The Birches Nursing Home

Wastewater Assessment Report

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Wastewater Assessment Preliminary Report - Final
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Executive Summary

The Birches Nursing Home (TBNH) is a community-governed organization in Musquodoboit Harbour, Nova Scotia, providing long-term care to 42 residents and employing over 100 staff dedicated to delivering resident-centred service using the latest best practice information. With TBNH no longer compliant with current long-term care standards as well as infection protection and control during the Covid-19 pandemic, an expansion project has been approved by the Department of Health and Wellness for a new 48-bed long-term care facility. To ensure that all requirements are met for this expansion project, TBNH has commissioned a qualified Geotechnical Engineering firm to perform a geotechnical and wastewater investigation at the project site.

The investigation is proposed over two phases: Preliminary Investigation and the Detailed Investigation. The Preliminary Investigation phase (Phase 1) of the wastewater assessment consists of investigating the anticipated sewage flows from The Birches Nursing Home facility. The preliminary flows are used to determine suitable options for sewage treatment and disposal that will be reviewed by TBNH and evaluated based on capital investments and operation and maintenance costs. The report recommends an option best suited to the nursing home facility. The assessment report is structured as follows:

1. Site Background,
2. Facility Flow Characterization,
3. Dispersal Field Design Considerations,
4. Sewage Servicing Options,
5. Cost Analysis, and,
6. Conclusion/Recommendations.

Hydraulic loading for nursing homes is a critical element that requires experienced evaluation. Given the type of facility and the experiences from multiple sources, the daily hydraulic flow requirements account for the higher than standard levels of organic loading. Organic loading of the nursing home has the potential to contain increased chemical composites from pharmaceuticals or inhibitors. Also, It is important to note that fats oils and grease (FOG) loading can have a significant impact on the system and any changes in these loading parameters can affect both system sizing and performance. Pre-treatment is included in the recommended design to address potential strength parameters (BOD5, TSS and TKN).

The review of treatment and disposal options that are pre-approved by NS Environment resulted in two viable systems: Advantex recirculating textile filter system and BioPro AT300 treatment system. From the options available to service. The characteristics of each of the systems were evaluated based on performance, ease of use, cost and support.

Both systems provide a high level of treatment and dispersion. They are capable of handling high loads by adding pre-treatment processes that makes both suit the nursing home needs. The technology provides advanced levels of treatment resulting in BOD and TSS below 10 mg/l. The high level of treatment with an in-soil dispersion system allows replenishment of groundwater reserves without compromising environmental quality. The cost of the systems is comparable at this level of study. The differentiating factor between the two options is in the level of support that is available locally. Advantex Treatment systems has a long-time relationship with Orenco and has hundreds of products in operation in the area. Shaw Resources has a great reputation in support for their products, however, BioPro technology is relatively new in Atlantic Canada. The BioPro system is a bit more technical in that the recirculation will require adjustment. As well, technical adjustments of the BioPro system will be set up initially, however, the local support for the system will not translate to include nursing home wastewater.

The recommendation is to move forward to Phase 2 Detailed Design with the Advantex recirculating textile system. The preliminary cost estimate for this system is approximately $445,000 plus HST.

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1 Introduction

1.1 Project Background

Since 1979, The Birches Nursing Home (TBNH) has been an integral part of the Musquodoboit Harbour community. As a community-governed organization, TBNH is committed to providing the highest standard of care and services while honoring each resident's lifelong routine. TBNH currently offers long-term care to 42 residents and employs over 100 staff members who provide resident-centered care as well as utilizing the latest best practice information for all levels of service. The existing Nursing home is located on Marine Drive (Highway 7) as seen in Figure 1.

Figure 1 Location of the existing Birches Nursing Home

Due to the age of the current building, along with concerns over the frailty of its resident population and infection protection and control during the ongoing Covid-19 pandemic, The Birches Nursing Home (TBNH) is no longer compliant with current standards for long-term care.

Early in 2021, TBNH received news from the Department of Health and Wellness (DHW) that their facility would be replaced by a new 48-bed long-term care facility as seen in Figure 2 on the following page. The proposed development site is located approximately 700 m east of the existing site off Marine Drive (Highway 7) near the intersection with Highway 357, central to the community of Musquodoboit Harbour, as seen in the Figure 2.

To ensure that everything is in place for this expansion, TBNH has decided to engage a qualified Geotechnical Engineering firm to undertake a geotechnical and wastewater investigation at the proposed project site in Musquodoboit Harbour, Nova Scotia.

