than 24 feet below land surface. These conditions represent the most favorable conditions for siting an effluent disposal system based on criteria established by Title 5 with respect to the required size of the system and aspects related to offset to the mounded seasonal high groundwater.

Generally, the required size of an effluent disposal system is dictated by the ability of the naturally occurring soil material to accept effluent, which is most often determined by performing a percolation test. The percolation test is a means to estimate the permeability of the soil, which in turn is used to determine the soil's Title 5 Long Term Acceptance Rate (LTAR), which is based on the percolation rate and the class of soil. For this site, given the abundance of consistent record information, we would anticipate Class I soils to be present that yield percolation rates of less than 2 minutes per inch. Under this scenario, a LTAR would be applied (0.74 gpd/sf) to the site, which is the highest loading rate allowed by Title 5 and results in the smallest system footprint.

The second critical aspect of the siting of an effluent disposal system is its elevation in relation to seasonal high groundwater. In accordance with 310 CMR 15.212, the minimum vertical separation from the bottom of an effluent disposal system to season high groundwater is four feet for percolation rates greater than two minutes per inch, or in a case when the percolation rate is less than two minutes per inch, the required separation is five feet.

In addition, 310 CMR 15.212 requires that any system with a design flow of 2,000 gallons per day or greater consider the effects of groundwater mounding associated with the discharge in the requirements for the separation from seasonal high groundwater. Combining this Title 5 requirement with the planned system size being greater than 2,000 gallons per day and the soil conditions at the site, we anticipate that the effluent disposal system will need to maintain at least five feet from the mounded seasonal high groundwater. Given that, based on the record information, seasonal high groundwater was not observed in any soil observation logs with recorded depths of excavation of 24 feet below grade, we do not anticipate maintaining the minimum vertical separation requirements will result in a mounded (i.e., above grade) effluent disposal system.

Given these the anticipated favorable site conditions, the Team reviewed three types of effluent disposal system configurations to serve the planned development that have demonstrated success in similar soil conditions. These effluent disposal system configurations are;

- Standard stone leaching trenches,
- leaching chamber trenches and,
- a drip dispersal system.

With each system, the effluent disposal system would be sited in the adjacent baseball field's outfield. During our initial discussions with the Town, this area was determined to be the preferred location for the effluent disposal system in order to maximize the development ability of the project for the affordable housing units and so as to not create site constraints for the development's required infrastructure (i.e., buildings, stormwater management, water distribution, etc.).

Presented in Table 3 below is a summary of each effluent disposal system's specifications, size and opinion of probable cost. Additionally, Figures 12 through 14 at the end of this section portray the configuration of each system and its location within the baseball field. For the purpose of preparing the opinion of cost for each effluent disposal system, we wish to note the following:

- Each system is sized to accommodate a maximum day flow of 9,900 gallons.
- Each scenario includes 100 feet of force main from the I/A sewage treatment system at the planned development to the effluent disposal system.
- Each system configuration includes reserve area between trenches/lines.
- Each system would utilize pressure distribution as the means of effluent disposal in accordance with 310 CMR 15.254.

Table 3
I/A Subsurface Sewage Disposal System
Effluent Disposal System Summary and Opinion of Cost
95 Lawrence Road
Wellfleet, Massachusetts

	Stone Leaching Trenches	Leaching Chamber Trenches	Drip Dispersal System
Long Term Acceptance Rate	0.74 gpd/sf	0.74 gpd/sf	0.74 gpd/sf
Effective Leaching Area	6.0 sf/lf	8.9 sf/lf	1.0 gpd/sf
System Configuration	23 trenches – 100 feet long	16 trenches – 100 feet long	3 zones – 32 feet by 142 feet
System Footprint	100 feet by 178 feet	100 feet by 183 feet	96 feet by 142 feet
Opinion of Estimated Cost	$232,000 - $255,000	$238,000 - $260,000	$205,000 - $225,000

FIGURE 12

STONE LEACHING TRENCHES
9,900 GALLON EFFLUENT DISPOSAL SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 13

LEACHING CHAMBER TRENCHES
9,900 GALLON EFFLUENT DISPOSAL SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 14

DRIP DISPERSAL SYSTEM

9,900 GALLON EFFLUENT DISPOSAL SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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3.5 DISCUSSION

According to the best available information from the Town of Wellfleet Board of Health and MassGIS, we have not found any evidence that would not support the feasibility to implement an Innovative/Alternative subsurface sewage disposal system to address sewage treatment and disposal at the 95 Lawrence Road development. The project site and the surrounding area is not within any mapped areas of concern related to 310 CMR 15.000, Title 5, and the Town of Wellfleet Wellhead Protection District.

While this area has been included in the recent Massachusetts Estuaries Project study associated with Wellfleet Harbor, which indicated this area contributes to nitrogen loading of Duck Creek, during our discussions with MassDEP regarding the Estuaries Study, it was mentioned to us that there have been internal discussions within MassDEP about designating areas of influence to this Estuary as a Nitrogen Sensitive Area in accordance with 310 CMR 15.215 but that nothing formal has been proposed. If this were to occur, then the project site would likely be subject to the requirements of 310 CMR 15.214, which limits the allowable loading of a site from a subsurface sewage disposal system to 440 gpd/acre without alternative treatment, and up to 550 gpd/acre to discharges greater than 2,000 gallons with an Innovative/Alternative treatment system. When utilizing the 550 gpd/acre threshold, this limits the loading of the site to 5,546 gpd (50 bedrooms), which is less than the development currently proposed flow 9,900 gpd. As such, if this area were mapped as a Nitrogen Sensitive Area and the planned development is more than 50 bedrooms, then in order to accommodate this loading, the sewage treatment and disposal system would have to be permitted under the Groundwater Discharge Permit Program, 314 CMR 5.00.

Under the presumption that the project area would not be designated a Nitrogen Sensitive Area and the project would proceed with an Innovative/Alternative subsurface sewage disposal system, the six technologies reviewed appear adequate to meet the requirements of nitrogen reducing treatment systems. Based on our review of the proposals and consultation with a contractor that has installed multiple Innovative/Alternative subsurface sewage disposal system, the Amphidrome, Bioclere and FAST treatment systems represent the lowest capital cost, while the Nitrex, Advantex, and Amphidrome represent the systems with the least cost to operate. Overall, the treatment system costs range from $396,000 to $743,000 with a median cost approximately $500,000. The annual operational costs are in the range of $19,000 to $23,000 per year. Based on our experience, these cost appear consistent with similar size treatment systems of equal complexity.

As shown in the schematic figures, the configuration and footprint of each system can vary substantially. In an effort to provide a succinct summary of each vendor proposal and its suitability for the project and site conditions, we have provided Table 4 below:

Table 4
I/A Subsurface Sewage Disposal System
Treatment System/Site Suitability Assessment
95 Lawrence Road
Wellfleet, Massachusetts

Treatment System	Opinion of Cost	Advantages	Disadvantages
Advantex	$663,104	• Second lowest cost to operate system	• Higher capital cost compared to other systems • Certain system components are required to be installed above grade in non-traffic areas • Large system footprint
Amphidrome	$395,270	• Lowest capital cost compared to other system • Entire system can be installed under traffic areas • Lower end of range for cost to operate	• Requires more frequent sludge removal events than other systems
Bioclere	$470,750	• Lower capital cost compared to other system	• Certain system components are required to be installed above grade in non-traffic areas • Requires more frequent sludge removal events than other systems
FAST	$494,500	• Lower capital cost compared to other system • Entire system can be installed under traffic areas	• Second highest cost to operate
Nitrex	$742,460	• Entire system can be installed under traffic areas • Lowest cost to operate system • Lowest electrical consumption of all systems	• Highest capital cost compared to other systems • Large system footprint
SeptiTech	$498,000	• Entire system can be installed under traffic areas	• Highest cost to operate

In regard to the site's effluent disposal system, given the anticipated site conditions of this area, the effluent disposal system could be sited within the confines of the adjacent baseball, or in all likelihood anywhere within the confines of the site based the abundance of soil observation and percolation test data for this area and the lack of site constraints.

For the 95 Lawrence Road development, we reviewed three configurations of effluent disposal systems; stone leaching trenches, leaching chamber trenches, and drip dispersal. Based on our review, it appears that the lowest capital cost system would be the drip dispersal option followed by stone leaching trenches and then leaching chamber trenches. Overall, the cost range between options varies by 15% with the overall range of the high end cost between $225,000 and $260,000. Upon performing deep observation holes on the site to determine the extents/depth of top and subsoil layers, the costs difference among these options will likely result in one of the configurations becoming the clear lowest capital cost option.

SECTION 4 – DECENTRALIZED TREATMENT SYSTEM EVALUATION – LARGE SYSTEM OPTION

4.1 OVERVIEW

In addition to the review of I/A system alternatives for the site, the Town's RFP also requested that the Team review a larger, decentralized treatment system option to serve the area beyond the planned housing development. Under this scenario, a treatment system permitted under 314 CMR 5.00, the Groundwater Discharge Permit Program, would be provided to serve the development at 95 Lawrence Road and a combination of either:

1. The nearby Town-owned parcels consisting of the Town of Wellfleet Police Headquarters, Town of Wellfleet Fire Department Headquarters and the Wellfleet Elementary School (i.e., Scenario #1) or;
2. The nearby Town-owned parcels <u>plus</u> the surrounding/adjacent residential parcels to the project site (i.e., Scenario #2).

The fact that the 95 Lawrence Road development in combination with either scenario would result in a calculated theoretical design flow greater than 10,000 gallons necessitates permitting of the system under the Groundwater Discharge Permit Program versus Title 5.

4.2 DECENTRALIZED TREATMENT SYSTEM SERVICE AREA AND DESIGN FLOW

Under Scenario #1 above, the extents of the sewage collection system would service the Town of Wellfleet Fire Department Headquarters, the Town of Wellfleet Police Department Headquarters, and the Town of Wellfleet Elementary School. Based on MassGIS, it appears that the topography in the vicinity of these parcels slopes to the northeast along Lawrence Road with the lowest elevation at the Town of Wellfleet Police Department site. Under these conditions, a centralized sewage pump station could be located at the Police Department site to facilitate gravity sewage collection from the Fire Department and Elementary School parcels. From the Police Department site, the sewage could be lifted to the headworks of the decentralized treatment facility located on the 95 Lawrence Road site. The opinion of probable cost to construct the above-described collection system is in the range of $775,000 to $900,000 and is shown conceptually as Figure 15.

For Scenario #2, using the Town of Wellfleet Assessor data in concert with MassGIS data, we reviewed the topography and number of abutters to area adjacent to 95 Lawrence Road site to determine the area that could be reasonably served by a decentralized treatment system located on the 95 Lawrence Road parcel. With the intent of balancing the cost associated with providing an extensive/expansive collection system in relation to the number of users, while also considering limiting the number of centralized/decentralized pump systems needed by maximizing gravity collection, the focus of the service area for Scenario #2 was limited to Gross Hill Road, Lawrence Road, Long Pond Road, Nimitz Way, Old Long Pond Road, Old Kings Highway, Pine Valley Road, and Whereaway Lane. A summary of the residential and Town owned parcels included under Scenario #2 is located in Appendix B and is shown conceptually on Figure 16.

