CLIENT: MICCO COMPANIES LIMITED

PHOSPHORUS NET LOADING ASSESSMENT

3195 HIGHWAY 2, FALL RIVER, NS

PHOSPHORUS NET LOADING ASSESSMENT

3195 HIGHWAY 2, FALL RIVER, NS

MICCO COMPANIES LIMITED

REPORT (VERSION 01)

PROJECT NO.: 191-12517-00
DATE: JUNE 01, 2021

WSP - DARTMOUTH

WSP.COM

June 01, 2021

Mr. Colin MacDonald
Micco Companies Ltd.
741 Bedford Highway
Halifax, NS, B3M 2M1

Dear Mr. MacDonald

Subject: Phosphorus Net Loading Assessment for 3195 Highway 2, Fall River, NS – Revision 01

WSP is pleased to submit the revised Phosphorus Net Loading Assessment (PNLA) prepared in support of the proposed redevelopment project of the 3195 Highway 2, Fall River, NS property. We trust that this report meets your requirements.

Please contact us to address any questions or concerns you may have.

Kind regards,

[redacted]

Kevin O'Leary
Municipal Engineer

Encl.

WSP ref.: 191-12517-00

REVISION HISTORY

FIRST ISSUE

Dec. 22, 2020	Issued for Regulatory Use and Approval			
Prepared by: Kevin O'Leary, P.Eng.	Reviewed By:	Approved By:		
Municipal Engineer				
REVISION 01				
June 01, 2021	Reissued for Regulatory Use and Approval			
Prepared by: Kevin O'Leary, P.Eng.	Reviewed By:	Approved By:		
Municipal Engineer				

SIGNATURES

PREPARED BY

Kevin O'Leary, P.Eng.
Municipal Engineer

Date

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1 INTRODUCTION

As part of the Development Agreement application for the 3195 Highway 2 property in Fall River, Nova Scotia (PID 00504076), a Phosphorus Net Loading Assessment was completed by WSP. The project area falls within the River-Lakes Secondary Planning Strategy for Planning Districts 14 & 17 and is subject to Policy RL-22 which states:

> *"An assessment prepared by a qualified person shall be required for any proposed development pursuant to these policies to determine if the proposed development will export any greater amount of phosphorus from the subject land area during or after the construction of the proposed development than the amount of phosphorus determined to be leaving the site prior to the development taking place."*

The proposed mixed residential and commercial development consists of four attached townhouses and a small, light commercial building. The development will share a single common access driveway onto Highway 2. This development will manage its stormwater through a combination of surface conveyance and catch basins with discharge outlets directed towards Thomas Lake. For reference, refer to the preliminary servicing, erosion and sediment control and stormwater management plans in the appendices.

The purpose of this assessment was to estimate the total available phosphorus discharge from the site in pre- and post development conditions and to recommend mitigation methods to achieve at a minimum, balanced pre- and post-development phosphorus mass loading to Thomas Lake.

This document should satisfy the requirements of RL-22 listed above and confirm that the post-development scenario will not export any greater amount of phosphorus from the property than the pre-development scenario.

The demolition of the existing single-family residence and construction of four new semi-detached dwellings and commercial building, will cause the land use to shift from residential with grass and treed covered areas to mixed residential commercial use with asphalt driveway and parking areas. This change in land use will require specific passive and engineered stormwater management features to adequately maintain pre-development phosphorous levels. As in most properties that utilize onsite wastewater disposal systems, phosphorous control and treatment is usually required as they are often the largest contributor of phosphorous. Pre and post- total phosphorous balancing were completed per the guidelines promulgated within Halifax's Municipal Planning Strategy for Planning Districts 14/17 (Shubenacadie Lakes) and the Halifax Regional Municipality Stormwater Management Guidelines published by Dillon Consulting in March 2006 and other resources as indicated.

1.1 EXISTING SITE CONDITIONS

The property currently supports a detached single-family home located on an established treed and grassed parcel. The property is approximately 0.54 ha (58,000 ft^2) large and abuts both Highway 2 and Thomas Lake. The property is serviced by an existing onsite wastewater disposal system, municipal water service and overhead electric and data communications.