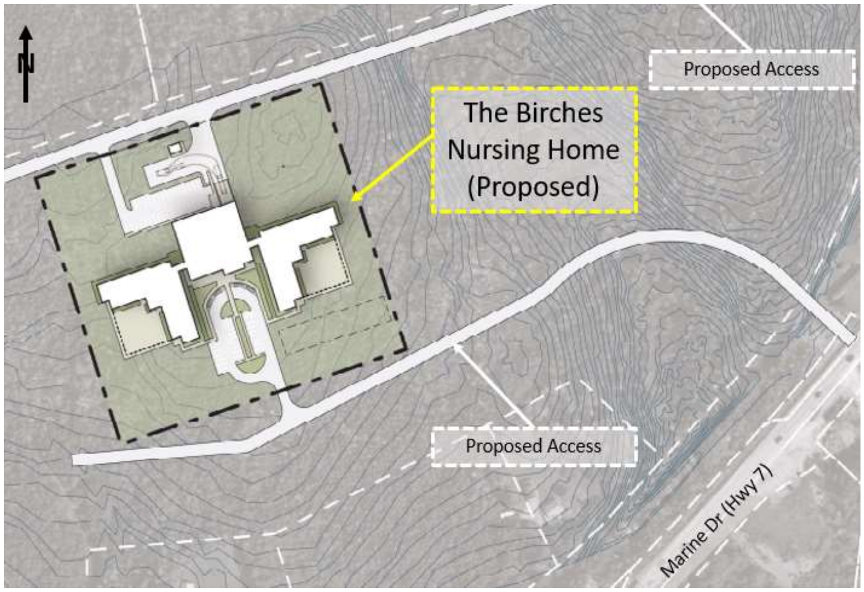

Figure 2: Proposed New Birches Nursing Home

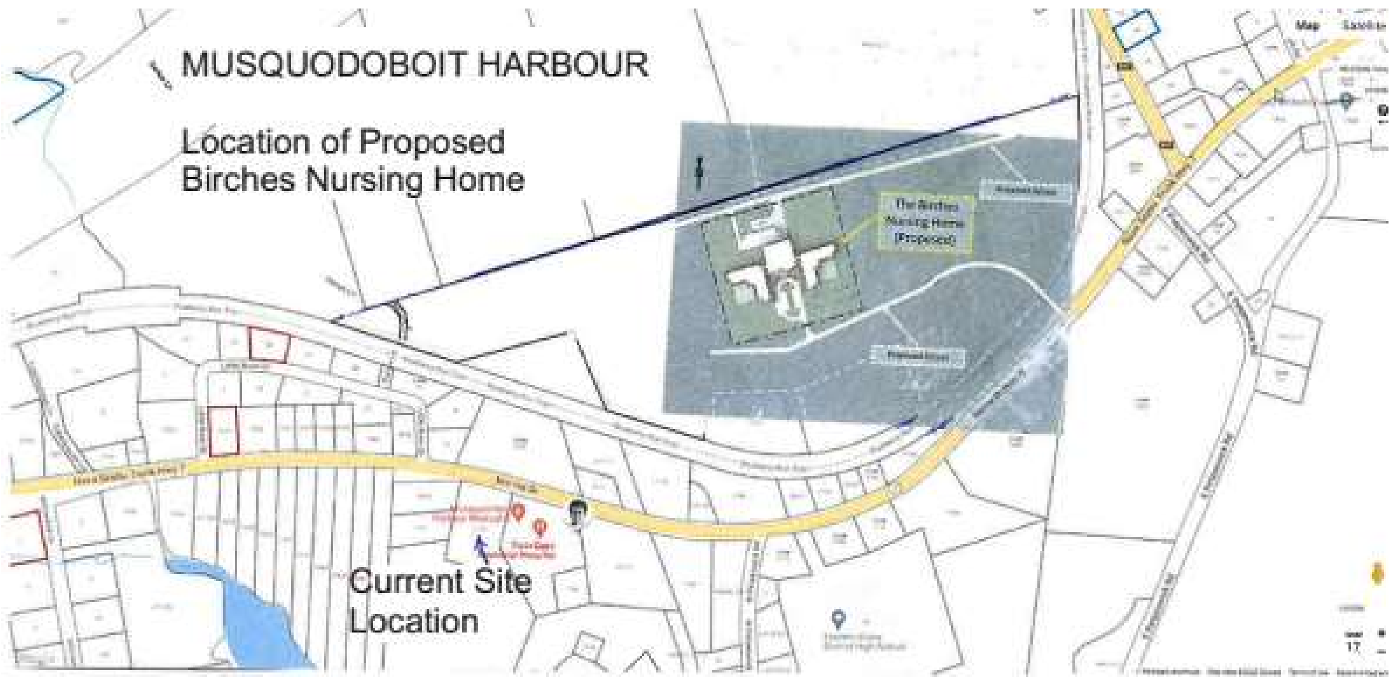

Figure 3: Proposed Location in Musquodoboit Harbour

1.2 Scope of Work

Englobe was engaged by TBNH to complete a wastewater assessment for the new development. The wastewater assessment is broken down into two (2) phases: (1) Preliminary Investigation, and (2) Detailed Investigation. This report will form the basis of preliminary assessment (Phase 1) for the new on-site sewage disposal system and the decision to proceed into Phase 2, Detailed Design will follow.

The Preliminary Investigation phase of the wastewater assessment consists of investigating the anticipated sewage flows from The Birches Nursing Home facility. These preliminary flows are used to determine suitable options for sewage treatment and disposal that will be reviewed by TBNH and evaluated based on capital investments, operations, and maintenance costs.

The following is a list of tasks that are included in the preliminary investigation and report phase.

- Review of available municipal and provincial codes and by-laws and incorporate requirements where applicable. The Nova Scotia Environment On-Site Sewage Disposal Systems Standard will be the basis of design for the system.
- Estimate the sanitary sewage flows for the facility.
- Compile the sewage treatment and disposal options and assess the suitability to the development.
- Coordinate the test pit investigation with the geotechnical team using a local excavation company for assessment of the soils for on-site disposal.
- Prepare a preliminary assessment design brief, including the suitability of options, to be presented to the team, and.
- Prepare a scaled drawing of the property and the proposed location of key features based on the layout provided by the client.

The Detailed Investigation phase (Phase 2) of the project will use the information from Phase1 to prepare a detailed design for the sewage disposal system that best suits the new development. The design will be coordinated with the Design Team.

The following is a list of tasks that are included in Phase 2 - Detailed Investigation and Report:

- Detailed design of the chosen sewage treatment and disposal option.
- Prepare a scaled set of design drawings that will be suitable for NSE approval and for a Contractor to use to construct the work.
- Application to NS Environment and correspondence to inquiries,
- Notification of Installation of the system.
- Conduct final inspection visits, complete and submit certification of installation and
- Prepare record drawings.

