MAC WILLIAMS ENGINEERING LIMITED

Fall River South Development

Fall River, Nova Scotia
On-Site Sewage Treatment/Disposal Systems
Pre-Design Report

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1.0 Project Description

This report provides a conceptual level design for the treatment and disposal of both domestic and commercial sewage from the proposed Fall River South Concept Plan, (refer to SK01). The proposed development is a combination of multi-residential and commercial development, consisting of two 40 unit residential apartment buildings, one 36 unit residential apartment building, one self-storage commercial building and one commercial building for medical offices and a proposed restaurant.

Each building will be constructed on its own lot and therefore each building/lot will have its own onsite sewage treatment system. The three multi-unit residential buildings and the one commercial/restaurant structure will utilize primary and secondary sewage treatment at a centralized site on the lot. The secondary treatment will be by a recirculating trickle filter (RTF) pod system (such as AdvanTex). The RTF system includes a recirculation tank and a number of treatment pods.

Effluent from the RTF system would then flow to a dosing tank before final discharge to a sub-surface drip irrigation system. The drip irrigation system will be constructed utilizing the infiltrator system for even distribution and sub-surface absorption.

The commercial building, which will be utilized as self-storage will generate very little sanitary sewage and, therefore, it will utilize a more conventional passive onsite sewage treatment system. In this case the use of a Premier Tech Peat Ecoflo peat module unit will be utilized to minimize impact on the property and reduce the required footprint needed for the sub-surface discharge component of the system.

2.0 Flow Estimates

The NS Department of the Environment recommends design flows for onsite sewage treatment systems in the On-Site Sewage Disposal System Technical Guidelines. For comparison, in establishing residential home flows for a typical 3 bedroom home, we used an average flow of 50 USGPD (190 L/D) per person and a peak flow of 2 x average flow = 100 USGPD (380 L/D) per person for design purposes. If we assume average occupancy around 2.5 persons per 3-4 bedroom home (Canada average, 2011; NS average = 2.3 in 2011), then the average flow would be 2.5 persons x 50 USGPD (190 L/D) per person = 125 USGPD (475 L/D) and the peak would equate to 2 x 125 = 250 USGPD (950 L/D). The NS Guidelines recommend a design flow of 1000 liters per day or 265 USGPD for a three bedroom unit , which is comparable, 750 liters per day or 200 USGPD for two bedroom units and 500 liters per day or 132 USGPD for a one bedroom unit. Considering this, we can assume the NS Guidelines essentially represent peak design flows for system sizing purposes.

Based on these guidelines it was determined that the daily sanitary sewage design flows (peak) for each of the five building sites are as follows.

2.1 - Lot 1 - 36 Unit Residential Structure (The Addison of Fall River South)

This structure will consist of 22 one bedroom units (500 L/day/unit) and 14 two bedroom units (750 L/day/unit) for a total daily peak design flow of 21,500 L/day.

2.2 - Lot 2 - 40 Unit Residential Structure (The Chloe of Fall River South)

This structure will consist of 24 one bedroom units (500 L/day/unit) and 16 two bedroom units (750 L/day/unit) for a total daily peak design flow of 24,000 L/day.

2.3 - Lot 3 - Self-Storage Commercial Building (Fall River Storage)

This structure will consist of self-storage units. As there may be a small office component associated with this structure we have selected a daily peak design flow 1000 L/day.

2.4 - Lot 4 - 40 Unit Residential Structure (The Rylan of Fall River South)

This structure will consist of 24 one bedroom units (500 L/day/unit) and 16 two bedroom units (750 L/day/unit) for a total daily peak design flow of 24,000 L/day.

2.5 - Lot 5 - Commercial Building with proposed Restaurant and Medical/Dental Services (The Morgan of Fall River South)

This structure will consist of a 2,000 sq.ft restaurant space (9 L/day/sq.ft) and 2,000 sq.ft of dental/medical space (6,000 L/day) for a total daily peak design flow of 24,000 L/day.

Because the sanitary collection systems are minimal on each lot and rain leaders and stormwater systems are isolated from the sewer collection system, it is reasonable to assume that the impacts of inflow and infiltration will be insignificant.

A system flow meter will be included in the system configuration, for the RTF's, to monitor all incoming flows, except for the self-storage commercial building. The measured effluent flow data will be used to evaluate the daily design flows and adjustments can be made to suit. Also, each structure will be supplied by the HRM central water supply system and therefore each structure will have metered water supplies as well. This will provide for a secondary check on the daily sanitary design flows from each structure.

3.0 Primary/Secondary Sewage Treatment General Description

Primary Tankage & Treatment, (Lots 1, 2, 4 and 5)

The primary treatment stage provides for gross solids removal as well as BOD and TSS

reduction prior to the RTF secondary stage. The primary tankage is intended to provide for capture, separation and stratification of any large organic or inorganic solids and any residual fats, grease, oils, etc. The solids, scum and trash captured in this tankage would require periodic pump out or removal.

Generally, RTF design guidelines for commercial and multi-family developments suggest that the primary tanks be sized for 3-5 days of hydraulic retention of peak flows. In strictly residential applications, given the lower organic load, this guideline can be reduced to 2.2 days of peak flow retention as long as the user understands that more frequent pump out of solids may be required.