FIGURE 15

SCENARIO #1 - SEWAGE COLLECTION SYSTEM SCHEMATIC

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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SCALE:1"=200' DATE: 08/21/2020

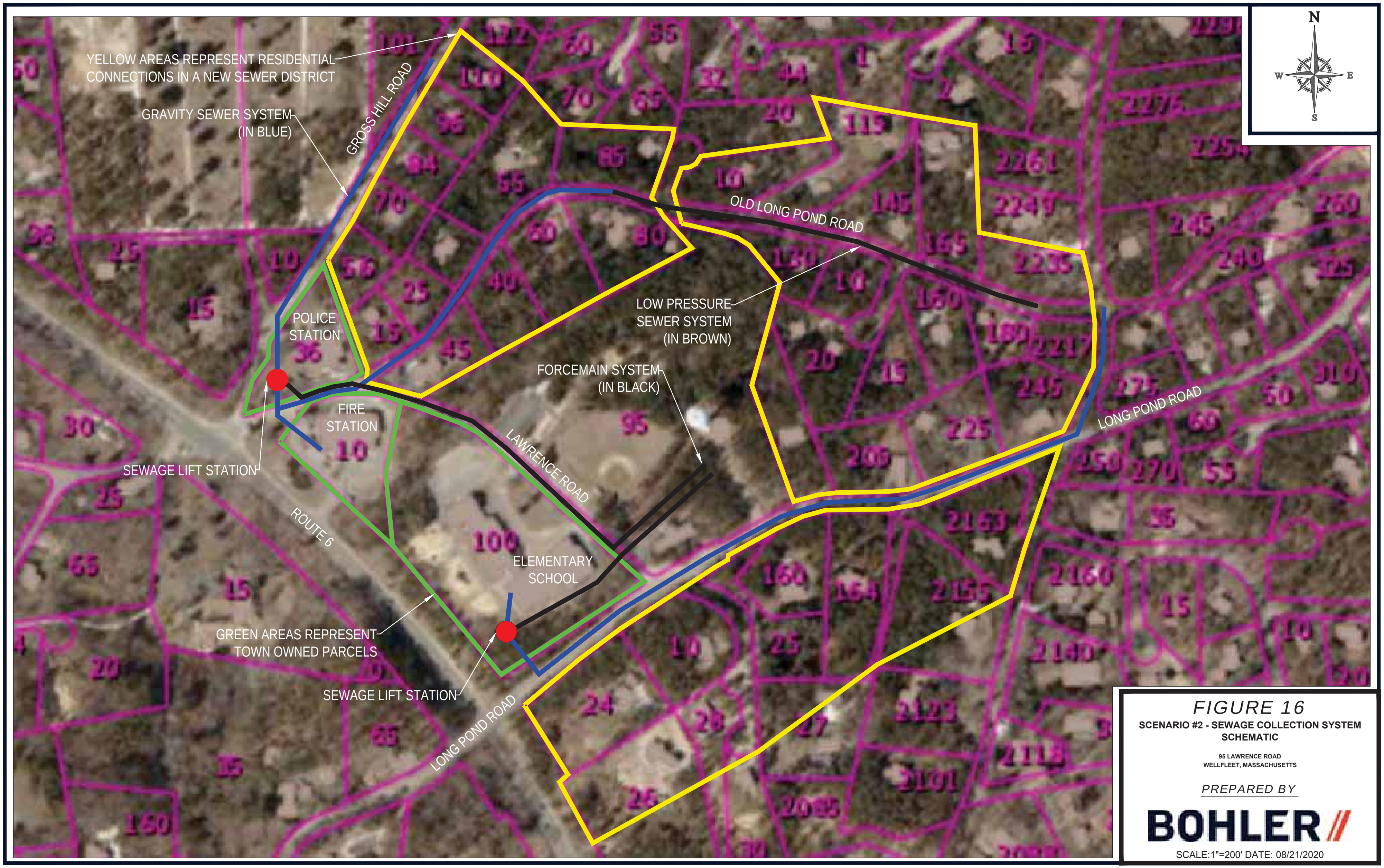

FIGURE 16

SCENARIO #2 - SEWAGE COLLECTION SYSTEM SCHEMATIC

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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Based on the topography of this area, the service area generally slopes from north to south, with the lowest elevations being where Gross Hill Road and Long Pond Road intersect Route 6 (Grand Army of Republic Highway), with the topography divide being located at 55 Old Long Pond Road and 180 Old Long Pond Road. Given this topography, it appears that a collection system consisting of both low pressure sewer and gravity sewers with two pump stations could service this area.

As shown on Figure 16, the area between 55 Old Long Pond Road and 180 Old Long Pond Road, including Nimitz Way and Pine Valley Road, could utilize a low pressure sewer system to lift the sewage to gravity collection sewer segments located at the crest of Old Long Pond Road. From either crest location, the gravity sewage collection systems could be used to direct sewage flows to new sewage lift stations located on the Town of Wellfleet Elementary School and Town of Wellfleet Police Department parcels. From these new pump stations, the sewage could be lifted to the headworks of a decentralized treatment facility located on the 95 Lawrence Road Parcel. The opinion of probable cost to construct the above-described collection system is in the range of $2,100,000 to $2,400,000.

Using the extents of the sewer area for Scenarios #1 and #2, we then compiled the information regarding the size of the Town-owned facilities (Scenario #1) as well as the corresponding number of bedrooms for each identified residential connection (Scenario #2). Using this information, we then calculated the theoretical maximum day sewage generation for Scenarios #1 and #2 using System Sewage Flow Design Criteria established by 310 CMR 15.203, Title 5. The summary of the maximum day sewage generation for each scenario are listed in Table 5 and Table 6 below.

Table 5
Maximum Day Sewage Generation – Scenario #1
95 Lawrence Road
Wellfleet, Massachusetts

Use/Location	Units	Design Flow Criteria	Design Flow (Gallons)
95 Lawrence Road Development	90 bedrooms	110 gallons/bedroom	9,900
Police Station	11,067 sf	75 gallons/1,000 sf	830
Fire Station	14,898 sf	75 gallons/1,000 sf	1,117
Wellfleet Elementary School	363 people	20 gallons/person	7,260
		Total	19,107

Table 6
Maximum Day Sewage Generation – Scenario #2
95 Lawrence Road
Wellfleet, Massachusetts

Use/Location	Units	Design Flow Criteria	Design Flow (Gallons)
95 Lawrence Road Development	90 bedrooms	110 gallons/bedroom	9,900
Police Station	11,067 sf	75 gallons/1,000 sf	830
Fire Station	14,898 sf	75 gallons/1,000 sf	1,117
Wellfleet Elementary School	363 people	20 gallons/person	7,260
Residential Abutters	109 bedrooms	110 gallons/bedroom	11,990
		Total	31,097

Based on the above methodology, the calculated maximum day sewage generation for each scenario are 19,107 gallons and 31,097 gallons, respectively. Because Title 5 design flow criteria represents a maximum day sewage generation, we anticipate that the actual sewage flows would generally fall into the range of 50% to 65% of these maximum day flows, on average. Therefore, for these scenarios we would anticipate an actual sewage generation to be between 9,400 gpd and 12,500 gpd for Scenario #1, and 15,600 gpd and 20,213 gpd for Scenario #2.

As the last part of the sewage flow calculations, which were used to determine the minimum capacities of the decentralized treatment systems, we reviewed the effects that infiltration within the collection system could have on the overall flow to the decentralized system. In accordance with Technical Release 16 (TR-16) guidance document published by the New England Interstate Water Pollution Control Commission (NEIWPCC), it suggests as part of sewer/treatment designs adding an allowance between 250 to 500 gpd/inch diameter/mile of sewer for infiltration into the collection system due to the normal aging of pipes. Given that the area, in general, is not subject to high groundwater conditions, the likelihood of excessive infiltration into the system, in our opinion, is remote. Regardless, we estimated the amount of infiltration to be 1,300 gpd (less than 1 gpm) based on 3,320 feet of 8 inch gravity sewer at 250 gpd/inch diameter/mile. In accordance of good engineering practice and in an effort to be conservative during the planning and evaluation phase, we added this volume to the maximum day sewage calculations for both scenarios, which results in an adjusted flow volume of 20,407 gallons and 32,397 gallons, respectively.

4.3 DECENTRALIZED TREATMENT SYSTEMS OVERVIEW

Treatment systems approved under the Massachusetts Ground Water Discharge Permit Program utilize a combination of treatment units generally consisting of primary settling/screening followed by aerobic treatment, secondary settling and tertiary filtration. Additional units are often appended to the treatment process to accomplish nitrogen removal in environmentally sensitive areas.

In general, these type of treatment systems will employ primary treatment, an advanced aerobic and anoxic biological process with settling to accomplish treatment, which in turn produce an effluent far superior to that provided by conventional and I/A subsurface sewage disposal systems. These types of systems utilize advanced aerobic biological treatment processes that are capable of removing substantial amounts of Biochemical Oxygen Demand (BOD) and Total Suspended Solid (TSS), and are also capable of nitrifying the ammonia-nitrogen present in the wastewater to Nitrate-Nitrogen, which can subsequently be removed through an anoxic denitrification process with carbon source addition.

Based on the above calculated design flows for each scenario, the Team requested proposals from treatment system vendors for systems to meet the requirements of the Groundwater Discharge Permit Program under a General Permit Category, which included membrane bioreactor technology, Amphidrome technology, sequencing batch reactor technology, and the Nitrex System. The following presents an overview of each treatment technology.

Membrane Bioreactor Technology

The membrane bioreactor (MBR) process is a modified activated sludge treatment process, which combines a conventional activated sludge treatment process with a membrane filter that acts as a physical barrier by combining clarification and tertiary filtration into one step. For small facilities, this physical barrier allows multiple treatment units to be combined into one basin, reducing capital costs, facility footprint, and treatment complexity.

One of the primary attributes of the MBR wastewater treatment system is that this variation of the activated sludge process provides an enormous degree of flexibility in the design variations available to meet the requirements of specific waste treatment applications. Due to this flexibility and other inherent advantages, MBR systems are being employed in a variety of process design situations with increased frequency in residential, municipal and industrial wastewater treatment applications.

Furthermore, MBR's are capable of producing an extremely high quality effluent while operating over a wide range of hydraulic and organic loadings. The biological growth providing waste treatment develops in response to the imparted load and the MBR can contain a very high level of solids and organisms within the system because of the membrane barrier. Therefore, the treatment level achieved is typically excellent and is more often than not at the level of water reuse quality. During periods of low hydraulic or organic loading (during school vacations for example), the biological growth can be concentrated and maintained within the reactor by reducing the frequency of sludge wasting. However, as the flow (or organic load) is increased, the organisms begin to proliferate and a larger percent can remain in the system and be used for high levels of treatment. Therefore, sludge wasting from an MBR system is typically much less than in conventional activated sludge systems. Thus, the system is quickly able to adjust to the strength and volume of the influent wastewater stream.

In addition to removing organic matter, MBR treatment systems are also capable of oxidizing influent nitrogen typically present in the reduced ammonia-nitrogen and organic nitrogen forms. Treatment facilities equipped with an anoxic treatment removal process have proven capable of further treating the oxidized wastewater, performing a treatment step referred to as denitrification. This process releases nitrogen to the atmosphere as nitrogen gas.

Amphidrome Bioreactor Technology

The Amphidrome® process is a proprietary treatment system that utilizes fixed sand media beds operated in both aerobic and anoxic environments to biologically treat and filter wastewater. Systems sized for flows greater than 10,000 gpd are based on the same concept as the I/A system but with additional reactor volume and a dedicated anoxic denitrification reactor, which allows for greater organic and nitrogen pollutant removal. Given this, the system is capable of producing a high quality effluent while operating over a wide range of hydraulic and organic loadings. The biological growth providing waste treatment develops in response to the imparted load and the system can contain a very high level of organisms within the reactors because of the nature of the interstitial space within the sand bed reactors.

During periods of low hydraulic or organic loading, the biological growth can be concentrated and maintained within the reactor by adjusting the frequency of filter backwashes. However, as the flow (or organic load) is increased, the organisms begin to proliferate and a larger percent can remain in the system and be used for high levels of treatment. Thus, the system is quickly able to adjust to the strength and volume of the influent wastewater stream.

In addition to removing organic matter, the Amphidrome® treatment system is also capable of oxidizing influent nitrogen typically present in the reduced ammonia-nitrogen and organic nitrogen forms. The anoxic Amphidrome Plus reactor provides further treating of oxidized wastewater, performing a treatment step referred to as denitrification. This process releases nitrogen to the atmosphere as nitrogen gas.

Sequencing Batch Reactor Technology

The sequencing batch reactor (SBR) process is a modified activated sludge treatment process, which combines a conventional activated sludge treatment process in a single tank batch process that completes all the major steps of biological wastewater treatment in a single reactor vessel. During a batch, the SBR reactor will go through five phases of treatment consisting of the react phase, pre-settle phase, settle phase, decant phase and sludge wasting. During the react phase (aerobic treatment), both the mixer and aspirator are operated by set points associated with dissolved oxygen content in the reactor for set a time period specified by the operator. After the react phase has finished, the pre-settle phase (anoxic treatment) begins as the mixer cycles on and off while Micro-C (carbon source) is added to the SBR reactor.

Once the pre-settle phase time has expired, the settle phase (clarification step) is initiated during which, all mixing/aeration is stopped. This provides a quiescent environment for solids to settle to the bottom of the tank for a predetermined amount of time. Following the settling phase, the clarified treated effluent is drawn from the reactor during the decant phase and directed to a final effluent pump chamber. The decant phase begins once an actuated plug valve is opened and continues until the water is lowered to a preset water level in the reactor. Lastly, once the water level in the SBR reactor has reached the decant phase, the sludge wasting phase begins and directs the sludge that has accumulated on the bottom of the SBR reactor tank to the aerobic waste holding tank.

One of the primary attributes of the SBR treatment system is that this variation of the activated sludge process provides an enormous degree of flexibility in the design variations available to meet the requirements of specific waste treatment applications. Due to this flexibility and other inherent advantages, SBR systems are employed more frequently in a variety of process design situations with residential, municipal and industrial wastewater treatment applications. Furthermore, SBR's are capable of producing an extremely high quality effluent while operating over a wide range of hydraulic and organic loadings.