2 Wastewater Treatment Assessment

2.1 Site Background

The Birches Nursing Home (TBNH) building is no longer compliant with current standards for long-term care and has received news from the Department of Health and Wellness (DHW) that their facility would be replaced by a new 48-bed long-term care facility. To ensure that everything is in place for this expansion, TBNH has decided to engage a qualified Geotechnical Engineering firm to undertake a geotechnical and wastewater investigation for the proposed project site in Musquodoboit Harbour, Nova Scotia

This report will form the basis of Phase 1 of the wastewater assessment to accompany the Phase 1 Geotechnical Investigation. The Preliminary Wastewater Assessment Report follows the following outline.

- Site Background,
- Facility Flow Characterization,
- Dispersal Field Design Considerations,
- Sewage Servicing Options,
- Cost Analysis, and,
- Conclusion/Recommendations.

The work started with a review of available municipal and provincial codes and by-laws and incorporating the necessary requirements. Potential options for treatment and disposal were compiled based on their suitability for the facility, with consideration given to capital investments, operations, and maintenance costs.

For such facilities the Nova Scotia Environment has an Onsite Sewage Disposal Standard and Regulation that outlines the use of traditional contour bed systems using imported sewage sand. However, the Regulations have recently approved the use of Alternative Treatment Systems that offer smaller footprints, requiring less soil-based treatment and disposal. Approved systems must meet the requirements of a testing standard outlined by NSF 40, CAN/BNQ 3680-600 or NQ3680-910 Certified Technology.

Of the alternative sewage treatment systems, the variation between the systems allows for choosing the best fit based on several characteristics of the site.

2.1.1 Geotechnical Findings

The geotechnical investigation identified a 3.8 m deep glacial till under the rootmat organic layer. This till ranged from a silty sand and gravel till to a silt and clay till. The area of the dispersion system was in the location of three test pits (TP-04, TP-05 and TP-06). The thickness of silty sand and gravel ranges from about 0.8 m to 1.2m thick. The sand and clay till below this layer is a poorer draining material. It is best to locate any dispersion system in the upper soils characterized by the sand and gravel tills. The elevations of the overall development are not known at this time; however, the relocation of sand and gravel surface soils should be considered in the design of the dispersion system.

2.2 Facility Flow Characterization

2.2.1 Hydraulic Loading

In order to assess the available sanitary sewer demand for the facility, the hydraulic flow is the primary parameter that dictates the estimated size of the system. This is typically done based on historic flow measurements usually expressed as an average daily flow.

The Nova Scotia Environment On-Site Sewage Standard and On-Site Sewage Regulations anticipates expected flow from several developments from residential homes to industrial, commercial and institutional facilities. For this assessment, the institutional flow best suited for predicting the type of flow is for a Nursing Home facility. The facility's anticipated sewage flows will be gathered from historic data for similar facilities in Nova Scotia, as well as from flows from other parts of Canada and the United States.

The first approach is to use the Nova scotia Environment document for on-site wastewater for nursing home facilities. Also, the Atlantic Canada Wastewater Design Manual for the Collection, treatment and Disposal of Sanitary Sewage is used, however, the design flow table is not large and does not include the number of sample facilities as the other document. These documented values account for the flow as well as how the flow might relate to actual performance of the system. The typical design flows used in as outlined by the variety of sources, including regulatory guidelines are summarized in Table 1 and Table 2 below:

Table 1. Typical Peak Design Flows by Guidelines.

Reference	Type of Facility	Design Flow	Total Flow (48 Residents and 40staff) liters per day, (l/d)
Atlantic Canadian Guidelines (2006)	Nursing and Rest Homes	450 LPD (119 USGPD) per resident	21,600
(NB Technical Guidelines for On-site Sewage - Version 6 - Apr 2020)	Special Care Homes/Adult or Child Residential Facilities	450 LPD (119 USGPD)/per bed (+75 LPD (20 USGPD) per staff)	24,600
NS Technical Guidelines	Senior Citizen Homes	227 LPD (60 USGPD) Per person + Staff	19,976
(CSA Installation Code for Decentralized Wastewater Systems)	Nursing and Rest home	450-900 per resident	21,600 to 43,200

Table 2. Typical US Peak Design Flows for Nursing/Rest Homes.

State	Flow (gals-US/day)	Flow (litres/day)	Unit
Colorado	100	378	bed
Delaware	125	473	bed
Florida	100	378	bed
Idaho	125	473	bed
Kentucky	100	378	bed
Louisiana	100	378	bed
Maine	150	576	bed
Massachusetts	150	576	bed
Missouri	120	454	bed
New Hampshire	125	473	bed
New Jersey	150	576	bed
New Mexico	125	473	person
North Carolina	120	454	bed
Oklahoma	100	378	bed
Rhode Island	100	378	person
South Dakota	100	378	person
Utah	200	757	bed
Washington	200	757	bed
Wyoming	100	378	bed

The Atlantic Canada Guidelines indicates the design flow for Nursing and Rest Homes of 450 LPD (119 USGPD) per resident for a total of 21,600 liters per day for the Birches facility. The NS Environment Guideline indicates flow levels are lower for nursing homes at 227 liters per person, per day (48 beds and 40 average staff) for a total of 19,978 liters per day. These flow values are consistent with estimates from other jurisdictions. From this review, it is recommended to move forward with the Atlantic Canada flow of 21,600 liters per day (LPD).

2.2.2 Organic Loading

Organic loading for these sites is the second key sizing parameter we need to establish (as noted below and on the attached design guidelines) for design purposes. As a nursing home, the organic loading has a possibility to have higher than typical organic loading, along with the potential for chemistry from pharmaceuticals or other toxic inhibitors. The waste streams from these facilities are commercial in nature and primarily from black water sources.