The primary capacity at the residential sites (Lot 1, 2 & 4) has been designed to achieve approximately 2.5 days retention under peak flow conditions. This will provide for even longer retention times during average flow periods. Lot 5 primary tankage has been designed to achieve approximately 3 days retention under peak flow conditions. This may require some further review based on the nature of the restaurant operations and their ability to exercise any source control over kitchen operations. Some national restaurant chains can be limited by corporate policy while smaller local operations can have more flexibility to adjust operations, kitchen practices, chemical & detergent use, etc. to improve wastewater discharge quality.

The primary effluent from the end of the clear zone in the last primary tank would flow by gravity through and effluent filter to the recirculation tank for secondary treatment.

Secondary Treatment, (Lots 1, 2, 4 and 5)

Secondary treatment would be accomplished by a Recirculating Trickling Filter (RTF) pod system (such as AdvanTex). Effluent from the primary tanks would enter the centralized recirculating tank and blend with returning RTF pod effluent at one end of this tank. At the other end of the tank, while tank levels are low, a recirculation pump would recirculate timed, short, intermittent doses of effluent continuously through the RTF pod filters. Once the effluent levels in the recirculation tank increase to a point where discharge is necessary, 100% of the return flow from the filters would discharge to the dispersal system. The minimum recirculation tank sizing is typically 80-100% of the average daily flow.

RTF pod systems are passive filtration and biological treatment systems. The filters have very high loading rates resulting in a footprint that is several times smaller than traditional sub-surface contour beds or sand filter options.

RTF pods come fully assembled and ready for connection to the treatment system so on-site construction activities are minimized. Factory assembly also enhances the quality of the filter installation over sand filters that are assembled and installed on site. The RTF pod configuration is modular allowing users to minimize the initial system configuration and add filters as required to reach the desired treatment level. The filter media is also sealed from rain or infiltration by retractable covers and is readily accessible for inspection and maintenance through the covers.

Incorporating flow measurement in the design will facilitate monitoring of actual flows and assist in determining the daily design flows in compliance with the sewage treatment facility capacity.

Disinfection by an ultraviolet light system will be provided if required by Nova Scotia Environment (NSE).

Refer to SK-2, SK-3, SK-5 and SK-6 for a preliminary layout of the configuration (AdvanTex) capable of treating effluent from Lots 1, 2, 4 and 5 at the estimated design flows.

Primary Tankage & Treatment, (Lot 3)

The use of a 4500 liter concrete septic tanks and effluent filter will be utilized to provide primary treatment for this property. Primary tankage clarifies the wastewater by letting the suspended solids settle to the bottom and retaining floating matter to prevent premature clogging of the treatment system. It is expected that very minimal flows will be generated by this commercial facility.

Secondary Treatment, (Lot 3)

Secondary treatment would be accomplished with the use of a Premier Tech Peat Module Unit. The peat within the module provides the secondary treatment for this passive type system. Effluent can be either gravity fed or pumped directly to the unit. The wastewater is evenly distributed over the surface of the peat media and undergoes treatment as it trickles through the natural fibrous filtering media. A dispersion bed will be constructed below the unit allowing for sub-surface discharge and providing for additional tertiary treatment.

Refer to SK-4 for a preliminary layout of the configuration capable of treating effluent from Lot 3, at the estimated design flow.

4.0 Subsurface Soil Dispersal System General Description

The use of subsurface Infiltrator trench or area bed systems can be utilized on the site for final wastewater dispersal without the requirement for UV disinfection. System applicability and sizing is very dependent on soil characteristics and the underlying soil and water horizons that can impact the vertical and horizontal flow of effluent once in the soil. The size of the area required for shallow dispersal is application specific and very dependent on the site soils and topography. Based on the known soil types typically found in this area the proposed vertical hydraulic loading rate for treated sewage effluent will utilize an application rate of 15 L/day/m^2 for the RTF treatment systems on Lots 1, 2, 4 and 5. The proposed vertical hydraulic loading rate for treated sewage effluent will utilize an application rate of 27 L/day/m^2 for the peat module treatment system proposed on Lot 3. The actual soil loading rate will have to be verified through appropriate soil analysis.

Shallow trench type subsurface dispersal systems apply high quality secondary effluent (30-30 mg/l BOD & TSS or lower) in small, intermittent pressurized doses, to the shallow and highly active area of the soil. These systems are typically placed in the top 8-16" of the soil where 40% of the plant root mat exists and 95% of the microbial activity occurs. Studies have shown that the soil's infiltrative capacity can be enhanced when high quality effluent is applied in this manner as the soil is not saturated by the dosing, no restricting biomat forms and there is an increased level of microbial activity. This activity also facilitates better aeration of the top layer, enhancing treatment capabilities.

Since modern secondary treatment processes like AdvanTex can virtually eliminate 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 help address everything else in the wastewater including nutrients such as nitrogen & phosphorus, and emerging contaminants such as pharmaceuticals, personal care products, etc. Complete treatment of most contaminants takes place within a short distance of the dispersal tube.

Pressurized trench systems require dosing tankage and pumping systems as well as field lateral piping, gravel or pre-fabricated distribution chambers (Infiltrator). The design of these systems provides for flushing and cleanout access as well as inspection ports for inspection and monitoring. The infiltrator chamber type configuration also facilities the use of video or other technologies as the dispersal trench is accessible through interconnected chambers. The systems also follow typical trench installation methods which are used regularly by contractors.

The proposed Infiltrator dispersal system can be split into multiple cells and zones in a trench type configuration to reduce the pump horsepower required and to facilitate deferral of infrastructure through modular expansion of the number of cells as required.