The biological growth providing waste treatment develops in response to the imparted load and the SBR can contain a very high level of solids and organisms within the system. During periods of low hydraulic or organic loading, the biological growth can be concentrated and maintained within the reactor by reducing the frequency of sludge wasting. However, as the flow (or organic load) is increased, the organisms begin to proliferate and a larger percent can remain in the system and be used for high levels of treatment. Therefore, sludge wasting from an SBR system is typically much less than in conventional activated sludge systems. Thus, the system is quickly able to adjust to the strength and volume of the influent wastewater stream.

In addition to removing organic matter, SBR treatment systems are also capable of oxidizing influent nitrogen typically present in the reduced ammonia-nitrogen and organic nitrogen forms. This system includes an anoxic treatment removal process have proven capable of further treating the oxidized wastewater, performing a treatment step referred to as denitrification. This process releases nitrogen to the atmosphere as nitrogen gas.

Nitrex System Technology

The Nitrex Filter is a proprietary treatment system and consists of nitrate-reactive media, formulated from wood by-products, contained in a watertight enclosure. Pretreatment is required to nitrify the wastewater. Nitrex systems sized for flows greater than 10,000 gpd are based on the same concept as the I/A system but with additional reactor volume, which allows for greater organic and nitrogen pollutant removal. The effluent from pretreatment percolates through the Nitrex Filter's reactive media. Effluent from the Nitrex Filter is recycled once or multiple times over the media, with the final effluent discharged to the soil absorption system. For installations indicating wastewater with high strength TKN-nitrogen and low alkalinity, an alkalinity feed system is provided with the Nitrex System.

4.4 DECENTRALIZED TREATMENT SYSTEM LAYOUTS AND COST EVALUATIONS

Consistent with the procedure to evaluate the Innovative/Alternative treatment system in Section 3, a Groundwater Discharge Permit RFP was forwarded to five vendors to obtain proposals for a system capable of servicing the uses listed in Scenarios #1 and #2, which are based on 25,000 gallon and 35,000 gallon system options. The RFP, included in Appendix C, requested the following information from the vendors, with the vendor proposals submitted to the Team on or about July 29, 2020.

- Budgetary cost of the proposed equipment package;
- Size system components and required layout;
- Operational costs;
- Maintenance costs.

The following paragraphs summarize each vendor's proposal and details the required size of the system, the necessary infrastructure components based on the MassDEP Guidelines for Small Wastewater Treatment Facilities and/or the technology manufacturer's requirements, and the cost of the equipment package. Figures detailing the conceptual layout of each system are included at the end of this section.

Membrane Bioreactor System

For the membrane bioreactor option, we solicited proposals from two vendors based on two different treatment system configurations; 1) a prefabricated skid configuration (Ovivo) and 2) an assemble in-place configuration (F.R. Mahony). The system proposal submitted by Ovivo proposed a 3-Zone MBR skid for the 25,000 gallon option and a 4-Zone MBR skid for the 35,000 gallon option, while F.R Mahony proposed a two (2) membrane cassette option for 25,000 system and a three (3) membrane cassette option for the 35,000 gallon system.

As proposed by Ovivo, the 25,000 gallon MBR treatment skid system would have a skid footprint of 8'-6" wide and 31'-7" long. The skid system would include an on-board fine screen system prior to the pre-aeration basin. Following the pre-aeration basin, the wastewater would be equally divided between two MBR basins, each containing two cassettes of M2 membranes. Within the three zones, the wastewater undergoes aerobic and anoxic treatment to remove organics and nitrogen compounds, and is then filtered via the membranes using a vacuum pump system. The final treated wastewater then undergoes ultraviolet disinfection treatment prior to being directed to a final effluent pump chamber. Also included as part of the skid system are recirculation pumps, wasting pumps and process blowers. For the proposed equipment package, Ovivo estimates a cost of $799,126.00.

Additional system components required would include a 14,000 gallon pretreatment tank and a 14,000 gallon flow equalization tank at the system headworks, a building with a minimum footprint of 28 feet wide by 38 feet long, a 10,000 gallon sludge storage tank, and a 7,000 gallon final effluent pump chamber. The proposed layout of the system, as shown on Figure 17, is based on locating the treatment system headworks, building, sludge storage tank and final effluent pump chamber within the northeast portion of the site and to the north of the water storage tank access road.

For the 35,000 gallon MBR treatment skid system option, Ovivo proposed an MBR skid footprint of 8'-6" wide and 49'-11" long. The skid system would include an on-board fine screen system prior to an anoxic zone. Following the anoxic zone, the wastewater would be directed to a pre-aeration zone and then be equally divided between two MBR basins, each containing four cassettes of M6 membranes. Within the four zones, the wastewater undergoes aerobic and anoxic treatment to remove organics and nitrogen compounds, and is then filtered via the membranes using a pump system. The final treated wastewater then undergoes ultraviolet disinfection treatment prior to being directed to a final effluent pump chamber. Also included as part of the skid system are the recirculation pumps, wasting pumps and process blowers. For the equipment package that would be furnished, Ovivo estimates a cost of $877,060.00.

Additional system components required include an 18,000 gallon pretreatment tank and an 18,000 gallon flow equalization tank at the system headworks, a building with a minimum footprint of 28 feet wide by 55 feet long, a 10,000 gallon sludge storage tank, and a 9,000 gallon final effluent pump chamber. The proposed layout of the system, as shown on Figure 18, is based on locating the treatment system headworks, building, sludge storage tank and final effluent pump chamber within the northeast portion of the site and to the north of the water storage tank access road.

The MBR systems proposed by F.R. Mahony are based on utilizing precast concrete tanks to serve as treatment zones with the treatment system components installed within each tank. For both treatment scenarios, the MBR system would include an anoxic zone, an aeration zone, and an MBR reactor to accomplish organics and nitrogen removal. The treated effluent is then drawn through the membranes using a vacuum pump system and directed to the ultraviolet disinfection system prior to the final effluent pump chamber. Also included as part of the equipment package are the process aeration systems, chemical feed systems, and internal recirculation pumps. F.R. Mahony estimates the cost of the equipment packages for the 25,000 gallon and 35,000 gallon options to be $352,000 and $390,050, respectively. The difference in cost is associated with the size of equipment provided as the configuration is the same, but the volumes and equipment capacities increase commensurate with the volume of sewage to be treated.

Additional system components for the 25,000 gallon system include a 14,000 gallon pretreatment tank and a 14,000 gallon flow equalization tank at the system headworks, a building with a minimum footprint of 20 feet wide by 22 feet long, a 10,000 gallon sludge storage tank, and a 7,000 gallon final effluent pump chamber. The proposed layout of the system, as shown on Figure 19, is based on locating the treatment system headworks, sludge storage tank and final effluent pump chamber within the southeast portion of the site in the area in front of the 16 unit proposed building. The MBR treatment system building could be located in the northwest of this parking lot.

The additional system components for the 35,000 gallon system includes an 18,000 gallon pretreatment tank and an 18,000 gallon flow equalization tank at the system headworks, a building with a minimum footprint of 20 feet wide by 22 feet long, a 10,000 gallon sludge storage tank, and a 9,000 gallon final effluent pump chamber. The proposed layout of the system, as shown on Figure 20, is based on locating the treatment system headworks, sludge storage tank and final effluent pump chamber within the southeast portion of the site in the area in front of the 16 unit proposed building. The MBR treatment system building could be located in the northwest of this parking lot.

Amphidrome System

F.R. Mahony also provided proposals for the Amphidrome Treatment System at the two flow volume scenarios. For each proposal, F.R. Mahony proposed an Amphidrome system based using an Amphidrome Reactor and an Amphidrome Plus Reactor. The systems would each be configured to include an anoxic/equalization tank, the Amphidrome Reactor, a clear well, an Amphidrome Plus Reactor, and a combination final effluent/Plus backwash chamber.

The proposed layout for the 25,000 gallon system, shown on Figure 21, includes a 25,000 gallon anoxic/equalization tank followed by an 8-foot diameter Amphidrome Reactor. The primary screened wastewater is then filtered through the Amphidrome media and directed to a 7,000 gallon Amphidrome clear well. Within the Amphidrome clear well there are two sets of duplex pump systems, with one set serving as the Amphidrome reverse flow/backwash pumps and the other set dedicated to the Amphidrome Plus feed. The wastewater is then directed to the 4-foot diameter Amphidrome Plus reactor for enhanced nitrogen removal and is collected in a 7,000 gallon Amphidrome Plus clear well for re-treatment or discharged to the ultraviolet disinfection system and effluent disposal system.

Ancillary equipment included in the proposed system include duplex blowers, chemical feed systems, and an ultraviolet disinfection system. With this system, a small building (10' x 20') would be required to house the control panel, blowers, and chemical feed system. For the equipment package that would be furnished, F.R. Mahony estimates a cost of $193,500.00.

The proposed layout for the 35,000 gallon system, shown on Figure 22, would include 35,000 gallon anoxic/equalization tank followed by a 9'-6" wide by 10'-6" long Amphidrome Reactor. The primary screened wastewater is then filtered through the Amphidrome media and directed to an 11,000 gallon Amphidrome clear well. Within the Amphidrome clear well there are two sets of duplex pump systems, with one set serving as the Amphidrome reverse flow/backwash pumps and the other set dedicated to the Amphidrome Plus feed. The wastewater directed to the 5-foot diameter Amphidrome Plus reactor is collected in a 9,000 gallon Amphidrome Plus clear well for re-treatment or discharge to the ultraviolet disinfection system and effluent disposal system.

Ancillary equipment included in the proposed system includes a duplex blower package, chemical feed systems, and an ultraviolet disinfection system. With this system, a small building (10' x 20') would be required to house the control panel, blowers, and chemical feed system. For the equipment package that would be furnished, F.R. Mahony estimates a cost of $261,000.00.

The proposed layout for both systems are based on locating the anoxic/equalization tank, Amphidrome Reactor, clear wells and Amphidrome Plus Reactor within the southeast portion of the site in the area in front of the 16 unit proposed building. The Amphidrome treatment system building could be located to the northwest of the tankage within the lawn area.

Sequencing Batch Reactor System

Aqua-Aerobic Systems, Inc. provided proposals for a sequencing batch reactor system at the two flow volume scenarios. For each proposal, the proposed system included a pretreatment tank, a flow equalization tank, the sequencing batch reactor system, a final effluent pump chamber and a sludge storage tank.

The proposed layout for the 25,000 gallon system, shown as Figure 23, includes a 14,000 gallon pretreatment tank, a 14,000 gallon flow equalization followed by two (2) 12 foot by 19 foot SBR basins. Once the wastewater has undergone treatment in the reactors, the effluent is decanted to a 7,000 gallon final effluent pump chamber. There is also 5,000 gallon sludge storage tank.

We wish to note that some ancillary equipment that was included in proposals by others and most likely will be needed, such as chemical feed systems and an ultraviolet disinfection system were not included in their proposed price. With this system, a small building (18' x 22') would be required to house the control panel, blowers, and chemical feed system. For the equipment package that would be furnished, Aqua-Aerobics estimates a cost of $293,000.00.

The proposed layout for the 35,000 gallon system, shown on Figure 24, includes an 18,000 gallon pretreatment tank and an 18,000 gallon flow equalization followed by two (2) 20 foot by 21 foot SBR basins. Once the wastewater has undergone treatment in the reactors, the effluent is decanted to a 9,000 gallon final effluent pump chamber.

As with the 25,000 gallon system, the chemical feed and ultraviolet disinfection ancillary systems was also not included in their proposed price. With this system, a small building (18' x 22') would be required to house the control panel, blowers, and chemical feed system. For the equipment package that would be furnished, Aqua-Aerobics estimates a cost of $299,000.00.

The proposed layout of the systems is based on locating the pretreatment tank, flow equalization tank, SBR basins, control building and final effluent pump chamber and sludge storage tank within the northeast portion of the site and to the north of the water storage tank access road.

Nitrex System

Lombardo Associates, Inc. provided proposals for a Nitrex treatment system at the two flow volume scenarios. For each proposal, the proposed system included a pretreatment tank, a flow equalization tank, AUF tank, Nitrex RMFs, Nitrex Filters, recirculation tanks, and a final effluent dosing tank.

The proposed layout for the 25,000 gallon system, shown on Figure 25 would include a 14,000 gallon pretreatment tank and a 14,000 gallon flow equalization followed by the Nitrex system. After the Nitrex system, the final effluent would be directed to an ultraviolet disinfection system prior to discharge to the ground. The total required tank volumes and sizes were not provided in the vendor's proposal, however a figure was provided indicating a total planned system footprint of 10,000 square feet is required. With this system, a small building (10' x 15') would be required to house the control panel(s) and alkalinity chemical feed system. For the equipment package that would be required, Lombardo Associates estimates a cost of $784,300.00.