It is important to note that BOD and FOG loading have a significant impact on the system and any changes in these loading parameters can affect both system sizing and performance. Design guidelines for treatment systems note that pre-treatment is often added to assist the primary treatment system. Typical parameters from such facilities are often elevated above domestic values but within the following ranges:

— BOD_5 300-700 mg/L

— TSS 100-350 mg/L

— TKN 70-120 mg/L

2.2.3 Kitchen Facilities

It is important to clarify whether a commercial kitchen will be established in this facility, or whether the units will be like apartments, with separate small kitchens in each. Commercial kitchens in these facilities can add significant surge, fats, oils, grease, sugar and carbohydrate loading to the system that would require additional retention time in a grease pre-treatment tank, prior to blending with the primary treatment tankage. If there is a commercial kitchen in the facility, it is good practice to provide a separate kitchen wastewater drain, in the building design layout, that goes to the grease pre-treatment tankage first prior to blending with the sanitary system in the primary tanks.

2.2.4 Source Control of Toxics

Antibiotics and other pharmaceutical products in the waste stream related to senior citizens and nursing care may impair microorganism health in the primary tank and treatment systems. The system design will account for negatively affects from toxic substances and care should be taken to implement some level of source control to limit their discharge (ie. avoid flushing medications, dumping excessive cleaning compounds, etc.).

2.2.5 Aeration Pre-Treatment

Some facilities incorporate the aeration pre-treatment in the treatment system design up front, or include contingency features in the tank design and controls to incorporate septic tank aeration, in the event it is ever required to knock down organic loading or help with breakdown, or oxidation, of toxic compounds related to pharmaceutical and other waste streams, or to handle higher organic loading for the treatment component of the system.

2.3 Dispersal Field Design Considerations

The treated effluent from the primary components of the treatment systems has most of the organic loading removed through treatment process but will still require disposal. Since modern secondary treatment processes can virtually eliminate most of the BOD and TSS before the effluent is applied to the soil, the full treatment capacity of the soil, microbes, fungi and plant roots is made available to address everything else in the wastewater including nutrients such as nitrogen & phosphorus, and emerging contaminants such as pharmaceuticals, personal care products, etc. Because significant treatment of most contaminants takes place within a very short distance of the dispersal piping, some jurisdictions allow reduced separation distances or drain field sizes to match the technology and soil conditions of the site.

Nova Scotia has plenty of surface water, however, much of the inland water is freshwater and environmentally sensitive to direct treated-effluent discharge.

3 Sewage Servicing Options

3.1 Approved Alternative Sewage Treatment Options

Nova Scotia Environment's requirements for small on-site sewage systems are outlined in the Onsite Sewage Disposal Regulation and Standards. The Regulation outlines traditional contour beds systems using imported sewage sand. These systems using natural soils require larger tracts of land. The Regulations have recently pre-approved the use of Alternative Treatment Systems. The approved systems still meet the requirements of a rigorous testing standard outlined by NSF 40, CAN/BNQ or BNQ (CAN/BNQ 3680-600 or NQ 3680-910) Certified Technology. These systems generally offer smaller footprints that rely less on the natural soils to provide treatment and disposal. Any of these products be used for the sewage treatment component of the system. These technologies include the following:

1. Orenco Recirculating Sand Filter;
2. Ecoflo peat system;
3. Advantex textile system;
4. Bluewater ATU;
5. AeroCell and BioCOIR;
6. Aquarobic ;and
7. BioPro.

These systems generally require an operation and maintenance agreement between the owner and the manufacturer, or a designated service provider mandated by Nova Scotia Environment (NSE). NSE will make the maintenance agreement as a part of the approval of the alternative system. The contracts are agreements between the owner and company representative that outline the frequency of site visits, and an agreement with the local distributor.

3.2 Suitability of Sewage Disposal Systems

3.2.1 Treatment System Options

The concept for most sewage treatment facilities is to use naturally occurring micro-organisms to provide treatment ready to disperse treated effluent back into the ground. This does a couple of things; it relies on micro-organisms that grow naturally to consume organic waste and it replaces treated water back into the ground to reinstate groundwater supplies. The filtration offered by the soil also cleans up any residual organic strength with no need for disinfection.

All systems outlined above approach treatment in the same manner, they rely on naturally occurring micro-organisms to break down the organics (food) provided the conditions (temperature and oxygen) are supportive. This type of system requires oxygen encouraging a non-odorous aeration process.

Given that the Nursing Home is part of an overall plan where there are development opportunities on adjacent land parcels, the sewage system should be compact. The area identified for sewage treatment and dispersion fits with the layout of the building and circulation space. The sewage disposal system can be incorporated in the overall design.

The available technologies approved by Nova Scotia Environment can supply the treatment needs. While any of these technologies could be used for sewage treatment, several of them have a long track record of providing sewage service in Nova Scotia with excellent support. With multiple applications comes knowledge and ease of operation and maintenance. As mentioned above, constructing these systems requires a long-term operation and maintenance agreement, and therefore selecting a system that has local operations success is a key element in making the selection.

Recirculating sand filters have had great success all across Nova Scotia. Such systems are heavily relied upon for remote public service facilities, such as the Toll Booth on the Cobequid Pass. The popularity of this rest stop has required it to go through a number of upgrades because of increasing use. These systems have also been very popular for public schools throughout the province; Barrington High School, West Hants Middle School and Sir John A. MacDonald to name a few. The systems have consistently provided biological oxygen demand (BOD) and total suspended solids (TSS) readings below 10/10 mg/l (BOD/TSS).