5.0 Preliminary Design – Sewage Treatment Systems

5.1 - Preliminary Design – Sewage Treatment System (Lot 1)

The sewage treatment preliminary design is based on the AdvanTex Treatment System. Below are the preliminary design parameters for the full build out of Lot 1.

Full Build Out Design Parameters Lot 1 :
Number of residential units (22 – 2 Bdrm units & 14 – 1 Bdrm units) = 36 units
Peak Flow (Q_P) = 21,500 L/d = 5,680 USgpd
Average Flow (Q_a) = ½ Q_P = 10,750 L/d = 2,840 USgpd
BOD5 from Primary = 150 mg/l average; 250 mg/L peak
AdvanTex Filter average hydraulic loading rate is 25 USgal/ft^2/day
AdvanTex Filter peak hydraulic loading rate is 50 USgal/ft^2/day
AdvanTex Filter organic loading rate is between 0.04 – 0.08 lbsBOD/ft^2/day

Primary Tankage Sizing

- 200% x Q_p = 2.5 x 21,500 Litres = 53,750 Litres (14,200 USgal)

Recirculation Tank Sizing

- 75% Q_p = 0.75 x 21,500 Litres = 16,125 Litres (4,260 USgal)

Dosing Tank Sizing

- At minimum recommend 2 x 11,400 liter (2 x 3000 USgal) concrete tanks for dosing tank capacity.

Peak Organic Loading

- 250 mg/L x 2.205 $x10^{-6}$ lb/mg x 3.785 L/USgal = 2.09 x 10^{-3} lbBOD/USgal
- 5,680 USgpd x 2.09 x 10^{-3} lbBOD/USgal = 11.9 lbBOD/d

Recommended AdvanTex filter size based on Peak Organic Load

- 11.9 lbBOD/d / 0.08 lbBOD/ft^2/d = 148.8 ft^2
- Use two (2) AdvanTex AX100 Pods at 100 ft^2 per pod

Recommended AdvanTex filter size based on Peak Hydraulic Load

- 5,680 USgpd / 50 USgal/ft^2/day = 113.6 ft^2
- Use two (2) AdvanTex AX100 Pods at 100 ft^2 per pod.

5.2 - Preliminary Design – Sewage Treatment System (Lot 2)

The sewage treatment preliminary design is based on the AdvanTex Treatment System. Below are the preliminary design parameters for the full build out of Lot 2.

Full Build Out Design Parameters Lot 2 :
Number of residential units (24 – 2 Bdrm Units & 16 – 1 Bdrm Units) = 40
Peak Flow (Q_P) = 24,000 L/d = 6,340 USgpd
Average Flow (Q_a) = ½ Q_P = 12,000 L/d = 3,170 USgpd
BOD5 from Primary = 150 mg/l average; 250 mg/L peak
AdvanTex Filter average hydraulic loading rate is 25 USgal/ft^2/day
AdvanTex Filter peak hydraulic loading rate is 50 USgal/ft^2/day
AdvanTex Filter organic loading rate is between 0.04 – 0.08 lbsBOD/ft^2/day

Primary Tankage Sizing

- 200% x Q_p = 2.5 x 24,000 Litres = 60,000 Litres (15,850 USgal)

Recirculation Tank Sizing

- 75% Q_p = 0.75 x 24,000 Litres = 18,000 Litres (4,760 USgal)

Dosing Tank Sizing

- At minimum recommend 2 x 11,400 liter (2 x 3000 USgal) concrete tanks for dosing tank capacity.

Peak Organic Loading

- 250 mg/L x 2.205 $x10^{-6}$ lb/mg x 3.785 L/USgal = 2.09 x 10^{-3} lbBOD/USgal
- 6,340 USgpd x 2.09 x 10^{-3} lbBOD/USgal = 13.3 lbBOD/d

Recommended AdvanTex filter size based on Peak Organic Load

- 13.3 lbBOD/d / 0.08 lbBOD/ft^2/d = 166.3 ft^2
- Use two (2) AdvanTex AX100 Pods at 100 ft^2 per pod

Recommended AdvanTex filter size based on Peak Hydraulic Load

- 6,340 USgpd / 50 USgal/ft^2/day = 126.8 ft^2
- Use two (2) AdvanTex AX100 Pods at 100 ft^2 per pod.

5.3 - Preliminary Design – Sewage Treatment System (Lot 3)

The sewage treatment preliminary design is based on the Premier Tech Ecoflo Peat Module Unit Treatment System. Below are the preliminary design parameters for the full build out of Lot 3.

Full Build Out Design Parameters Lot 3 :
Number of commercial units = 1
Average Daily Flow = Q = 1,000 L/day

Primary Tank Sizing

- Use a minimum of 4,500 Litres

Peat Module Unit Sizing

- ST 500 unit with maximum treatment capacity of 1080 L/day

5.4 - Preliminary Design – Sewage Treatment System (Lot 4)

The sewage treatment preliminary design is based on the AdvanTex Treatment System. Below are the preliminary design parameters for the full build out of Lot 5.