The proposed layout for the 35,000 gallon system, shown on Figure 26, would include an 18,000 gallon pretreatment tank and an 18,000 gallon flow equalization followed by the Nitrex system. After the Nitrex system, the final effluent would be directed to an ultraviolet disinfection system prior to discharge to the ground. The total required tank volumes and sizes were not provided in the vendor's proposal, however a figure was provided indicating a total planned system footprint of 15,000 square feet is required. With this system, a small building (10' x 15') would be required to house the control panel(s) and alkalinity chemical feed system. For the equipment package that would be required, Lombardo Associates estimates a cost of $955,100.00.

The proposed layout of the systems shown on the attached figures is based on installing the system in the northeast portion of the site and to the north of the water storage tank access road because this is the only area that is vacant to facilitate the siting of the system. Given the proposed layout provided by the vendor, it appears that some customization of the system in conjunction with modifications to the planned site development would be required to accommodate this system, particularly at the 35,000 gallon size.

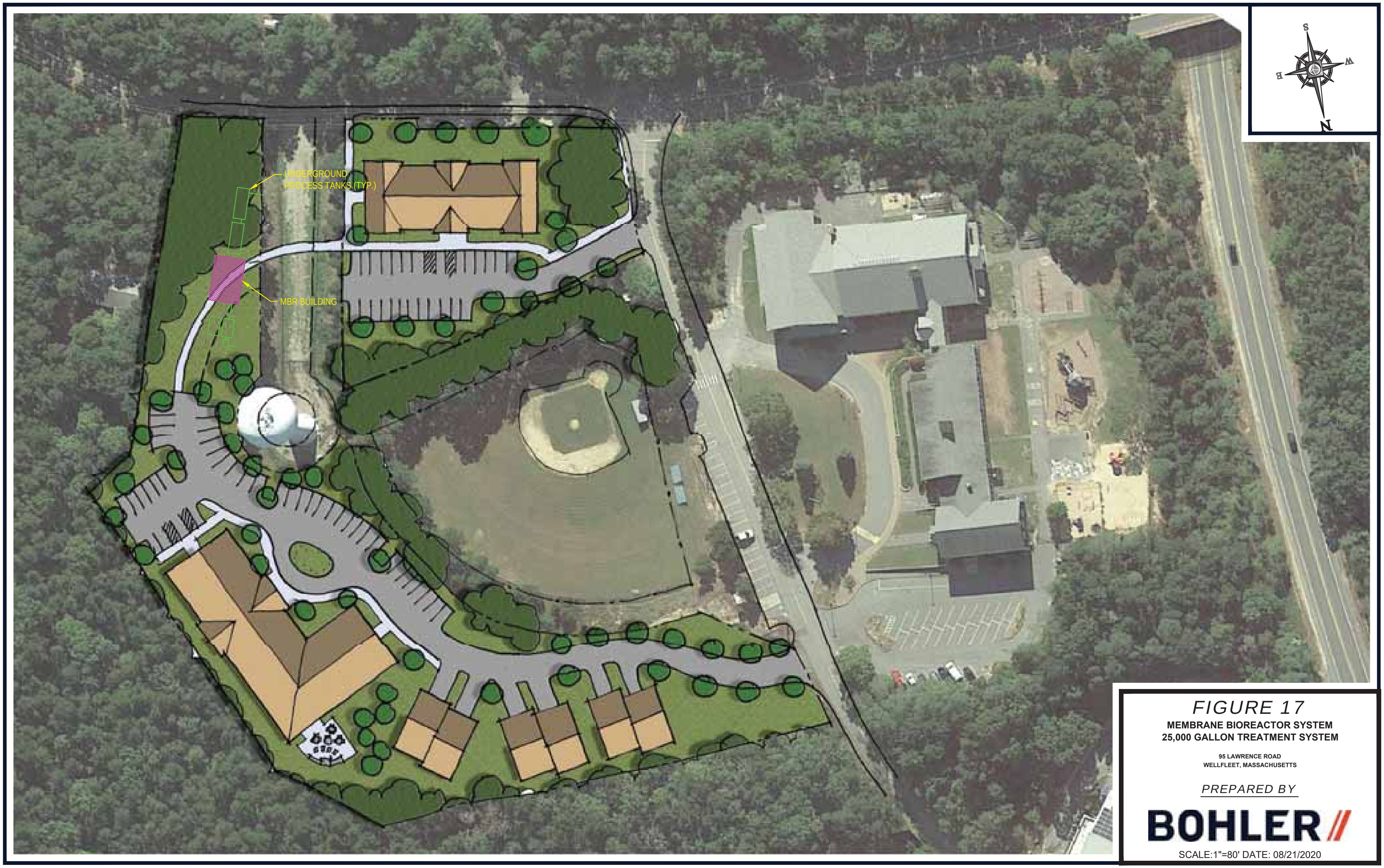

FIGURE 17
MEMBRANE BIOREACTOR SYSTEM
25,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

PREPARED BY

BOHLER

SCALE:1"=80' DATE: 08/21/2020

FIGURE 18

MEMBRANE BIOREACTOR SYSTEM
35,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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SCALE:1"=80' DATE: 08/21/2020

FIGURE 19

MEMBRANE BIOREACTOR SYSTEM
25,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 20

MEMBRANE BIOREACTOR SYSTEM
35,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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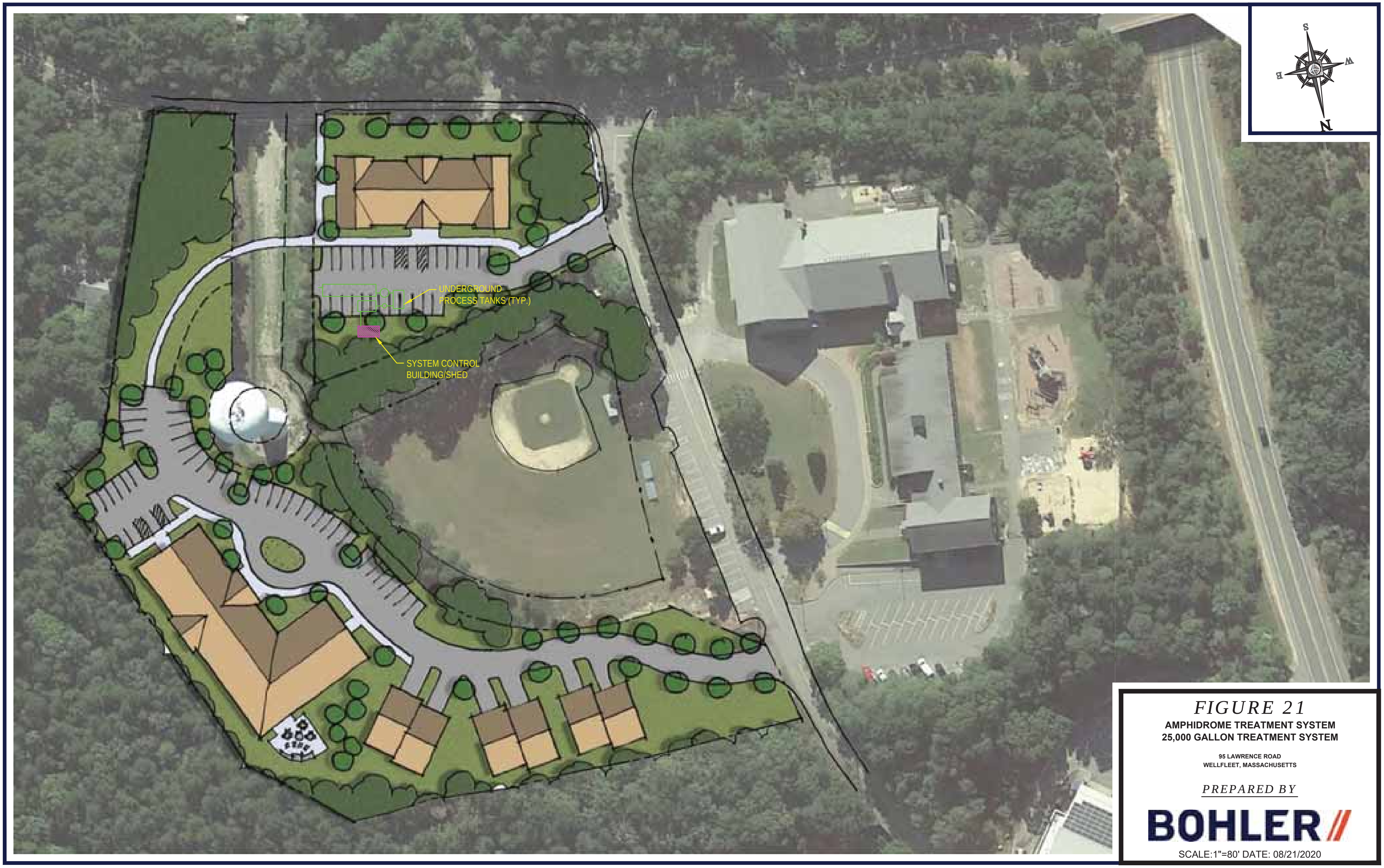

FIGURE 21

AMPHIDROME TREATMENT SYSTEM
25,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 22

AMPHIDROME TREATMENT SYSTEM
35,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 23

SEQUENCING BATCH REACTOR SYSTEM
25,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 24

SEQUENCING BATCH REACTOR SYSTEM
35,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 25

NITREX SYSTEM
25,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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FIGURE 26

NITREX SYSTEM
35,000 GALLON TREATMENT SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

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Overall Decentralized System Capital Cost Evaluation

In order to be consistent with the evaluation scope, the Team also developed and compared overall treatment system package costs to determine anticipated total capital cost associated with each system. Using the proposals that were furnished by each vendor, we compiled the information into four categories that, in general, would influence the overall cost of each system. These categories include; the proposed equipment package cost, the volume/number of tanks required for each system, required building size (if needed), and an estimate of installation/labor costs required to install each package, which takes into consideration the complexity of system installation and the amount of process piping/equipment labor. To assist with determining the cost associated with the complexity of system installation and process piping costs, the Team again consulted with a contractor that is familiar and experienced with Groundwater Discharge Permit treatment systems and has completed multiple system installations on Cape Cod.

Tables 7 and 8 below presents a summary of these costs. As noted with the I/A system cost evaluation, the cost information below is not intended to represent the total cost to build the treatment system, but rather is intended to provide a fair and objective comparison among the systems based on common aspects of the required infrastructure and work associated with a particular treatment system. These costs do not consider aspects related to collection system, miscellaneous site work, etc., that will most likely be the same for all technologies. Lastly, please note the following criteria, conditions assumptions that were used to develop this treatment system comparison:

- The costs for the sewage collection system has not been included in this analysis.
- The cost difference with providing electrical feed and distribution systems for mechanical equipment is assumed to be consistent among all technologies.
- Final site restoration work among the systems is not included, given that the site is not yet designed and it is safe to assume that the final site work would be similar for all systems.
- Building structure costs are estimated based on a $175.00 per square foot.
- The proposal for the Nitrex system did not provide the required tank volumes, we were informed this information is proprietary and would not be provided.
- The Nitrex system proposal includes costs associated engineering and permitting, which are not included by the other vendors. Therefore, the Nitrex package cost was reduced by $20,000.00 to account for this work for the purposes of this comparative analysis.
- An effluent pump chamber with a minimum volume of 7,000 gallons is proposed for the 25,000 gallon option.
- An effluent pump chamber with a minimum volume of 9,000 gallons is proposed for the 35,000 gallon option.
- Proposed equipment costs do not include local sales tax.