The popularity of recirculating sand filters in our region has expanded to textile systems. The textile filters offer the advantage of a smaller footprint and the ability to rejuvenate the media in the future. Textile filters also perform better with fats, oils and greases from kitchens. These characteristics were used to assess the suitability of the technology to the nursing home. There are many of these installations in Nova Scotia currently.

The cost of alternative systems for similar flows are generally comparable. The system is expected to be work using gravity flow from the facility into the initial tankage. From there, larger on-site systems generally control the circulation based on timers to disperse the organic waste regularly to the micro-organisms. This regular food to micro-organism control is the key to the high level of treatment done by these systems.

Table 3 outlines the suitability of these treatment type alternatives for The Birches Nursing Home.

Table 3: Sewage Treatment Type Suitability

Sewage Treatment	Appropriate for The Birches (yes = 1)	Proven Track Record (BOD/TSS) (yes = 1)	Ease of Use (easy = 1)	Requires Discharge (no = 1)	Expandable (yes = 1)	Compact Size (yes = 1)	Totals
On-Site Contour Beds	No	Yes	Easy	No	No	No	3
Composting Systems	No	Yes	Easy	No (liquid periodically)	No	No (1 unit per washroom)	3
Mechanical Systems (Alternative ATU)	Yes	Yes	Medium	Yes	Yes	Yes	4.5

*One point for a positive attribute / one half (½) point for medium attribute

Traditional onsite contour systems are not an option, as there is not an available contour length large enough to house the contour system. Composting systems are a valid technology however, the system would require a composting digester for each washroom unit resulting in too much space to handle the flow. Textile filters have a good treatment with the advantage of a small footprint and the ability to backwash the media. The most appropriate technology for the Birches Nursing Home sewage treatment would be an Alternative Treatment system, as defined by Nova Scotia Environment.

Table 4 outlines an assessment of the alternative treatment technologies and the appropriateness for application to The Birches Nursing Home from NS Environment's On-Site Sewage Disposal Regulations and Standards:

Table 4: Alternative Treatment Unit Evaluation

Item	ATU System	Local Distribution	Maximum Treated Flow per Unit, l	No. of Units Required	Land Size Required, sq. ft.	Appropriate for The Birches
1	Recirculating Sand Filter	Atlantic Purification	Expands to any size	1	1,500	No, due to perception
2	Advantex Textile Filter	Atlantic Purification	5,000	2	200	Yes
3	Ecoflo Peat System	Shaw	5,000	5	280	Yes, relies on peat media-regular replacement
4	Bluewater ATU, B-900	Ontario	3,500	8	1,000*	No, too large
5	AeroCell (ANUA, formerly Quanics) (Purasys SBR/ Puraflo)	Sansom Equipment	45,000	1	1,000*	No, SBR too complex (not onsite system)
6	Aquarobic Maxi-Plant Sequencing Batch Reactor	Ontario	45,000	1	1,000*	No, too complex (not onsite system)
7	BioPro, AT-300	Shaw	45,000	1	80	Yes, more mechanical

*Estimated based on literature

Summaries for the various systems are as follows:

1. Recirculating sand filters have been a great success addressing commercial, institutional and industrial needs across Nova Scotia. Many recirculating sand filters are more than 20 years old, such as the Cobequid Pass Toll Booth, Oakfield Golf and Country Club and Barrington High School. The same systems have also proved to be popular in several commercial installations with the treatment levels consistently below biological oxygen demand (BOD) and total suspended solids (TSS) requirements (10/10 mg/l (BOD/TSS)). Recirculating sand filters, although very common and effective in Nova Scotia, would require a larger land footprint and expose a pea stone surface, which would not be suitable for the Nursing Home. These have been replaced with textile filters in many instances.
2. Advantex textile filters have been applied to several systems and have proven to be very effective. This system is air-tight to control odours. One of the downsides to textile systems is that large amounts of tankage are required as septic tanks and recirculation tanks are required however their design does provide for an under-lawn dispersion system.
3. Ecoflo has a system capable of handling the flow from the home. The Ecoflo uses peat media and, with the largest unit, would require 5 units to handle the hydraulic flow. The 5 units would not be very large and would fit in to the landscape neatly. The peat media, however, must be replaced more frequently. Given the media replacement frequency and the uncertainty of handling potential toxicity, this technology, although possible, would not be the first recommendation.
4. Bluewater ATU provide units more suited to single family homes, requiring many units to treat a communal system. For that reason, this unit would require too much land space for this Nursing Home application.
5. AeroCell/Purasys systems suited to the size required as a commercial/institutional system, would be similar to a sequencing batch reactor. This is legitimate technology; however, these are more complex to operate and require a higher degree of expertise and would be less appropriate for the Nursing Home maintenance staff.

6. Aquarobic systems like the AeroCell/Purasys systems are similar to a sequencing batch reactor. The complexity of operation makes it less suitable to the Nursing Home facility.
7. BioPro requires no septic tankage, nor recirculation tankage, however, solids that represent a small portion of undegradable residual will accumulate and require more frequent maintenance. These systems also have a higher level of operational complexity and, although not defined as a treatment plant, resemble a treatment plant. For this reason, the recommendation is to use textile filter technology for this application moving forward.

3.3 Treatment Evaluation

From the data summarized in the above Table 4, the following two (2) technologies have emerged as options for The Birches Nursing Home; Advantex Textile filters and BioPro AT-300, further discussed below:

3.3.1 Recirculating Textile Filters

Textile systems are also gaining popularity as an alternative to recirculating sand filters. They come with several advantages, such as a smaller footprint and the capacity to be rejuvenated through media replacement. They also provide greater performance when dealing with oils and greases from restaurants.