Full Build Out Design Parameters Lot 4 :
Number of residential units (24 – 2 Bdrm Units & 16 – 1 Bdrm Units) = 40
Peak Flow (Q_P) = 24,000 L/d = 6,340 USgpd
Average Flow (Q_a) = ½ Q_P = 12,000 L/d = 3,170 USgpd
BOD5 from Primary = 150 mg/l average; 250 mg/L peak
AdvanTex Filter average hydraulic loading rate is 25 USgal/ft^2/day

AdvanTex Filter peak hydraulic loading rate is 50 USgal/ft^2/day
AdvanTex Filter organic loading rate is between 0.04 – 0.08 lbsBOD/ft^2/day

Primary Tankage Sizing

- 200% x Q_p = 2.5 x 24,000 Litres = 60,000 Litres (15,850 USgal)

Recirculation Tank Sizing

- 75% Q_p = 0.75 x 24,000 Litres = 18,000 Litres (4,760 USgal)

Dosing Tank Sizing

- At minimum recommend 2 x 11,400 liter (2 x 3000 USgal) concrete tanks for dosing tank capacity.

Peak Organic Loading

- 250 mg/L x 2.205 x10^{-6} lb/mg x 3.785 L/USgal = 2.09 x 10^{-3} lbBOD/USgal
- 6,340 USgpd x 2.09 x 10^{-3} lbBOD/USgal = 13.3 lbBOD/d

Recommended AdvanTex filter size based on Peak Organic Load

- 13.3 lbBOD/d / 0.08 lbBOD/ft^2/d = 166.3 ft^2
- Use two (2) AdvanTex AX100 Pods at 100 ft^2 per pod

Recommended AdvanTex filter size based on Peak Hydraulic Load

- 6,340 USgpd / 50 USgal/ft^2/day = 126.8 ft^2
- Use two (2) AdvanTex AX100 Pods at 100 ft^2 per pod.

5.5 - Preliminary Design – Sewage Treatment System (Lot 5)

The sewage treatment preliminary design is based on the AdvanTex Treatment System. Below are the preliminary design parameters for the full build out of Lot 4.

Full Build Out Design Parameters Lot 5 :
Commercial units (1-Restaurant & 1-Medical Office) = 2
Peak Flow (Q_P) = 24,000 L/d = 6,340 USgpd
Average Flow (Q_a) = ½ Q_P = 12,000 L/d = 3,170 USgpd
BOD5 from Primary = 150 mg/l average; 250 mg/L peak
AdvanTex Filter average hydraulic loading rate is 25 USgal/ft^2/day
AdvanTex Filter peak hydraulic loading rate is 50 USgal/ft^2/day
AdvanTex Filter organic loading rate is between 0.04 – 0.08 lbsBOD/ft^2/day

Minimum Grease Tank Sizing

- 300% x ($Q_{kitchen\ peak}$) = 3.0 x 18,000 LPD = 54,000 Litres (14,300 USgal)

Primary Tankage Sizing

- 300% x Q_p = 3.0 x 24,000 Litres = 72,000 Litres (19,000 USgal)

Recirculation Tank Sizing

- 100% Q_p = 1.00 x 24,000 Litres = 24,000 Litres (6,340 USgal) given potential for peak flows during meal hours and majority of daily flows occurring during 8-12 hour business period only.

Dosing Tank Sizing

- At minimum recommend 2 x 11,400 liter (2 x 3,000 USgal) concrete tanks for dosing tank capacity.

Peak Organic Loading

- 300 mg/L x 2.205 $x10^{-6}$ lb/mg x 3.785 L/USgal = 2.5 x 10^{-3} lbBOD/USgal
- 6,340 USgpd x 2.5 x 10^{-3} lbBOD/USgal = 15.9 lbBOD/d

Recommended AdvanTex filter size based on Peak Organic Load

- 15.9 lbBOD/d / 0.08 lbBOD/ft^2/d = 198.8 ft^2
- Use two (2) AdvanTex AX100 Pods at 100 ft^2 per pod

Recommended AdvanTex filter size based on Peak Hydraulic Load

- 6,340 USgpd / 50 USgal/ft^2/day = 126.8 ft^2
- Use two (2) AdvanTex AX100 Pods at 100 ft^2 per pod.

6.0 Preliminary Design – Subsurface Effluent Disposal System

The hydraulic loading rate for this purpose was based on the existing soils being a sandy silty material which allows for the application rate of 15 L/day/m^2 of dispersal bed area for the RTF for Lots 1, 2, 4 and 5 and an application rate of 27 L/day/m^2 for the peat module unit on Lot 3.

Dispersal System Sizing Summary Table

Lot	Number of Pods Required	Design Flow (LPD)	Dispersal Field Length (m)	Dispersal Field Width (m)	Dispersal Field Area [m^2]
1	2	21,500	45	33	1,435
2	2	24,000	50	32	1,600
3	1	1,000	7	5.3	37
4	2	24,000	50	32	1,600
5	2	24,000	50	32	1,600

7.0 Maintenance of Sewage Disposal Systems

RTF Sewage Treatment System

Annual maintenance includes accessing and inspecting tank equipment and pods against the start-up baseline. The inspection is primarily a visual check to identify any impending problems, any irregular wear or component blockages (such as laterals or spray nozzles) plus some light rinsing or cleaning of any components that may have heavy solids loading (such as an effluent filter).

Activities might include exercising valves, checking filters, verifying proper pump and float functionality, testing lateral squirt heights against baseline measurements and visually inspecting filter material for any signs of bridging or abuse (such as FOGs, Gas, Grease or Oil, etc.) and the effluent clarity for turbidity, grease and oily films, foam, color, etc. The operator would also check for any obvious odors around the system and should clean the pump filters and flush distribution piping if necessary. Squirt testing of the laterals would be an annual requirement to identify any blockages or leaks in the system. The required checks should only take an operator a few hours each year on a larger system.