Table 7
Decentralized System
Cost Comparison Summary - 25,000 Gallon System
95 Lawrence Road
Wellfleet, Massachusetts

Vendor/Technology	Amphidrome	Membrane Bioreactor – Skid	Membrane Bioreactor – Assembled	Nitrex System	Sequencing Batch Reactor
Equipment Package	$193,500	$825,816	$352,000	$784,300	$343,000
Building Size (SF)	560	1,064	528	150	396
Required Tankage (gallons)	47,200	43,000	58,850	100,000	40,000
Process Piping & Installation Cost	$241,875	$165,163	$176,000	$117,645	$257,250
Building Cost	$98,000	$186,200	$92,400	$26,250	$29,700
Tank Furnish & Installation Costs	$306,800	$215,000	$294,250	$250,000	$350,000
Total Cost	$840,175	$1,392,179	$914,650	$1,178,195	$979,950

Table 8
Decentralized System
Cost Comparison Summary - 35,000 Gallon System
95 Lawrence Road
Wellfleet, Massachusetts

Vendor/Technology	Amphidrome	Membrane Bioreactor – Skid	Membrane Bioreactor – Assembled	Nitrex System	Sequencing Batch Reactor
Equipment Package	$261,000	$903,750	$390,050	$935,100	$349,000
Building Size (SF)	560	1,540	528	150	396
Required Tankage (gallons)	69,900	55,000	74,100	100,000	55,000
Process Piping & Installation Cost	$195,750	$135,562	$292,538	$140,265	$174,500
Building Cost	$98,000	$269,500	$92,400	$26,250	$69,300
Tank Furnish & Installation Costs	$487,500	$275,000	$370,500	$300,000	$475,000
Total Cost	$1,042,250	$1,583,812	$1,145,488	$1,401,615	$1,067,800

Decentralized Treatment System Operations Cost Evaluation

In addition to assessing the capital costs associated with furnishing and installing these systems, as part of our analysis, we compiled and compared the anticipated operational costs associated with the ongoing operation and maintenance of the systems.

To complete this task, the Team requested that each vendor furnish a summary of their estimated annual operational costs associated with their system. As part of this process, we also requested estimated electricity and chemical use as well as anticipated sludge generation and disposal costs.

Tables 9 and 10 below summarizes the costs for operations and maintenance of each system at the two flow assessment options, as provided by the vendors and includes estimated costs associated with electricity, chemicals, sludge pump, and requirements for operation and oversight.

In addition, as separate line items, we have included operational costs associated with the MassDEP annual compliance fee, operator oversight, and laboratory testing requirements that are standard conditions of a General Groundwater Discharge Permit. These items were included in order to provide a complete estimate of annual operation costs associated with each system.

We wish to note the following criteria used for the annual operation and maintenance cost summaries:

- Laboratory influent and effluent sampling requirements, in addition to the MassDEP annual compliance fee, were based on a General Groundwater Discharge Permit. This is based on a system design flow of less than 50,000 gallons and the discharge not being located within a Zone II or an Interim Wellhead Protection Area (IWPA).
- Sludge pumping is based on a minimum of 14,000 gallons, which accounts for pumping of the system headworks at least once per year.
- Electrical costs are based on a rate of $0.1491 per kilowatt hour.
- Sludge pumping costs are based on a rate of $0.18 per gallon.
- Chemical costs associated with alkalinity adjustment (sodium bicarbonate) and supplemental carbon (Micro-C) are based $0.10/lb. and $8.00/gallon, respectively. The Nitrex system alkalinity adjustment system is based soda ash at $1.56/lb.

Table 9
Groundwater Discharge Permit
Opinion of Annual Operation Cost Summary
25,000 Gallon System
95 Lawrence Road
Wellfleet, Massachusetts

Vendor/Technology	Amphidrome	Membrane Bioreactor – Skid	Membrane Bioreactor – Assembled	Nitrex System	Sequencing Batch Reactor
Electricity (kWh/day)	59	301	187	47	230
Sludge Pumping (gallons)	36,100	144,305	61,340	27,333	69,000
Chemicals					
Alkalinity/pH Adjustment (lbs./day)	43.8	-	-	-	-
Supplemental Carbon (gallons/day)	0.95	-	-	-	-
Estimated Costs					
Electricity Cost	$3,200	$16,380	$10,176	$2,558	$12,517
Chemical Cost	$4,372	$4,028	$3,928	$4,223	$4,000
Sludge Pumping	$6,498	$25,975	$11,041	$4,920	$12,420
Vendor's Estimated Operation Cost	$14,070	$46,383	$25,145	$11,701	$28,937
Contract Operations Oversight	$40,000				
Laboratory Testing	$7,000				
MassDEP Annual Compliance Fee	$1,080				
Routine Maintenance	$10,000				
Estimated Overall Annual Cost	$72,150	$104,463	$83,225	$69,781	$87,017

Table 10
Groundwater Discharge Permit
Opinion of Annual Operation Cost Summary
35,000 Gallon System
95 Lawrence Road
Wellfleet, Massachusetts

Vendor/Technology	Amphidrome	Membrane Bioreactor – Skid	Membrane Bioreactor – Assembled	Nitrex System	Sequencing Batch Reactor
Electricity (kWh/day)	89	340	226	105	317
Sludge Pumping (gallons)	70,500	161,934	128,230	30,667	97,000
Chemicals					
Alkalinity/pH Adjustment (lbs./day)	65.7	-	-	-	-
Supplemental Carbon (gallons/day)	1.1	-	-	-	-
Estimated Costs					
Electricity Cost	$4,844	$18,503	$12,299	$5,714	$17,252
Chemical Cost	$5,610	$8,264	$4,892	$5,913	$6,000
Sludge Pumping	$12,690	$29,148	$23,081	$5,520	$17,460
Vendor's Estimated Operation Cost	$23,144	$57,464	$40,272	$24,247	$40,712
Contract Operations Oversight	$40,000				
Laboratory Testing	$7,000				
MassDEP Annual Compliance Fee	$1,080				
Routine Maintenance	$10,000				
Estimated Overall Annual Cost	$81,224	$115,544	$98,352	$82,327	$98,792

4.5 DECENTRALIZD SYSTEM EFFLUENT DISPOSAL SYSTEM EVALUATION

As detailed in Section 2, based on MassGIS and record drawings available at the Town of Wellfleet Board of Health, the soils in the vicinity of site are indicative of a sand parent material with seasonal high groundwater at a depth of greater than 24 feet below land surface. These conditions represent the most favorable conditions for siting an effluent disposal system based on criteria established by the MassDEP Guidelines for the Design of Small Wastewater Treatment Facilities (Guidelines) with respect to the required size of the system and aspects related to offset to the mounded seasonal high groundwater.

As detailed previously in Section 3, the required size of an effluent disposal system is dictated by the ability of the naturally occurring soil material to accept effluent, which is most often determined by performing a percolation test. The percolation test is a means to estimate the permeability of the soil, which in turn is used to determine the soil's Long Term Acceptance Rate (LTAR) based on the percolation rate and the class of soil. For this site given the abundance of consistent record information, we anticipate Class I soils to be present that yield percolation rates less than 2 minutes per inch. Under this scenario, the highest allowable LTAR under the Guidelines would be applicable to this site, which varies between 2.5 gpd/sf to 3.0 gpd/sf based on the system configuration utilized.

The second aspect of the siting of an effluent disposal system is its elevation in relation to seasonal high groundwater. In accordance with the Guidelines, the minimal vertical separation from the bottom of an effluent disposal system to season high groundwater shall be a minimum of four feet. Additionally, the Guidelines require that the effects of groundwater mounding associated with the discharge be considered in regard to the separation from seasonal high groundwater. Given that, based on the record information available from the Town of Wellfleet Board of Health, seasonal high groundwater was not observed at depths as deep as 24 feet below grade, therefore, we do not anticipate that maintaining the minimum vertical separation requirements will result in a mounded (i.e., above grade) effluent disposal system.

Consistent with Section 3 effluent disposal system evaluation, the Team reviewed three types of effluent disposal system configurations to serve a 25,000 gallon and 35,000 gallon wastewater discharge. These effluent disposal system configurations are based on stone leaching trenches, leaching chamber trenches, and a drip dispersal system. For each configuration, the system would be sited in the baseball field's outfield adjacent to the site. During our initial discussions with the Town, this area was determined to be the preferred location for the effluent disposal system in order to maximize the development ability of the project for the affordable housing units and not create site constraints for the development's required infrastructure (i.e., stormwater management, water distribution, etc.).

Tables 11 and 12 below present a summary of each system's specifications, size and opinion of probable cost for the 25,000 gallon discharge and 35,000 gallon discharge, respectively. Additionally, Figures 27 through 32 portray the configuration of each system and its location within the baseball field. For the purpose of preparing the opinion of probable cost for each effluent disposal system, we wish to note that

- Each scenario includes 100 feet of force main from the decentralized sewage treatment facility at the planned development to the effluent disposal system.
- Each system configuration includes reserve area between trenches/lines.

Table 11
Effluent Disposal System Summary and Opinion of Probable Cost
25,000 Gallon Discharge
95 Lawrence Road
Wellfleet, Massachusetts

	Stone Leaching Trenches	Leaching Chamber Trenches -	Drip Dispersal System
Long Term Acceptance Rate	2.5 gpd/sf	3.0 gpd/sf	1.5 gpd/sf
Effective Leaching Area	6 sf/lf	8.9 sf/lf	1.5 gpd/sf
System Configuration	17 trenches – 100 feet long	10 trenches – 100 feet long	2 zones – 56 feet by 149 feet
System Footprint	100 feet by 130 feet	100 feet by 111 feet	112 feet by 149 feet
Opinion of Estimated Cost	$207,000 to $227,000	$195,000 - $215,000	$280,000 – $309,000

Table 12
Effluent Disposal System Summary and Opinion of Probable Cost
35,000 Gallon Discharge
95 Lawrence Road
Wellfleet, Massachusetts

	Stone Leaching Trenches	Leaching Chamber Trenches -	Drip Dispersal System
Long Term Acceptance Rate	2.5 gpd/sf	3.0 gpd/sf	1.5 gpd/sf
Effective Leaching Area	6 sf/lf	8.9 sf/lf	1.5 gpd/sf
System Configuration	24 trenches – 100 feet long	14 trenches – 100 feet long	3 zones – 48 feet by 162 feet
System Footprint	100 feet by 186 feet	100 feet by 159 feet	144 feet by 162 feet
Opinion of Estimated Cost	$238,000 - $262,000	$225,000 - $248,000	$327,000 - $360,000

FIGURE 27

STONE LEACHING TRENCHES
25,000 GALLON EFFLUENT DISPOSAL SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

PREPARED BY

BOHLER

SCALE:1"=80' DATE: 08/21/2020


EFFLUENT DISPOSAL SYSTEM
FIGURE 28
LEACHING CHAMBER TRENCHES
25,000 GALLON EFFLUENT DISPOSAL SYSTEM
95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS
PREPARED BY
BOHLER
SCALE:1"=80' DATE: 08/21/2020

FIGURE 29

DRIP DISPERSAL SYSTEM
25,000 GALLON EFFLUENT DISPOSAL SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

PREPARED BY

BOHLER

SCALE:1"=80' DATE: 08/21/2020

FIGURE 30

STONE LEACHING TRENCHES
35,000 GALLON EFFLUENT DISPOSAL SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

PREPARED BY

BOHLER

SCALE:1"=80' DATE: 08/21/2020

FIGURE 31

LEACHING CHAMBER TRENCHES
35,000 GALLON EFFLUENT DISPOSAL SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

PREPARED BY

BOHLER

SCALE:1"=80' DATE: 08/21/2020

FIGURE 32

DRIP DISPERSAL SYSTEM

35,000 GALLON EFFLUENT DISPOSAL SYSTEM

95 LAWRENCE ROAD
WELLFLEET, MASSACHUSETTS

PREPARED BY

BOHLER

SCALE:1"=80' DATE: 08/21/2020

Also, as part of our review of an effluent disposal system for a decentralized treatment system option, we reviewed the adjacent Town-owned parcels for either siting of additional effluent disposal systems and/or utilizing existing effluent disposal system(s). These Town-owned parcels include the Town of Wellfleet's Fire Department Police Department and Elementary School sites. We wish to note that the record drawing for the Town of Wellfleet Fire Department parcel was not available, therefore the effluent disposal system configuration at this site is unknown.

Based on the available record information, the Town of Wellfleet Elementary School has the largest effluent disposal system, which was designed in April 1990 using a leaching galley trench system and has a permitted capacity of 7,920 gallons. The leaching galley trench system includes two galley systems that are 60 feet long, 12 feet wide, and 9 feet deep. According to the soil observation logs associated with the design, the site consisted of medium sand and yielded percolation rates of less than 2 minutes per inch.

Using today's current regulatory requirements, only 2 feet of the total depth of 9 feet could be counted toward allowable leaching area calculation, therefore the allowable dimensions of the galley system would be 12 feet wide by 2 feet deep. Using these dimensions and the allowable Long Term Acceptance Rate afforded by the Guidelines based on a percolation rate less than two minutes per inch (2.5 gpd/sf), the calculated theoretical design capacity of the school's effluent disposal system would be 4,800 gallons.

The effluent disposal system servicing the Town of Wellfleet Police Department, which was designed in February 1983, consists of two (2) 8-foot diameter leaching pits with a 5'-9" working level and a theoretical design capacity of 750 gallons. Using these dimensions and the allowable Long Term Acceptance Rate afforded by the Guidelines based on a percolation rate less than two minutes per inch (3.0 gpd/sf), the calculated theoretical design capacity of the Police Department's effluent disposal system would be 942 gallons.