To better assess the site, a study of the grounds subsurfaces were required. The test pit investigations were coordinated with the geotechnical team to assess local soils in the estimated location of the disposal system for possible on-site disposal.

The subsurface conditions encountered at the test pit locations at the site consisted of a rootmat/topsoil layer overlying glacial till or glacial till and inferred bedrock/boulders. At TP1, TP2 and TP3 underlying the glacial till, bedrock/large boulders were inferred by refusal of the excavator bucket to advance the test pit. Groundwater seepage was detected at all test pits locations. Groundwater depth ranged from 0.23 metres to 0.45 metres.

One of the suitable systems is Orenco’s Advantex Treatment Systems, which is developed for the long-term processing of domestic- and commercial-strength wastewater to advanced treatment levels. This system is ideal for sites with poor soils and small sites, especially those that require a compact “filter on top of tank” configuration.

Hydraulic Loading for nursing homes is determined by the proposed daily flow based on regulatory guidelines. In most cases, these flows are on the low-average side and should be doubled to reflect peak flow. The NS Regulation amount for Senior Homes is closer to the average daily flow seen in most jurisdictions but is still double that which would equate to typical peak flow seen in other jurisdictions. It is suggested to consider the design flow of 9,228 L/day (2438 USGPD) to be the average design flow. In the absence of metered data, in residential type applications, we could assume a peak flow to be roughly 2 times this amount or 18,456 LPD (4,876 USGPD x 2).

Organic loading for nursing homes must meet Orenco's Type 4 application levels, which are primarily black water waste with pharmaceuticals or toxic inhibitors. By utilizing Vita-Aer modern, self-aspirating septic tank aeration technology in the primary stage, BOD5, TSS and TKN levels can be reduced to residential range prior to Advantex secondary stages. This should enable a consistent supply of pre-conditioned effluent of residential strength or less to the AX-100 pod with a hydraulic residence time (HRT) of 3 days or more in the primary tankage.

Advantex systems can typically be loaded at higher rates due to the high quality of their secondary wastewater effluent (30-30 mg/l BOD & TSS or lower). Pre-treatment from these systems allow more of the treatment capacity of the soil to be used for addressing pollutants and emerging contaminants such as pharmaceuticals, personal care products. Because significant treatment of most contaminants takes place within a very short distance of the dispersal piping, some jurisdictions allow reduced separation distances or drain field sizes for the dispersal fields of these technologies. The dispersal field configuration can incorporate any approved dispersal technology, and, in many cases, larger fields can be constructed using various configurations.

Figure 4. Orenco's Advantex Treatment Systems.