In general, unless the system is being abused or overloaded in some way, or is subject to some external influences that damage equipment, the system is low maintenance. Although annual inspection and maintenance activities are not extensive, the manufacturer promotes regular inspections and annual maintenance because, given the engineering and accessibility of the system, it can be done quite easily and to the long term benefit of the system owner.

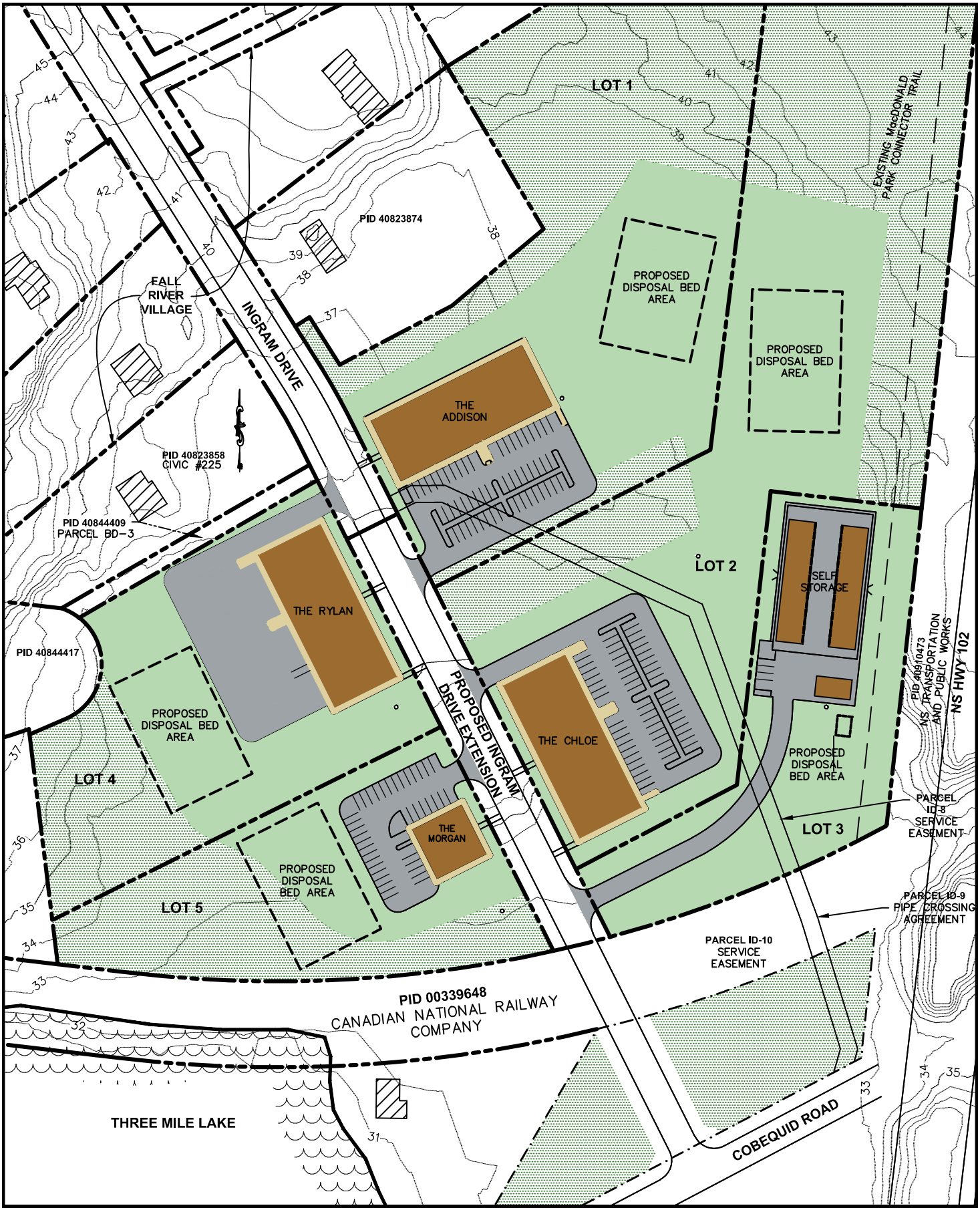
It is also important to note that the 24/7 system monitoring by the TCOM panel provides for remote monitoring and servicing of the site in many cases, deals with emergencies, minimizes site visits and duration (by identifying the key issue) and also allows lifetime tracking of system performance and maintenance.

Peat Unit Sewage Treatment System

Annual maintenance includes accessing and inspecting the peat unit along with the internal components including the tipping bucket and distribution plates, the removal of all particles that could affect proper operation on the peat unit. The entire media filter surface is scarified to ensure adequate wastewater infiltration. Photos are taken of the filter media and filed in the manufacturer's data base for review and verification purposes. Regular pumping of the septic tank (every 2-3 yrs) will be required along with periodic cleaning of the effluent filter within the septic tank.