The existing site has stands of relatively mature deciduous trees along the existing driveway, along the edge of Thomas Lake and along the northern boundary of the property. A portion on the property has been identified as wetland during the wetland delineation survey. This portion of the property has a mix of low height bushes and grasses and was formed in part due to the partial infilling of the property. Refer to the appendices for a copy of the wetland delineation map. The full wetland report has been submitted under separate cover.

The remainder of the site consists of a mix of grassed areas (maintained lawn) and unmaintained grasses and bushes along the northern and southern edges of the property or tree line. The overall slope of the property lies in a northwest direction and ranges from 1-3% with the highest elevation of existing ground above the observed lake level of 3m ±.

The test pits dug during the onsite wastewater system assessment showed seepage at a depth of approximately 1 meter below existing ground. It is expected that the long-term groundwater table on the site will be very close to the water elevation of Thomas Lake.

The existing detached single-family home is serviced by an onsite wastewater system which has not yet been located on the property. It is expected to consist of a concrete septic tank and gravity fed raised bed disposal field. There is an existing well identified on the property, but it is unlikely that it is in service. If required, the well will be decommissioned as part of the property development as the property has an available service connection from Halifax Water for potable water supply.

1.2 PROPOSED DEVELOPMENT

The proposed development is outlined in the accompanying documents in support of the Development Agreement. For reference, the servicing schematic and proposed site plan is included in the appendices.

Figure 1: Aerial photograph of site (Source: Google Earth, 2020; north to top of page)

1.3 REGULATORY CRITERIA

This assessment will utilize the HRM By-Law G-200 "Respecting Grade Alteration and Stormwater Management Associated with Land Development", the "Guidelines for No Net Increase in Phosphorus for River-lakes Secondary Planning Strategy" (Hutchinson Environmental Sciences Ltd and AECOM Canada, 2014) and other references as required or cited to develop the project property while maintaining no net phosphorous discharge.

2 SCOPE AND METHODOLOGY

2.1 SCOPE

The purpose of the phosphorus loading assessment is to complete the following:

- Determine the pre-development total available phosphorous mass loading to Thomas Lake from the parcel;
- Determine the post-development total available phosphorus mass loading to Thomas Lake from the parcel; and
- Determine suitable stormwater and phosphorus controls to balance the pre- and post-development phosphorous mass loadings to Thomas Lake from the parcel.

It is expected that some phosphorous loadings will be carried onto the site with stormwater from offsite sources. This stormwater and associated components including phosphorous will not be treated with the mitigation measures proposed for the development site.

2.2 METHODOLOGY

The phosphorous loading assessment will utilize a review of historical climate data, basic hydrological modelling, and water quality modelling. The stormwater discharge phosphorus loads are modeled using annualized loadings. The annual phosphorus loading approach was used as mitigation measure removal efficiencies are typically assessed on annual phosphorus load reductions.

The scope of this report includes the development of a preliminary Stormwater Management Plan and Erosion and Sediment Control Plan. During the detailed design of the site, this phosphorus loading assessment will be used to contribute to the final development of these plans. These plans will be developed by a professional engineer licensed to practice in Nova Scotia. In particular,

- Stormwater Management Plan (SWP): The SWP will address the relevant regulations including the new G-200 By-Law and will address quantity and quality of stormwater flow leaving the site. BMPs will also include measures to reduce the amount of TSS reaching the lake (e.g. bioswales).
- Erosion and Sediment Control Plan (ESCP): The ESCP will address the relevant regulations with particular emphasis of capturing run off and siltation prior to reaching the lake.

Pre- and post-development mass loadings were determined using the following:

- Review of Existing and Historical Data: WSP reviewed aerial photographs and historic Environment Canada climate data. WSP staff also visited the site during an investigation for an onsite wastewater system

- Hydrology: The project site is small (0.54 ha) and will be considered a single watershed as stormwater from the adjacent property and road will be carried to Thomas Lake via the existing swales or piping.
- Water Quality Modelling: Total phosphorus loadings will be modelled using cited references including Stormwater Management Standards for Development Activities (HRM, 2020) and Guidelines for No Net Increase in Phosphorus for River-Lakes Secondary Planning Strategy (Hutchinson Environmental Sciences Ltd and AECOM, 2014). The models will reflect existing and proposed conditions, recommended estimated total phosphorous runoff coefficients and stormwater Best Management Practices (BMPs).