Given that both systems theoretical design capacities would not accommodate the anticipated full flow from the planned development plus any additional combination of abutting parcels, the re-use of these systems for the 95 Lawrence Road development, in our opinion, will not be cost effective because the cost savings realized will be offset by the complexity of siting, permitting and constructing three separate leaching areas and a significant new leaching area will be required for all configurations.

4.6 DISCUSSION

In this Section, we reviewed two options, for siting a larger, decentralized treatment system to serve the proposed 95 Lawrence Road development and nearby parcels of land. As presented, the two options included a system to accommodate only the adjacent Town owned properties and one that would accommodate that, plus flow from the surrounding residential lots to the 95 Lawrence Road site. The first scenario resulted in a maximum day sewage generation of 20,407 gallons, with the second scenario, which included select residential abutters, increased the maximum day sewage generation of 32,397 gallons. Using these two sewage volumes, the Team evaluated four types of treatment technologies; membrane bioreactors, the Amphidrome system, sequencing batch reactors, and the Nitrex system.

Based on our review of the proposals and consultation with a contractor that has installed multiple decentralized treatment systems, the Amphidrome treatment system resulted in the lowest overall capital cost. Overall, the treatment system costs for the 25,000 gallon option ranged from $840,000 to $1,393,000 and the 35,000 gallon option ranged from $1,043,000 to $1,583,000. In addition, we also compiled and asses the estimated operations and maintenance costs associated with the running these systems. These costs ranged from $70,000 to $105,000 per year for the 25,000 gallon system and $82,000 to $115,000 for the 30,000 gallon system. Based on our experience, these costs appear consistent with similar size treatment systems of equal complexity.

As shown in the schematic layouts, the configuration of each system can vary substantially along with the footprint required for each system. For the purpose of this evaluation, we selected the area associated with the southwest portion of the site as the area to site each treatment system. Given that the site development is in its initial stages, there is still the possibility to locate the treatment system elsewhere on the site, if that is determined to be the most advantageous scenario.

Consistent with 95 Lawrence Road development effluent disposal system evaluation, we reviewed the same effluent disposal system configurations, which consisted of stone leaching trenches, leaching chamber trenches, and a drip dispersal system. Based on our review, it appears that the lowest capital cost system would be the leaching chamber system for both the 25,000 gallon and 35,000 gallon scenarios, which, when using the high end of the cost ranges would be $215,000 and $248,000, respectively. As noted in the Section 3 discussion, upon performing deep observation holes on the site to determine the extents/depth of top and subsoil layers, the costs difference among these options may result in one of the configurations becoming the clearer lowest capital cost option.

SECTION 5 – BUDGETARY COST SUMMARIES

5.1 SUMMARY

Based on the information and cost data generated in Sections 3 and 4, we have prepared the following Tables to compile, summarize and present a comprehensive budget and timeframe associated with each option presented for the wastewater treatment systems for the proposed 95 Lawrence Road project. The tables include comprehensive costs for the various options and systems evaluated and presents budgetary numbers that can be used to evaluate the cost/benefits for both various technologies but also to compare the cost impacts derived from increasing nitrogen removal from the watershed by incorporating additional parcels into the proposed project.

Table 13
Innovative/Alternative Treatment Systems
Opinion of Planning Budget and Timeframes
95 Lawrence Road
Wellfleet, Massachusetts

Vendor/Technology	Advantex	Amphidrome	Bioclere	FAST	Nitrex	SeptiTech
Innovative/Alternative System	$663,104	$395,270	$494,750	$494,500	$742,460	$498,000
Effluent Disposal System	$225,000	$225,000	$225,000	$225,000	$225,000	$225,000
Sub-Total	$888,104	$620,270	$719,750	$719,500	$967,460	$723,000
Contingency – 20%	$177,620	$124,054	$143,950	$143,900	$193,492	$144,600
Engineering & Permitting Services	$20,000					
Total Budget Cost	$1,085,724	$764,324	$883,700	$883,400	$1,180,952	$887,600
Design & Permitting Timeframe	6 to 9 months					
Construction Period	9 to 12 months					

Table 14
Large Decentralized Treatment System
Opinion of Planning Budget and Timeframes
25,000 Gallon Option
95 Lawrence Road
Wellfleet, Massachusetts

Vendor/Technology	Amphidrome	Membrane Bioreactor – Skid	Membrane Bioreactor – Assembled	Nitrex System	Sequencing Batch Reactor
Sewage Collection System	$900,000	$900,000	$900,000	$900,000	$900,000
Treatment Facility	$840,175	$1,392,179	$914,650	$1,178,195	$979,950
Effluent Disposal System	$215,000	$215,000	$215,000	$215,000	$215,000
Sub-Total	$1,955,175	$2,507,179	$2,029,650	$2,293,195	$2,094,950
Contingency – 20%	$391,035	$501,435	$405,930	$486,639	$418,990
Survey, Engineering & Permitting Services	$200,000	$200,000	$200,000	$200,000	$200,000
Total Budget Cost	$2,546,210	$3,208,614	$2,435,300	$2,979,834	$2,713,940
Design & Permitting Timeframe	18 to 24 months				
Construction Period	15 to 20 months				

Table 15
Large Decentralized Treatment System
Opinion of Planning Budget and Timeframes
35,000 Gallon Option
95 Lawrence Road
Wellfleet, Massachusetts

Vendor/Technology	Amphidrome	Membrane Bioreactor – Skid	Membrane Bioreactor – Assembled	Nitrex System	Sequencing Batch Reactor
Sewage Collection System	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000
Treatment Facility	$1,042,250	$1,583,812	$1,145,488	$1,401,615	$1,067,800
Effluent Disposal System	$248,000	$248,000	$248,000	$248,000	$248,000
Sub-Total	$3,690,250	$4,231,812	$3,793,488	$4,049,615	$3,715,800
Contingency – 20%	$738,050	$846,362	$758,697	$809,921	$743,160
Survey, Engineering & Permitting Services	$275,000	$275,000	$275,000	$275,000	$275,000
Total Budget Cost	$4,704,300	$5,353,174	$4,827,185	$5,134,536	$4,733,960
Design & Permitting Timeframe	18 to 24 months				
Construction Period	18 to 24 months				

As shown, the cost associated with the expanded sewage collection system for the 35,000 gallon option significantly increases the estimated total project cost.

SECTION 6 – NITROGEN REMOVAL IMPACT ASSESSMENT

6.1 OVERVIEW

Based on feedback received from Town representatives, stakeholders and regulatory agencies, we were tasked with collaborating with the Town's wastewater committee and representatives of the Cape Cod Commission (CCC) to formally develop a metric system that could be used to assess the various options presented in the technology report from both a nitrogen removal (environmental impact) and cost benefit perspective.

As part of these efforts, we reviewed the preliminary work completed on assessing the impacts the various development scenarios would have on the Duck Creek Watershed and then tailored that to the specific information developed and presented as part of the 95 Road treatment technology assessment completed as part of the Onsite/Bohler scope of work. The intent of this was to correlate and integrate the information and results developed by these two efforts into one cohesive planning document that the Town can use to determine the most environmentally and costs effective plan for developing affordable housing on the 95 Lawrence Road parcel.

6.2 MATRIX DEVELOPMENT

To complete this task, we engaged with the Town Health Agent, the CCC technical consultant assisting the Wellfleet Wastewater Planning Committee and the Town's consultant tasked with reviewing existing and future nitrogen loading impacts on the Duck Creek and Wellfleet Harbor Watersheds. As a result of this effort, a multi-faceted approach to assessing the overall watershed level nitrogen impacts associated with the various wastewater management scenarios under consideration was developed and is presented herein.

In order to accurately assess the impacts from these scenarios, the project Team felt it was necessary to review the impacts from the three categories of projects that were developed in the first phase of this study relative to anticipated nitrogen loading and removal rates. Essentially, reviewing the impacts associated with developing the 95 Lawrence Road parcel using one of the various treatment scenario's under consideration against completing the housing project using a standard Title 5 compliant septic system and making no changes to the surrounding septic systems.

As noted in Section 5 of this report, we developed comprehensive budgetary preliminary costs associated with three types of treatment scenarios; providing a stand-alone I/A treatment system for just the Lawrence Road Housing project; providing a larger treatment system that would serve the housing development and surrounding Town owned parcels and; lastly, the costs associated with completing a comprehensive sewer and treatment system that would serve not only the development and surrounding municipal parcels but the nearby residential properties as well.

It is important to note that, while many different treatment and leaching technologies were evaluated (as requested by the Town), we used the lowest capital cost for the collection, treatment and leaching systems to complete this cost/benefit analysis. If different technologies were to be used, we anticipate that the cost information utilized herein would need to be adjusted somewhat to reflect that information. It is important to understand that these selections was based solely on the previously compiled costs and that keeping the capital and O&M costs consistent across the various flow and loading scenarios analyzed was necessary to create a true "apples to apples" comparison of the cost-benefit analysis.

As discussed with the Team, various watershed nitrogen loading parameters had been established and used in the various impact models being used by the wastewater committee to ascertain impacts of current and future development and uses within the water shed. The resulting matrix developed as part of this analysis utilized this information and then combined it with both the technical and cost aspects of the treatment system feasibility work prepared as part of the first phase of this report. As a result, the matrix developed incorporates anticipated standard assumptions about wastewater nitrogen strength and flow volumes along with the cost information previously developed in order to present cost-benefit and nitrogen reduction information that is consistent with past analyses and regulatory standards, so future planning can be somewhat correlated to past assumptions.

However, while the information presented in that manner is important and should be considered in due course, as a practical matter, the Team also agreed that consideration of actual flow and loadings that are based on real world testing data from existing septic systems and treatment facilities is critical to determine what is currently happening at the water shed level relative to nitrogen pollution and what impacts any planned treatment can be expected to have for the various scenarios and configurations presented. This additional level of analysis is also critical to understanding the impacts treatment options would have on the overall watershed nitrogen levels when adding a large new discharge from the anticipated planned affordable housing project.

6.3 NITROGEN DISCHARGE IMPACTS & COST BENEFIT ANALYSIS PARAMETERS

As previously noted, we determined that a two phase analysis approach was appropriate for this additional effort. The first phase looked at anticipated nitrogen loading relative to estimated capital and operations costs associated with the three different projects under consideration. This phase was completed using the assumed standard flow and loading criteria published by the MassDEP for septic system discharges when performing nutrient loading model analysis work. Specifically, we assumed that the actual flow was equal to the Title 5 wastewater generation flow, that a liter of domestic wastewater holds 35 milligrams (mg) of nitrogen and that a standard septic system provides a small amount of nitrogen removal, to a discharge value of 26 mg/L of nitrogen.

Using these input parameters, we completed our nitrogen removal impact analysis further assuming that there were two levels of treatment that would be achieved, a low end, which assumes that treatment will be at the bare minimum required standard for I/A technologies, which is 25 mg/L, and that any tertiary level treatment system, with a groundwater discharge permit, would meet the minimum treatment standard of 10 mg/L of effluent nitrogen. In contrast, real world sampling data indicates that better performance and greater levels of nitrogen removal can reasonably be expected to occur from these systems. Therefore, under the high-end scenario, we assumed that achieving this higher level of treatment would result in an I/A discharge of 19mg/L nitrogen (from the MassDEP I/A standard) while the groundwater discharge wastewater treatment system will consistently discharge an average of 6 mg/L nitrogen. Based upon these various scenarios, we developed four matrix analyses that present the anticipated nitrogen impacts and costs for high and low treatment at assumed and actual flow and loading scenarios.

6.4 NITROGEN DISCHARGE IMPACTS & COST BENEFIT ANALYSIS RESULTS

Based upon the criteria presented in Section 6.3, Tables 16 and 17 below present the low-end and high-end anticipated treatment analysis completed for the three treatment configurations analyzed using the standard assumed flow and loading data. Table 18 and 19 present the same analysis using actual average flow and loading data that we have compiled from various I/A and wastewater treatment facility discharges throughout Massachusetts.

Each table includes a section detailing the aforementioned project parameters used as well as the anticipated design, construction and operations costs. These costs, as noted previously, were taken directly from the budgetary cost analyses performed as part of this project and presented in Sections 3, 4 and 5 of the report. In addition, in keeping with industry standard life cycle planning, we assumed a 30-year system life expectancy. Lastly, as published by USDA, we included their 2020 discount rate of 2.75% in the Net Present Value (NPV) calculations performed. NPV is a useful metric to understand when completing analyses such as this, as it captures the total present value of the future dollars expended for capital and recurring operations costs.