APPENDIX A

SK01 –SITE PLAN



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FALL RIVER SOUTH
FALL RIVER, NOVA SCOTIA

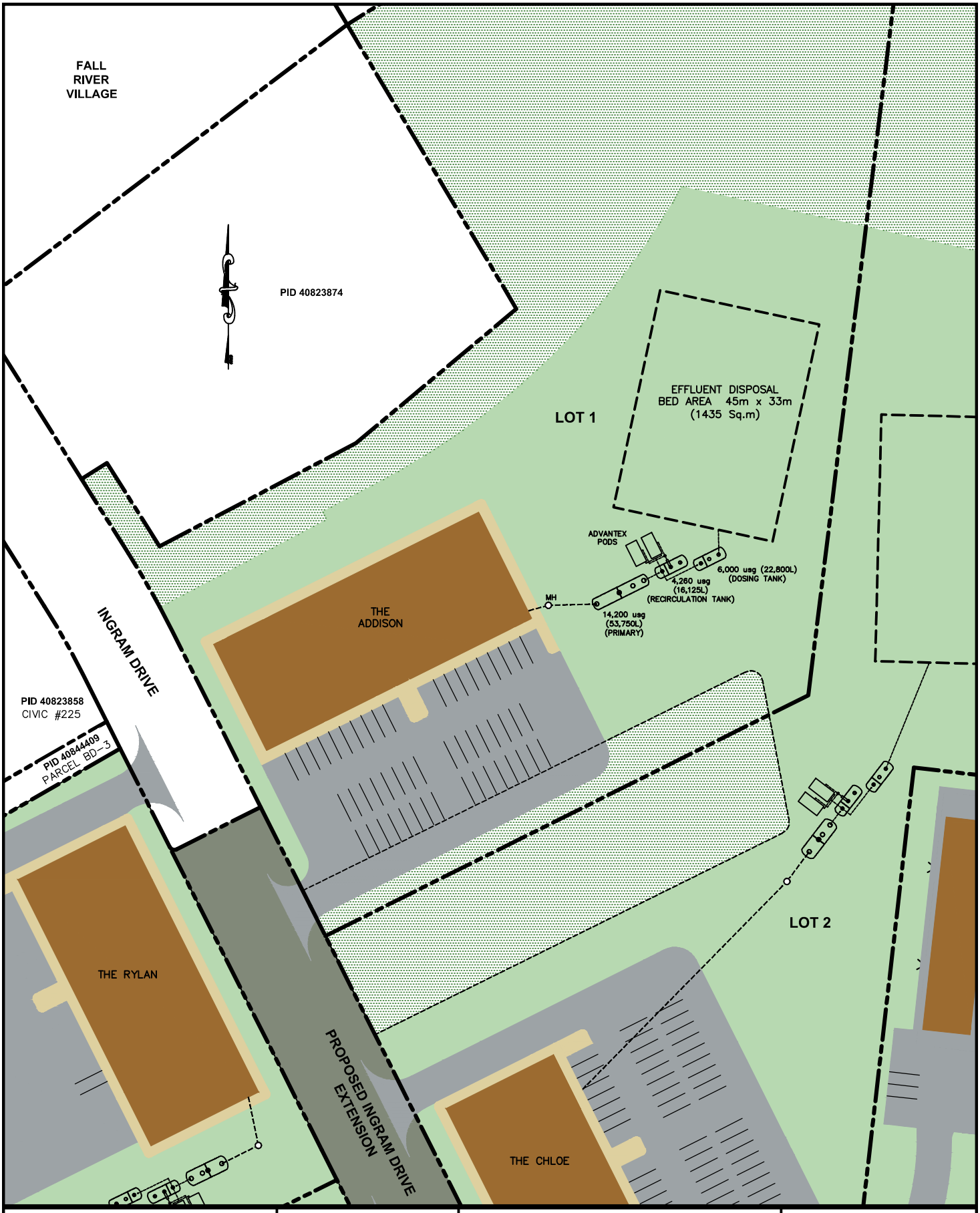
SITE PLAN

Revision			
No.	Comments	Date	By
0.	ISSUED FOR REVIEW	Jun 22/16	SRW

Date: June 2016
Scale: Not to Scale
Project No.: 09513
Drawing No.: 09513-SK01

APPENDIX B

SK02 –LOT 1 SEWAGE DISPOSAL SYSTEM LAYOUT