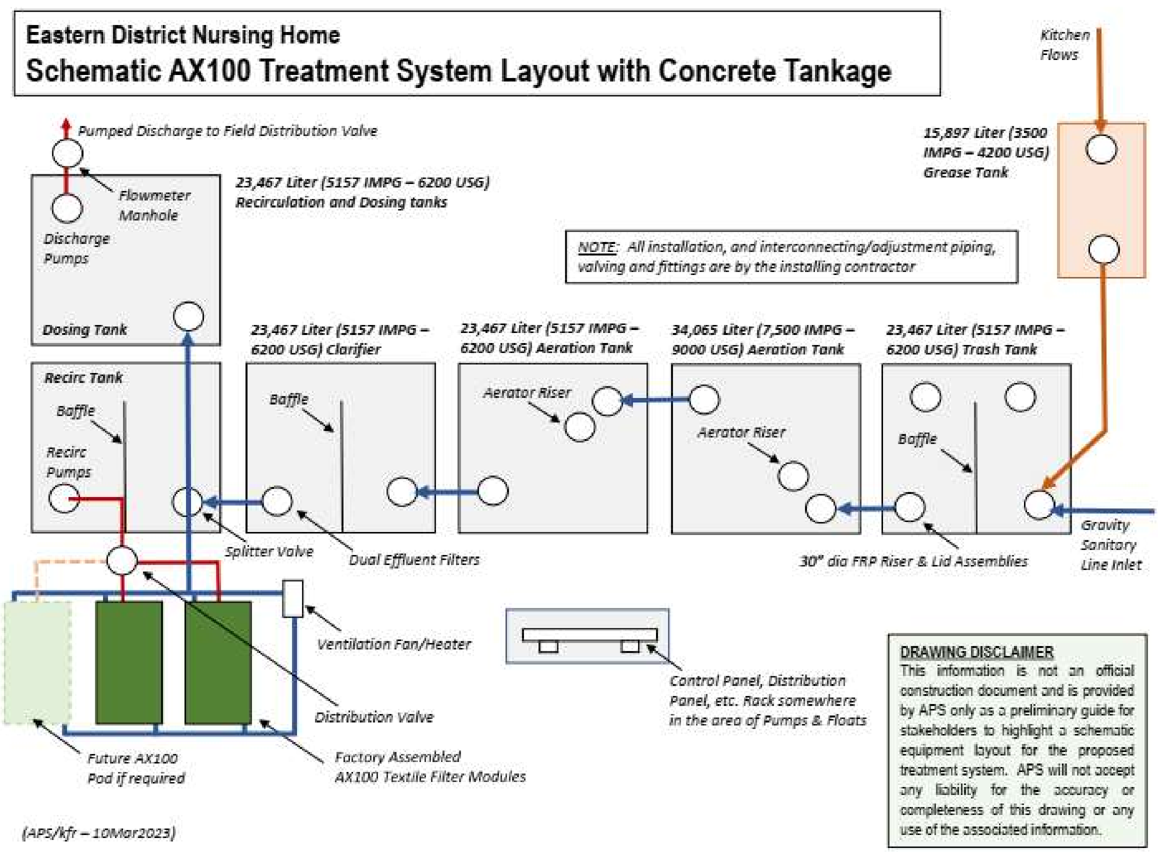

Figure 5: Advantex System Schematic

3.3.2 BioPro Treatment System

The BioPro system controls aeration recirculation of activated sludge and residence time in each chamber, so can provide treatment in a small package. This system does not require tankage (septic tank) for pre-treatment which is ideal for certain applications. As well, since the flows are controlled by pumps within the treatment module, there is only a small distance between the inlet and outlet. This is an advantage over many units that drain from the bottom of the treatment system and lose meters of elevation depth. The system is a valid technology, however, there are a number of adjustments that must be monitored that are subject to a knowledgeable operator familiar with the system and any changes in the wastewater flow and quality. The system has support from Shaw, but adjustments to the equipment will require monitoring more closely than other technology.

Shaw Resources has a great reputation in support for their products, however, BioPro technology is relatively new in Atlantic Canada. The BioPro system is a bit more technical in that the recirculation will require monitoring and adjustment. The installations that we have been familiar with were small commercial installations, where the system proposed for the nursing home is a mid-size treatment system. This system will require more effort in order to make sure the system control is set-up and monitored closely to ensure performance. Initial technical adjustments of the BioPro system will require local support for the system to address loading from the nursing home wastewater.

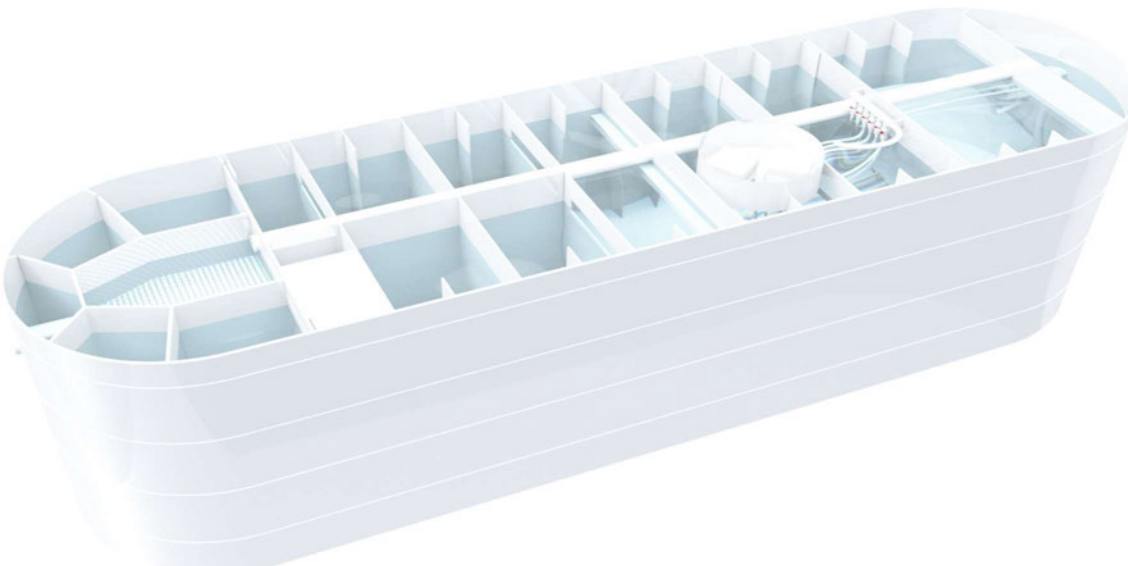

Figure 6: BioPro AT250 System

3.4 Treated Effluent Dispersion

3.4.1 Subsurface Discharge

A traditional option for discharge of treated effluent from on-site sewage systems is into the soil matrix through gravity percolation. The amount of effluent introduced to the soil is based on the percolation rate and the quality of the wastewater. The higher the quality of effluent, the longer the system will provide service. Distributing water will not deteriorate the soil and the longer the soil will maintain permeability.

There are two systems that are currently common for shallow dispersion, subsurface drip irrigation system and the infiltrator system. Both systems disperse the treated effluent into the soil based on the soil’s ability to absorb the moisture.

Shallow perforated pipes are placed over permeable soil, sized to expose the basal area to the soil based on the percolation rate of the soil. For commercial or institutional systems, treatment is done within a treatment system typically with a small footprint, however, there is always a discharge component to the treatment system.

Traditional systems discharged treated effluent into ditches or water bodies. This type of discharge requires close review of the condition of the receiving water body and, many times, it is no longer acceptable. As the level of treatment is quite high with modern treatment systems (BOD/TSS less than 10/10 mg/l), there is still some organic strength which may require dispersion into the soil. In the location of the Nursing Home, there is no receiving water body in which to discharge. Discharge into the ground soils is the best way to disperse treated effluent for this development.

There are some differences that are further developed in the following paragraphs:

3.4.1.1 Subsurface Drip Irrigation Dispersion

In areas where there are little opportunities for discharge, subsurface drip irrigation dispersion is used. This dispersion type has changed the industry when compared to the old method of piped discharges into water bodies or ditches. The potential effects on the environment are very low for the new methods. There are a number of companies who can provide these types of systems, originating from the US, as follows:

- Geoflow
- Netafim USA
- Norweco

One manufacturer who distributes in Nova Scotia by a local company is Geoflow Drip Irrigation system. This system is designed based on the permeability of natural soil to disperse the treated effluent into the ground. As the drip tubing is shallow, much of the dispersed liquid is available for evapotranspiration into the surface vegetation. At Musquodoboit Harbour, the surface soils are a gravelly sand, ideal for dispersion of water into the ground. The area planned for the dispersion system will be a grassed surface ideal for maintaining a manicured lawn.