Table 16
Estimate Nitrogen Reduction
Low-End Treatment Efficiency Using
Title 5 and MassDEP Assumed Flow and Loading Criteria
95 Lawrence Road
Wellfleet, Massachusetts

Low-End Treatment Efficiency (higher N in effluent)			
	Lawrence Road Only Amphidrome	**Lawrence Road + Town Buildings Amphidrome**	**Full Neighborhood Amphidrome**
Project Parameters			
Title 5 Flow (gal/day)	9,900	25,000	35,000
Estimated Discharged Effluent Nitrogen (mg/liter)	25	10	10
Title 5 comparison (mg/liter)	26	26	26
Estimated Annual Nitrogen from a Title 5 Compliant Lawrence Road Development Septic System (kg/Year)		360	
Estimated Project Costs			
Treatment System	$ 395,270	$ 840,175	$ 1,042,250
Offsite Collection System (Sewer)	--	$ 900,000	$ 2,400,000
Leaching System	$ 225,000	$ 215,000	$ 248,000
Soft Costs for Design & Contingencies	$ 144,054	$ 591,035	$ 1,013,050
Total Capital Costs	$ 764,324	$ 2,546,210	$ 4,703,300
Annual Operations Cost	$ 19,404	$ 72,150	$ 81,224
30 years Operation's Costs	$ 582,120	$ 2,164,500	$ 2,436,720
O+M Net Present Value	$ 392,917	$ 1,460,987	$ 1,644,729
Total Project Lifecycle Cost	**$ 1,346,444**	**$ 4,710,710**	**$ 7,140,020**
Annual Project Life Cycle Cost	$ 44,881	$ 157,024	$ 238,001
Total Project Net Present Value	$ 1,157,241	$ 4,007,197	$ 6,348,029
Equivalent Annual Cost (NPV)	$ 38,575	$ 133,573	$ 211,601
Est. Treatment System Nitrogen reduction (kg/year)	18	563	788
Total Nitrogen Discharged to Duck Creek (kg/year)	342	345	484
Net Annual Cost of Nitrogen Removed ($/kg)	$ 2,524.23	$ 278.92	$ 301.97
Net Duck Creek Nitrogen Reduction (kg/Year)	**-342**	**203**	**428**
Watershed Nitrogen Removal Cost ($/kg)	**N/A**	**$ 772.51**	**$ 555.49**
NPV for Watershed's Nitrogen Removed Benefit ($/kg)	**N/A**	**$ 657.14**	**$ 493.87**

As shown in Table 16, using low end treatment efficiency and standard MassDEP loading assumptions, there will be an increase in the overall nitrogen in the Duck Creek Watershed were just and I/A system used on the housing development, but a net decrease if the system were expanded to provide a higher level of nitrogen removal, which increases as the scale of the project also increases. Essentially, we found, as anticipated, that the more septic systems that are removed from use and connected into a treatment system, the greater the reduction in overall nitrogen load to the Watershed there will be.

Table 17
Estimate Nitrogen Reduction
High-End Treatment Efficiency Using
Title 5 and MassDEP Assumed Flow and Loading Criteria
95 Lawrence Road
Wellfleet, Massachusetts

High-End Treatment Efficiency (lower N in effluent)						
	Lawrence Road Only Amphidrome		Lawrence Road + Town Buildings Amphidrome		Full Neighborhood Amphidrome	
Project Parameters						
Title 5 Flow (gal/day)		9,900		25,000		35,000
Estimated Discharged Effluent Nitrogen (mg/liter)		19		6		6
Title 5 comparison (mg/liter)		26		26		26
Estimated Annual Nitrogen from a Title 5 Compliant Lawrence Road Development Septic System (kg/Year)				360		
Estimated Project Costs						
Treatment System	$	395,270	$	840,175	$	1,042,250
Offsite Collection System (Sewer)	--		$	900,000	$	2,400,000
Leaching System	$	225,000	$	215,000	$	248,000
Soft Costs for Design & Contingencies	$	144,054	$	591,035	$	1,013,050
Total Capital Costs	$	764,324	$	2,546,210	$	4,703,300
Annual Operations Cost	$	19,404	$	72,150	$	81,224
30 years Operation's Costs	$	582,120	$	2,164,500	$	2,436,720
O+M Net Present Value	$	392,917	$	1,460,987	$	1,644,729
Total Project Lifecycle Cost	**$**	**1,346,444**	**$**	**4,710,710**	**$**	**7,140,020**
Annual Project Life Cycle Cost	$	44,881	$	157,024	$	238,001
Total Project Net Present Value	$	1,157,241	$	4,007,197	$	6,348,029
Equivalent Annual Cost (NPV)	$	38,575	$	133,573	$	211,601
Est. Treatment System Nitrogen reduction (kg/year)		100		701		982
Total Nitrogen Discharged to Duck Creek (kg/year)		260		207		290
Net Annual Cost of Nitrogen Removed ($/kg)	$	449.52	$	223.96	$	242.47
Net Duck Creek Nitrogen Reduction (kg/Year)		**-260**		**341**		**622**
Watershed Nitrogen Removal Cost ($/kg)		**N/A**	**$**	**459.92**	**$**	**382.72**
NPV for Watershed's Nitrogen Removed Benefit ($/kg)		**N/A**	**$**	**391.23**	**$**	**340.27**

As anticipated, Table 17 shows that if we assume a higher level of treatment will be achieved, there is an increase in the anticipated net reduction in overall nitrogen in the Duck Creek Watershed and the relative cost per kg of nitrogen removed decreases. Given that these levels of treatment have been widely observed as being consistently achievable on an average basis, we are confident that this analysis and matrix would be appropriate to use by the Town in correlation with other widely used planning and development assessment tools relative to comparing these treatment impacts against the standard assumptions used in both Regional or State wide planning efforts relative to nitrogen impacts and removal rates.

As noted in Section 6.2, using consistent assumptions for flow and loading criteria is useful when comparing the effects of a proposed project relative to other planning initiatives or assumptions, but it can be somewhat misleading relative to determining the effects that any particular action might have on the actual nitrogen concentrations in and around the Duck Creek Watershed. Since the overall impacts and health of that Watershed are the primary focus of this effort, the Team took the additional step of completing two additional analyses using anticipated actual loading and flows to better reflect what we collectively feel is more accurate real world data under both the high and low treatment level scenarios.

As previously discussed, we have access to significant amounts of historic flow and loading data from MassDEP for residential and municipal wastewater systems. As shown, actual nitrogen loadings from residential uses can be much greater than the traditional 35 mg/L used in planning guidelines. Data compiled across the State from various types of residential locations indicates that incoming nitrogen levels are often more than double that of standard estimates and, as a result, untreated septic system nitrogen levels discharged to groundwater are often greatly underestimated. The systemic problem of nitrogen impacted embayments in and around Wellfleet and Cape Cod Bay are a leading indicator of this problem. Using this information, we have assumed that the average actual concentration of nitrogen in residential sewage is 75 mg/L, which is significantly greater than the 35 mg/L used in most planning documents.

Furthermore, while it is standard industry practice to simply use the Title 5 flow as the actual volume of sewage generated from a specific use, this is also a misrepresentation of actual conditions. Title 5 flow, as defined in the regulations, is considered a maximum day flow that could be generated from a specific use. Design standards are set up in this manner so as to provide for a factor of safety when sizing wastewater systems, so that they can accommodate a maximum day without sacrificing hydraulic capacity or treatment performance. That said, a given residential maximum day flow correlates to an actual average day flow that is approximately 50 to 60 percent of that maximum. Essentially, one can anticipate receiving approximately 60% of the Title 5 (max. day) flow on an actual average daily basis. Given this, for planning and evaluating the actual impacts a treatment system might have, especially when connecting existing septic systems into a treatment plant, it is prudent to use the actual average daily flow from the existing and proposed uses in order to better reflect the actual nitrogen loading the Watershed is currently experiencing.

Therefore, based upon these average actual flow and loading design parameters, we developed the two additional matrices that incorporate this information to more accurately determine the overall nitrogen removal effectiveness and to better assess the actual removal impacts that the Town might realize from the various treatment scenarios under consideration. Tables 18 and 19 below present these findings under the low-end and high-end efficiency options, respectively.

Table 18
Estimate Nitrogen Reduction
Low-End Treatment Efficiency Using
Actual Anticipated Flow and Loading Criteria
95 Lawrence Road
Wellfleet, Massachusetts

Actual Nitrogen Reduction Levels Low-End Treatment Efficiency (higher N in effluent)						
	Lawrence Road Only Amphidrome		Lawrence Road + Town Buildings Amphidrome		Full Neighborhood Amphidrome	
Project Parameters						
Actual Average Day Flow - 60% of Title 5 (gal/day)		5,940		15,000		21,000
Estimated Discharged Effluent Nitrogen (mg/liter)		25		10		10
Title 5 comparison (mg/liter)		75		75		75
Estimated Annual Nitrogen from a Title 5 Compliant Lawrence Road Development Septic System (kg/Year)			615			
Estimated Project Costs						
Treatment System	$	395,270	$	840,175	$	1,042,250
Offsite Collection System (Sewer)	--		$	900,000	$	2,400,000
Leaching System	$	225,000	$	215,000	$	248,000
Soft Costs for Design & Contingencies	$	144,054	$	591,035	$	1,013,050
Total Capital Costs	$	764,324	$	2,546,210	$	4,703,300
Annual Operations Cost	$	19,404	$	72,150	$	81,224
30 years Operation's Costs	$	582,120	$	2,164,500	$	2,436,720
O+M Net Present Value	$	392,917	$	1,460,987	$	1,644,729
Total Project Lifecycle Cost	**$**	**1,346,444**	**$**	**4,710,710**	**$**	**7,140,020**
Annual Project Life Cycle Cost	$	44,881	$	157,024	$	238,001
Total Project Net Present Value	$	1,157,241	$	4,007,197	$	6,348,029
Equivalent Annual Cost (NPV)	$	38,575	$	133,573	$	211,601
Est. Treatment System Nitrogen reduction (kg/year)		410		1,347		1,886
Total Nitrogen Discharged to Duck Creek (kg/year)		205		207		290
Net Annual Cost of Nitrogen Removed ($/kg)	$	109.38	$	116.57	$	126.21
Net Duck Creek Nitrogen Reduction (kg/Year)		**-205.16**		**732**		**1,270**
Watershed Nitrogen Removal Cost ($/kg)		**N/A**	**$**	**214.65**	**$**	**187.36**
NPV for Watershed's Nitrogen Removed Benefit ($/kg)		**N/A**	**$**	**182.60**	**$**	**166.57**

As shown in Table 18, assuming flows at 60% of the Title 5 flow and a raw sewage nitrogen concentration of 75 mg/L causes there to be an even greater anticipated net reduction in overall nitrogen in the Duck Creek Watershed at the low-end assumed treatment performance than even the high end treatment would achieve using the standard flow and loading assumptions. When factoring in the actual anticipated treatment system performance, as shown in Table 19 below, the performance and nitrogen removal becomes even greater.

Table 19
Estimate Nitrogen Reduction
High-End Treatment Efficiency Using
Actual Anticipated Flow and Loading Criteria
95 Lawrence Road
Wellfleet, Massachusetts

Actual Nitrogen Reduction Levels High-End Treatment Efficiency (higher N in effluent)						
	Lawrence Road Only Amphidrome		Lawrence Road + Town Buildings Amphidrome		Full Neighborhood Amphidrome	
Project Parameters						
Actual Average Day Flow - 60% of Title 5 (gal/day)		5,940		15,000		21,000
Estimated Discharged Effluent Nitrogen (mg/liter)		19		6		6
Title 5 comparison (mg/liter)		75		75		75
Estimated Annual Nitrogen from a Title 5 Compliant Lawrence Road Development Septic System (kg/Year)			615			
Estimated Project Costs						
Treatment System	$	395,270	$	840,175	$	1,042,250
Offsite Collection System (Sewer)	--		$	900,000	$	2,400,000
Leaching System	$	225,000	$	215,000	$	248,000
Soft Costs for Design & Contingencies	$	144,054	$	591,035	$	1,013,050
Total Capital Costs	$	764,324	$	2,546,210	$	4,703,300
Annual Operations Cost	$	19,404	$	72,150	$	81,224
30 years Operation's Costs	$	582,120	$	2,164,500	$	2,436,720
O+M Net Present Value	$	392,917	$	1,460,987	$	1,644,729
Total Project Lifecycle Cost	**$**	**1,346,444**	**$**	**4,710,710**	**$**	**7,140,020**
Annual Project Life Cycle Cost	$	44,881	$	157,024	$	238,001
Total Project Net Present Value	$	1,157,241	$	4,007,197	$	6,348,029
Equivalent Annual Cost (NPV)	$	38,575	$	133,573	$	211,601
Est. Treatment System Nitrogen reduction (kg/year)		460		1,430		2,002
Total Nitrogen Discharged to Duck Creek (kg/year)		156		124		174
Net Annual Cost of Nitrogen Removed ($/kg)	$	97.66	$	109.82	$	118.89
Net Duck Creek Nitrogen Reduction (kg/Year)		**-155.92**		**814**		**1,386**
Watershed Nitrogen Removal Cost ($/kg)		**N/A**	**$**	**192.81**	**$**	**171.67**
NPV for Watershed's Nitrogen Removed Benefit ($/kg)		**N/A**	**$**	**164.01**	**$**	**152.63**

SECTION 7 – CONCLUSIONS

7.1 CONCLUSIONS

As presented herein, there are several viable technologies, configurations and options that the Town of Wellfleet might consider when planning for the development of the affordable housing project at 95 Lawrence Road. As one would anticipate, when the level of treatment complexity increases from an I/A septic system to a tertiary level groundwater discharge system, the capital and operations costs also increase, but so does the nitrogen removal capabilities.