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PROPOSED LOT 1

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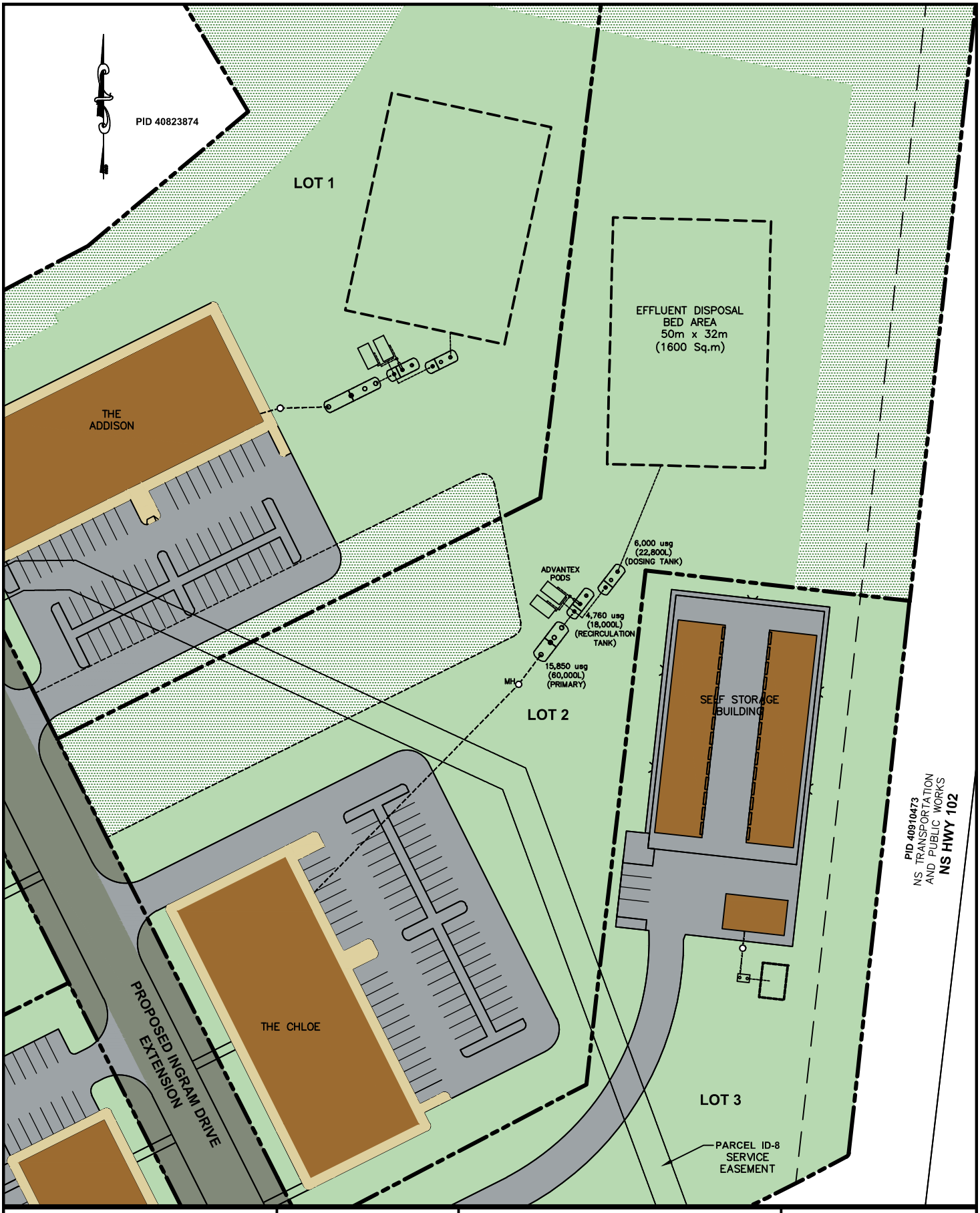
APPENDIX C

SK03 –LOT 2 SEWAGE DISPOSAL SYSTEM LAYOUT



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PROPOSED LOT 2

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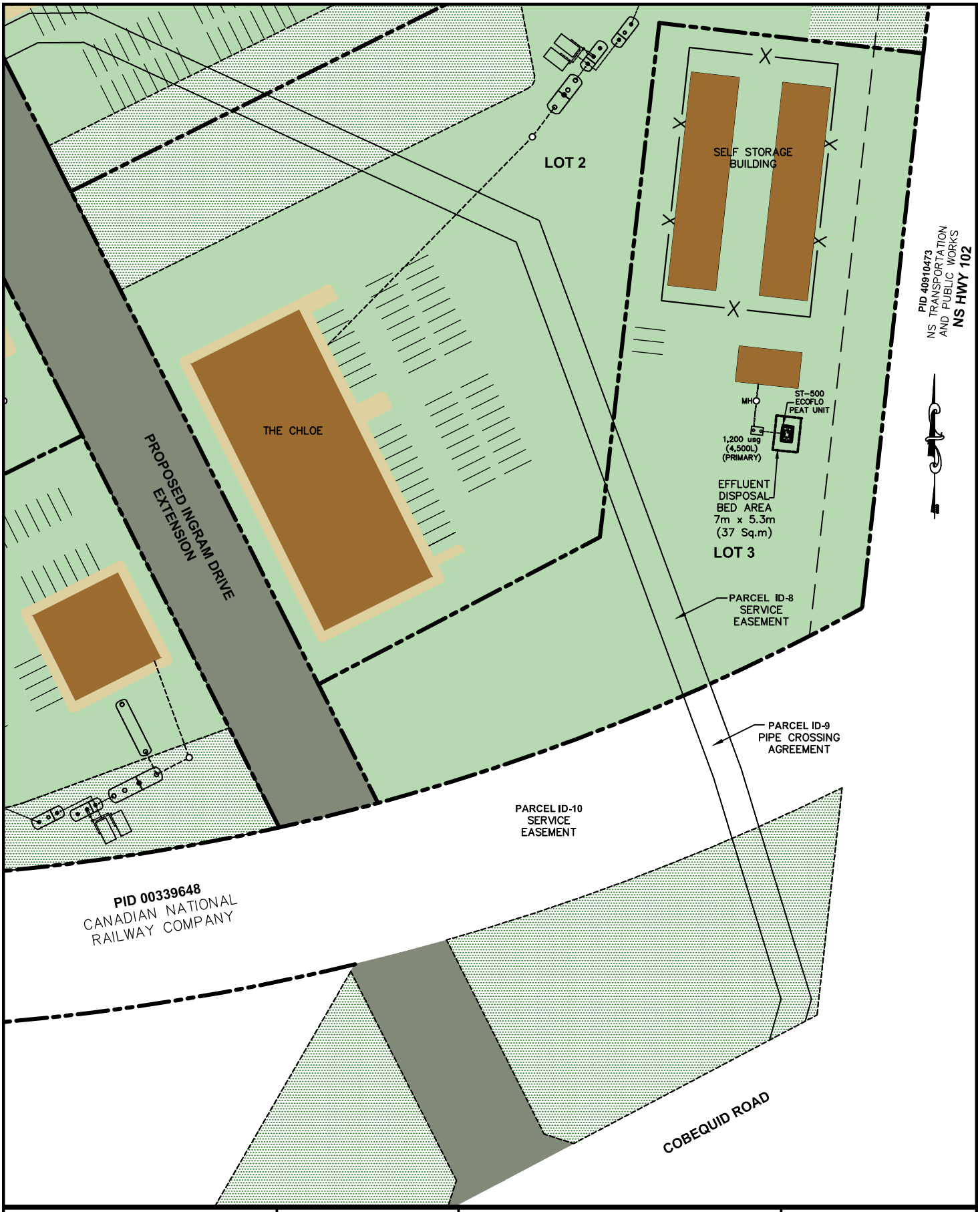
APPENDIX D