Small but robust, high head, low horsepower pumps can be used to provide equalized flow across the area trenches in timed and intermittent micro-doses over 24 hours which avoids saturation of the soil while enhancing re-aeration and facilitating microbial activity on the wastewater. This pressurized micro-dosing further enhances infiltration characteristics of the bed by enhancing evapotranspiration and soil microbial activity which facilitates higher loading rates.

Drip irrigation systems require small drip piping to be placed approximately 150 mm to 250 mm below the surface in the soil. The piping has emitter orifices at a spacing of 600 mm apart with pipes that are spaced about 600 mm apart throughout the dispersion area. The size of the system is dependent on the permeability of the soil such that the right amount of seepage of treated effluent will match the ability of the soil to disperse it.

An important feature of the system is herbicide located at the emitter. The herbicide at the emitter is impregnated into the pipe construction, as is the slimegard in the interior of the pipe. This is intended to last for the life of the system which is a 20-30 year period. It is intended to deter roots from growing toward the pipe which otherwise would cause problems, as root growth reduces the flow, eventually resulting in pipe failure. Roots from grass are shallow and not as large or invasive as shrubs such as willow. A key design consideration of the system is to design it to ensure that no water remains in the pipe when the system is not pressurized. Since the dispersion pipes are buried shallow, any stagnant water in the pipe system would tend to freeze. This is considered during detailed design by locating the dosing tank on the downslope side of the system.

3.4.1.2 Infiltrator System

Another type of dispersion system is a shallow infiltration system. Shallow Infiltrator type dispersal systems can be split into multiple zones to reduce the pump horsepower required and facilitate deferral of infrastructure through modular expansion of the designed dispersion zones required. The actual soil loading rate and sizing for these systems matches the soil conditions of the site. These systems are being loaded in our region at 0.5 to 2 USGPD/ft^2 based on the soil characteristics and topography. There is potential in good soils to load these shallow trench systems at even higher rates of 2-5 USGPD/ft^2 which can reduce the field size significantly over traditional dispersal mounds and contours. The infiltrator dispersion system uses gravels that are familiar to earthworks contractors and tends to require less construction oversight, so if they are suitable may be more advantageous.

Figure 7: Infiltrator System

Table 5 outlines the three types of dispersion systems. We have included composting in this list as this system serves as a treatment and dispersion system. There is still liquid that will need to be disposed from the composting process, however, the small volume is more in-line with discharging it into a garden. This leaves two technologies that are both possible dispersion systems; subsurface discharge and infiltrators.

Table 5: Sewage Dispersion/Discharge for Treatment Systems

Sewage Discharge System	Appropriate for Site	Environmentally Friendly	Ease of Use	Cost	Totals
Subsurface Discharge (Infiltrators)	High	High	High	Medium	3.5
Subsurface Drip Irrigation	Medium	High	Medium	High	2.5

Either drip or infiltrator systems will serve the final dispersion of treated wastewater for the facility. The subsurface drip irrigation system is valid, however, the complexity within the control system is eliminated by the use of the infiltrator system. Based on the assessment of the dispersion system, a system of infiltrator units built into the sandy gravel soil level is the best option for the nursing home facility.

4 Cost Analysis

The cost of sewage treatment and disposal systems can range based on the type of system, sewage strength and flow. When disposal systems are placed in natural permeable soils, the cost tends to be lower. This occurs regularly for detached homes, but when the development is commercial or institutional, the amount of land required to provide treatment and disposal becomes too large making this approach impractical for the nursing home facility.

Most shared systems take advantage of economies of scale, so the larger the system, the cheaper the cost per treated gallon. Alternative treatment systems costs experienced will depend on the final detailed design, however, at this stage a typical cost can be applied to the flow to determine a cost per treated gallon.

Alternative systems compete directly with each other and their costs usually end up being very close to each other. For this exercise, there is no discernable difference in cost of any of the alternate systems. Cost does not offer any parameter in which to determine that one system is better than the other. The same applies for maintenance and operating costs. The costs to provide maintenance to tanks will be the same for many of the systems. Others like the BioPro system doesn't require a septic tank. The system would still require other tankage to control some of the contaminants but pumping clean-out will be increased so the costs will still be the same.

The cost per treated US gallon is approximately $60/US gallon. Applying this to the estimated flow value of 21,660 l/d (5,706 US gallons /day) = $342,360. A contingency is often applied to this figure of 30%, resulting in an estimated cost of $445,000.

As more details are developed on the system, more refinements on this figure are recommended in Phase 2 of the investigation.

5 Conclusion

After carefully evaluating the various wastewater disposal options, it can be determined that Orenco's Advantex Treatment Systems is a good option for The Birches Nursing Home. Not only are they cost-effective and easy to install, but they also provide a high level of treatment, helping to ensure that all wastewater is disposed of in an environmentally responsible manner.

The conceptual design of the textile filter system is capable of responding to nursing home quality effluent and modifications have been considered that will aid in a high level of treatment.

This system is combined with an infiltrator dispersion system that operates with the same type of equipment that will be familiar to the operator. The system must be integrated into the sandy gravel-based soils found in the top 1.2 meters of the currently soil structure. This soil can be shaped however, the system will depend on using the permeability of the sandy gravel.

Most importantly, Orenco's systems are locally supported by Atlantic Purification Systems, who have many systems throughout Nova Scotia and the Atlantic Provinces. They have skilled professionals who provide routine and specialized support both locally and directly from Orenco.

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