In terms of the overall impacts to the Watershed, it is important to note that if the 95 Lawrence Road site was developed with a standard Title 5 compliant septic system, approximately 615 kg of additional nitrogen would be added to the Duck Creek Watershed each year. Furthermore, in the event that an I/A treatment system were employed, but was sized to only serve the new housing project, that would (even under the high-end removal scenario shown in Table 19) result in a net *increase* in nitrogen loading to the watershed. As show in the Tables above, even with I/A treatment, we anticipate the nitrogen to the watershed would increase by somewhere between 156 kg to 342 kg per year.

Given this information, the only feasible means to offset these potential impacts from the development is to require that existing septic systems surrounding the site be upgraded to include nitrogen removal in some form. As presented, the most cost effective way to achieve this is to require that the housing development employ a tertiary level treatment system with excess capacity that will allow for some combination of the surrounding municipal buildings and/or residential septic systems to be tied in. Given that the capital costs for these various scenarios increases as you add more flow into the system, the larger the project, the greater the capital and O&M costs, however, this also results in a greater the level of nitrogen removal. The key is to determine the largest project that is feasible, while providing the greatest level of nitrogen removal at the lowest overall cost.

When conducting the analysis of the calculated costs and NPV, there are several factors that appear to be important to assessing the best fit for the Town relative to how much nitrogen should be removed in order to mitigate the proposed project and/or improve the overall water quality in the Watershed. First, it is important to point out that, as previously discussed, using the anticipated actual high-end treatment levels in conjunction with the actual anticipated flows and loadings to the system demonstrates the highest overall nitrogen removal rates while not increasing capital and/or operations costs. Given that the stated goal of the Town is to improve the overall water quality in the Watershed while mitigating any impacts from the planned housing project, we believe it is appropriate rely on the data that will result in the most accurate assessment of the actual impacts any project might have.

Second, as one would suspect, the amount of nitrogen removed from the watershed increases as more septic systems are taken offline and connected into a treatment system. Therefore, on a pure, kg nitrogen removed per year basis, the largest project that can be conceived and financed will provide the greatest environmental impact. However, given the large capital cost associated with a complex sewage collection system, the cost per kg of nitrogen removed does not continue to go down at the same rate just because more and more septic systems are connected. Is shown in the cost per kg of nitrogen removed and NPV Benefit for nitrogen removed calculations shown at the bottom of Table 19. As you can see, the cost per kg of nitrogen removed doesn't decrease proportionally as the size of the system increases. As shown, this is largely a function of the cost associated with building the sewage collection system, since the treatment system and leaching costs do not significantly increase as you increase the system capacity.

Overall, it appears that in order to mitigate negative nitrogen impacts to the Watershed associated with the planned housing development at 95 Lawrence Road, some amount of existing septic systems would need to be taken offline and connected into a treatment system. Connecting in the surrounding municipal parcels to a tertiary level wastewater treatment facility at the housing development site would achieve this goal. However, given the overall NPV costs per kg nitrogen removed presented for that option versus the NPV costs associated with expanding the treatment system to include the surrounding residential area are fairly similar, it appears that removing residential septic system discharges, if desired by the Town, could be a way to cost effectively perform significant improvements to the overall Watershed's groundwater quality.

APPENDIX A

INNOVATIVE/ALTERNATIVE TECHNOLOGIES REQUEST FOR PROPOSAL

Request for I/A Treatment System Proposal
95 Lawrence Road
Wellfleet, Massachusetts

Design Intent

We are seeking budgetary cost proposals and preliminary design drawings/specifications to provide an Innovative/Alternative (I/A) Treatment System, approved under 310 CMR 15.000 - Title 5 as a “Nitrogen Reducing Technology” for a proposed residential development located in Wellfleet, Massachusetts. The project site is located at 95 Lawrence Road.

The vendor’s proposal should be based on providing a nitrogen reducing technology approved under the MassDEP’s Innovative/Alternative Program under either a General Use and/or Provisional Category that will provide a minimum effluent total nitrogen concentration of ≤ 25 mg/l. When considering the proposals, basis of evaluation of equipment for design will include, but not necessarily be limited to;

- the budgetary cost of the proposed equipment package,
- system size and complexity,
- compliance record of existing installations relative to meeting the 25 mg/L discharge limit,
- operational costs (electrical consumption, chemicals, sludge removal, etc.),
- maintenance costs, start-up services and post start-up customer support, etc.

As part of vendor’s proposal(s), information pertaining to the above-mentioned selection criteria must be submitted in a clear and concise manner, along with schematic design plans showing the proposed layout of the system, scope of supply, and necessary buildings/structures/components/tankage and/or chemical feed systems that will need to be included in the system and added to the site.

Design Criteria

Influent Characteristics (Raw Sewage):

Flow:	9,900 gallons (Maximum Day Flow)
	6,930 gallons (Maximum Month Flow)
BOD:	300 mg/L
TSS:	300 mg/L
NH3:	75 mg/L
TKN:	85 mg/L

- The system supplier shall include in their scope of supply any pump systems and chemical feed systems that are required.

- The system supplier shall incorporate all controls associated with treatment system, which shall include, but not necessarily be limited to, influent feed pump system and all chemical feed systems.
- The system supplier shall provide remote monitoring capability and alarm system (a minimum of an auto dialer is required). The monitoring system shall include five (5) spare contacts for remote monitoring of ancillary equipment beyond the required motor failure and high level alarms for all tanks, motors, etc.

Effluent Requirements:

BOD:	30 mg/L or less
TSS:	30 mg/L or less
Total Nitrogen:	25 mg/L or less
Nitrate-N:	25 mg/L or less

Proposal Due Date:

The proposals, with all pertinent information including summary of proposed equipment, necessary tankage and sizes, etc., shall be submitted to Onsite Engineering, Inc. on Friday, July 24th at 2:00pm via mail or email.

The contact for this Project is Raymond L. Willis, III, P.E., rwillis@onsite-eng.com.

End of Request for Proposal

APPENDIX B

SCENARIO #2 SERVICE AREA SUMMARY

Scenario #2 Service Area Summary
95 Lawrence Road
Wellfleet, Massachusetts

Property Address	Map/Parcel	Use	Size	Unit	GPD
10 Lawrence Road	13/3	Fire Station	6,324	SF	474
95 Lawrence Road	13/2/1	Out Building	N/A		995
100 Lawrence Road	13/2	School	484	Persons	7260
15 Cemetary Road	13/45	Residential	3	BR	330
36 Gross Hill Road	13/16	Police	11,067	SF	830
56 Gross Hill Road	13/18	Residential	2	BR	220
70 Gross Hill Road	13/17	Residential	3	BR	330
84 Gross Hill Road	13/19	Residential	2	BR	220
96 Gross Hill Road	13/20	Residential	3	BR	330
101 Gross Hill Road	13/41	Vacant	4	BR	440
110 Gross Hill Road	13/21	Residential	3	BR	330
15 Old Long Pond Road	13/15	Residential	2	BR	220
25 Old Long Pond Road	13/14	Residential	3	BR	330
45 Old Long Pond Road	13/13	Residential	2	BR	220
55 Old Long Pond Road	13/12	Residential	2	BR	220
85 Old Long Pond Road	13/10	Residential	3	BR	330
40 Old Long Pond Road	13/5	Vacant	4	BR	440
60 Old Long Pond Road	13/6	Residential	2	BR	220
80 Old Long Pond Road	13/7	Residential	5	BR	550
115 Old Long Pond Road	13/197	Residential	3	BR	330
130 Old Long Pond Road	13/198	Residential	3	BR	330
145 Old Long Pond Road	16/124	Residential	1	BR	110
160 Old Long Pond Road	16/130	Residential	3	BR	330
165 Old Long Pond Road	16/123	Residential	3	BR	330
180 Old Long Pond Road	16/131	Residential	2	BR	220
10 Nimitz Way	13/8	Residential	2	BR	220
2235 Old Kings Highway	16/122	Residential	2	BR	220
2217 Old Kings Highway	16/132	Vacant	4	BR	440
2163 Old Kings Highway	16/137	Residential	3	BR	330
10 Pine Valley Road	13/199	Residential	2	BR	220
15 Pine Valley Road	16/129	Residential	3	BR	330
20 Pine Valley Road	13/200	Residential	3	BR	330
160 Long Pond Road	13/201/1	Residential	3	BR	330
164 Long Pond Road	16/153	Residential	3	BR	330
185 Long Pond Road	13/1	Residential	3	BR	330
205 Long Pond Road	16/135	Residential	3	BR	330
225 Long Pond Road	16/134	Residential	4	BR	440
245 Long Pond Road	16/133	Residential	5	BR	550
10 Whereaway Lane	15/148/1	Residential	4	BR	440
24 Whereaway Lane	15/148/2	Residential	3	BR	330
25 Whereaway Lane	13/201/3	Vacant	4	BR	440

Total **21,549**

APPENDIX C

DECENTRALIZED TREATMENT SYSTEMS
REQUEST FOR PROPOSAL

ONSITE ENGINEERING INC.

Water, Wastewater and Stormwater Specialists

Request for Groundwater Discharge Permit Treatment System Proposal
95 Lawrence Road Site
Wellfleet, Massachusetts

Design Intent

We are seeking budgetary cost proposals and preliminary design information to provide a wastewater treatment system for a proposed development located in Wellfleet, Massachusetts.

The vendor proposals should be based on providing a treatment technology that will meet a General Groundwater Discharge Permit. When reviewing the proposals, basis of evaluation of equipment will include, but not necessarily be limited to;

- the budgetary cost of the proposed equipment package,
- system size and complexity,
- operational costs (electrical consumption, chemicals, sludge removal, etc.),
- maintenance costs, start-up services and post start-up customer support, etc.

As part of vendor's proposal(s), information pertaining to the above-mentioned selection criteria must be submitted in a clear and concise manner, along with schematic design plans showing the proposed layout of the system, scope of supply, and necessary buildings/structures/components/tankage that will need to be added to the site.

Design Criteria

Influent Characteristics (Raw Sewage):

Flow:	25,000 gallons (Maximum Day Flow)
	15,000 gallons (Maximum Month Flow)
BOD:	300 mg/L
TSS:	300 mg/L
NH3:	75 mg/L
TKN:	85 mg/L

- The system supplier shall include in their scope of supply a duplex influent feed pump system (assume 2 HP pumps), chemical feed pumps for alkalinity and supplemental carbon (primary pump with spare), duplex effluent feed pump system (assume 2 HP pumps) and a UV disinfection system.
- Any required VFDs, motor starters, control and power panels that are necessary to make a complete and functional system (even if they are not included in the main system control panel) shall be provided in the proposed layout and budgetary cost.

- The system supplier shall incorporate all controls associated with treatment system, which shall include, but not necessarily be limited to, influent feed pump system (flow equalization), all chemical feed systems, and the effluent pump system into their control and motor power package.
- The system supplier shall provide remote monitoring capability and alarm system (a minimum of an auto-dialer is required). The monitoring system shall include five (5) spare contacts for remote monitoring of ancillary equipment (i.e., flow switch, generator running, etc.) beyond the required motor failure and high level alarms for all tanks, motors, etc.

Effluent Requirements:

BOD:	30 mg/L or less
TSS:	30 mg/L or less
Total Nitrogen:	10 mg/L or less
Nitrate-N:	10 mg/L or less
Fecal Coliform:	200 col/100 mL
Oil & Grease:	15 mg/L

Proposal Due Date:

The proposals, with all pertinent information including summary of proposed equipment, necessary tankage and sizes, etc., shall be submitted to Onsite Engineering, Inc. on Friday, July 24th at 2:00pm via mail or email.

The contact for this Project is Raymond L. Willis, III, P.E., rwillis@onsite-eng.com.

End of Request for Proposal

BOHLER //

ONSITE
ENGINEERING INC.