SK04 –LOT 3 SEWAGE DISPOSAL SYSTEM LAYOUT



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PROPOSED LOT 3

Revision			
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APPENDIX E

SK05 –LOT 4 SEWAGE DISPOSAL SYSTEM LAYOUT

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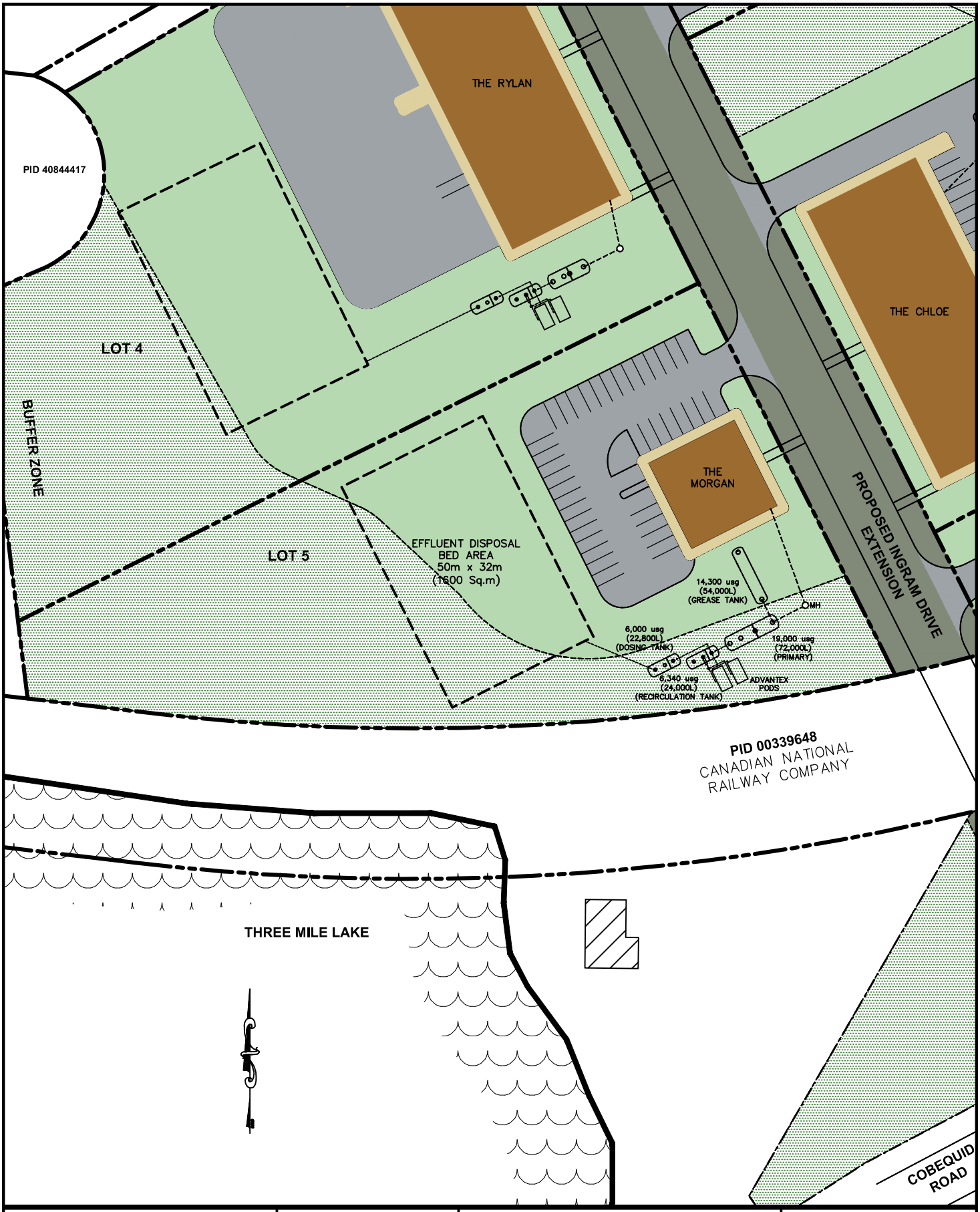
	PROPOSED LOT 4	0.	ISSUED FOR REVIEW	Jun 22/16	SRW	Project No.: 09513
						Drawing No.: 09513-SK05

APPENDIX F

SK06 –LOT 5 SEWAGE DISPOSAL SYSTEM LAYOUT



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