3 MODEL DEVELOPMENT

In the existing and proposed conditions, the model considered the annualized phosphorus loadings using existing the type and area of the various land cover and buildings. The phosphorus loadings from the existing and proposed onsite wastewater treatment system were also included.

The existing site utilizes overland flow and swales to carry stormwater from the roadway and adjacent property to Thomas Lake. The proposed development will utilize similar swales and overland flow combined with engineered controls for treatment, detention and retention.

3.1 STORMWATER CATCHMENT DELINEATION

The stormwater catchment area was delineated using aerial photography, site visits, property boundary survey and preliminary topographic data collected during the onsite wastewater assessment. Along the southern property line adjacent to the Turtleback Tap & Grill and Fall River Dental commercial building, stormwater is collected in a vegetated swale. Based upon observed site grading, the majority of stormwater collected on this adjacent property is controlled and retained on their property. Along the eastern property line adjacent to Highway 2 and west of the crown of the road, stormwater flows towards the proposed property development. Stormwater east of the crown on the road is captured by a curb and gutter system and is released further downstream away from the subject property. Stormwater that flows from the road is captured by a slight swale at the front of the subject property, flows north along the shoulder of the road until it intercepts the vegetated area and flows towards Thomas Lake into the identified wetland areas.

The phosphorus assessment considered all areas within the catchment area both pre- and post-development but will not include directly any phosphorus loadings that may arrive from offsite stormwater flow. A survey of the property is included in the appendices.

3.2 PRECIPITATION

Monthly precipitation data was obtained from Environment Canada's climate records for the Halifax Stanfield International Airport (Station ID 8202250). The snowfall data is assumed to melt to produce water at a ratio of 1 cm of snowfall to 1 mm of rainfall.

Table 1: 1981 to 2010 Canadian Climate Normals – Halifax Stanfield International Airport (Station ID 8202250)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Rainfall (mm)	83.5	65.0	86.9	98.2	109.8	96.2	95.5	93.5	102.0	124.6	139.1	101.8	1196.1
Snowfall (cm)	58.5	45.4	37.1	15.9	2.0	0.0	0.0	0.0	0.0	0.4	16.6	45.4	221.2
Precipitation (mm)	134.3	105.8	120.1	114.5	111.9	96.2	95.5	93.5	102.0	124.9	154.2	143.3	1396.2

3.3 LOCAL GEOLOGY, GROUNDWATER AND DEPTH TO BEDROCK

The project site is immediately adjacent to Thomas Lake. Based upon the two test pits dug on site in support of the wastewater treatment system assessment it appears that a substantial portion of the site was built on fill. The nearest groundwater well log to the proposed site as found in the Nova Scotia well database indicated that the depth to bedrock was 30 feet and that a static water table was found at 5 feet below grade. This site was located at 3405 Highway 2, Fall River and was located approximately 135 m away from the water course flowing between Fletchers Lake and Thomas Lake.

Given the nature of the fill material and the proximity of the lake it is expected that the shallow groundwater table found in the test pits will be under direct influence of the water level in Lake Thomas.

3.4 STORMWATER PRELIMINARY PRE- AND POST- DEVELOPMENT FLOWS

Using Nova Scotia 1:10,000 topographical maps, HRM LIDAR data and measured site topography, preliminary pre- and post-development flows were determined for the site. Pertinent stormwater flows as outlined in the procedures for HRM and Halifax Water design are outlined in the table below.

Table 2: Preliminary Pre- and Post-Development Flows Within and Arriving to the Site from Off-Site Flow

Event	Pre-Development (L/sec)	Post-Development (L/sec)	Offsite Flow to Site (L/sec)
1:5 yr	45	64	118
1:10 yr	57	78	150
1:25 yr	74	96	191
1:50 yr	86	110	222
1:100 yr	99	123	255

Pre- and post-development flows will be balanced onsite utilizing underground storage installed under the main parking area. The approximate storage volume required is 30 m^3. Most of the offsite water will be intercepted by a grassed swale along the roadway frontage and shunted to grassed swales along either side of the property.

Green spaces are estimated to be sufficient to retain and infiltrate the first 10mm of precipitation. An allowance within the underground chamber will also allow a portion of the runoff to be retained within the storage chambers for infiltration after the rainfall event has passed. Treatment of the stormwater collected within the paved areas will be accomplished utilizing an in-basin vortex style sediment capture device.

3.5 LAND USE

Pre- and post-development land use, their associated areas used in the development of the model and phosphorous loadings are outlined in the table below.

Table 2: Pre-Development Land Use

	Area (m^2)	Phosphorus loading values (mg/L)[3]	Phosphorus export coefficient (g/m^2-yr)
Wetland	710	0.2	0.008[1]
Treed	1,820	0.2	0.035[2]
Low Density Residential	2,950	0.2	0.035[2]

1 Forest Watershed with >15% cleared/wetland (Brylinksy (2004))
2 Residential Lot (Brylinksy (2004))
3 HRM Guidelines (2006) and Toronto Area Watershed Assessment

Table 3: Post-Development Land Use (No Stormwater Controls)

	Area (m^2)	Phosphorus loading values (mg/L)[5]	Phosphorus export coefficient (g/m^2-yr)
Wetland	235	0.2	0.008[1]
Treed	850	0.2	0.035[2]
Medium Density Residential/Commercial	2,500	0.2	0.035
Asphalt Parking	1,280	0.62	0.350[3]
Commercial Building	315	0.04	0.035[4]
Multi-Unit Attached	375	0.04	0.035[4]

1 Forest Watershed with >15% cleared/wetland
2 Residential Lot (Brylinksy (2004))
3 Public Highways (Brylinksy (2004))
4 Considered part of the medium density residential/commercial
5 HRM Guidelines (2006) and Toronto Area Watershed Assessment

3.6 ON-SITE WASTEWATER SYSTEM

Phosphorus concentrations in primary tank effluent varies widely from region to region but typically falls within the range of 10 – 35 mg/L of total phosphorus. Approximately two thirds to three fourths of this phosphorus is available as freely available orthophosphate. The remainder is bound with organic molecules (DNA) and other biological compounds. For the purposes of this assessment, we assumed an available phosphorus concentration of 20 mg/L in primary effluent.

It is understood that new septic disposal beds are greater than 95% effective at removing available phosphorous via reactions with soil minerals (particularly aluminum and iron

containing minerals). Long term phosphate attenuation is not well studied but similar to other soil mineral reactions with various cations and anions, it is expected that this ability would decrease as the available sites for reaction were either hidden via mineral deposition or otherwise unavailable for further reaction. One assessment showed that over the long term (14-22 years) disposal beds lost approximately 90% of their ability to capture and remove phosphorus (Eveborn *et.al*, 2012). Therefore designs for phosphorous treatment cannot rely on disposal bed capture and retention.

Phosphorus treatment with a typical onsite treatments system will not substantially remove phosphorus. Removal of phosphorus using biological means requires specialized unit processes capable of taking advantage of a subset of bacterial know as phosphorus accumulating organisms. These types of treatment technologies require additional tankage and knowledgeable operators which are not usually associated with small onsite systems.

Therefore, for this model, given the proximity of the lake, we assumed that any phosphorus reaching the disposal bed will be discharged into Thomas Lake. Although this does not account for any attenuation due to reactions or travel time but does yield a conservative estimate for phosphorus loading. Outside of the overuse of fertilizers, onsite wastewater is one of the largest contributors of phosphorus to the receiving body.

3.6.1 Existing System

The existing onsite septic system servicing the single-family home is assumed to consist of a precast concrete tank with effluent filter. Primary effluent is likely discharged via gravity flow to a mound type system consisting of filter sand laid above native material or approved fill.

Onsite wastewater systems are designed to accommodate the expected peak flows from their service area or unit. For a single-family home, the design flow for up to a three-bedroom home is 1,000 litres per day. Average daily flows are typically 50% of the prescribed design flows so for the purposes of modelling, 500 litres per day of effluent discharge to the bed was used.

3.6.2 Proposed System

The proposed onsite septic system will consist of primary tankage, an advanced treatment unit and a disposal bed. The prescribed design flows for the townhouse units is 3,250 L/d. The 630 m^2 commercial space (usable square footage) has no specified tenants therefore the prescribed flow is given by an upper limit of 61 office workers at 50 litres per day per office worker. For the purposes of modeling, 6,300 litres per day of effluent discharge to the bed was used. This is the peak expected wastewater flow.

3.7 AREA LOADING METHOD

A composite water quality model for phosphorous loading was developed that incorporates stormwater and land use phosphorous transport. A separate phosphorous loading model component for the onsite wastewater system was developed.

For the areal loading method, the annual phosphorous export loading is estimated using the following:

$$\dot{m}_{P,Land\ Use} = \sum_{i=1}^{n} P_{Land\ Use\ i}\, A_{Land\ Use\ i}$$

where:

$\dot{m}_{P,Land\ USe}$: Total mass loading of phosphorus leaving the site based on all of the land use types (kg/yr P)

$P_{Land\ Use\ i}$:Phosphorus unit loading rate for a given land use *i* (g/(m^2*yr))

$A_{Land\ Use\ i}$: Area with a given land use *i* (m^2)

This model treats the onsite wastewater system as a point source and the estimation of the loading is given by the following:

$$\dot{m}_{P,Septic} = C_{p,septic} * Q_{septic}$$

where:

$\dot{m}_{P,Septic}$: Mass Loading of phosphorus leaving the primary tank prior to treatment (kg/yr P)

$C_{P,\ septic}$: concentration of phosphorus in primary effluent (mg/L P)

Q_{septic}: average flow from the septic system (L/d)

If an additional physicochemical treatment process is added to the treatment train, the expected phosphorus removal fraction is applied to the effluent mass loading calculated previously. Typical chemical and electrochemical removal efficiencies are 95% or greater.

4 RESULTS AND DISCUSSION

4.1 PHOSPHORUS MASS LOADING FROM LAND USE ACTIVITIES AND ON-SITE SEPTIC SYSTEM

The area mass loadings were run for both pre- and post-development scenarios without the addition of any stormwater controls. The results for both runs are outlined below.

The proposed end use of the commercial building is for undefined commercial and office space. The proposed onsite system can receive 3,050 litres per day of typical domestic wastewater (average daily flow). Typical strength of raw domestic wastewater is 200 mg/l total suspended solids, 175 mg/L biochemical oxygen demand, 425 chemical oxygen demand, 20 mg/L of ammonia nitrogen and 20 mg/L P. Any tenants that would cause the strength or treatability of the wastewater to change should be subject to review prior to acceptance. This includes tenants such as brewery pubs, veterinary clinics, cleaning supply and service companies. In general, tenants that create overstrength wastewater or release discharges that affect the treatment system's process biology should be restricted from becoming a tenant.

Table 4: Pre-Development Uncontrolled Phosphorus Loadings

Land Use	**Area**	**Area (ha)**	**P Export Coefficient**	**Phosphorus Loading**	
	m^2	**ha**	**$g/(m^2*yr)$**	**kg/yr**	**g/yr**
Wetland	710	0.071	0.008	0.006	6
Treed	1820	0.182	0.035	0.064	64
Low Density Residential	2950	0.295	0.035	0.103	103
Total	5480	0.548	---	**0.173**	173
	Flow	**P Conc.**	**Phosphorus Loading**		
	l/d	**mg/L**	**mg/d**	**kg/yr**	
Onsite Septic System	500	20	10000	3.65	
Total Loading				**3.83**	

Table 5: Post Development Uncontrolled Phosphorus Loadings and Wetlands Loss

Land Use	**Area**	**Area (ha)**	**P Export Coefficient**	**Phosphorus Loading**	
	m^2	**ha**	**$g/(m^2*yr)$**	**kg/yr**	**g/yr**
Wetland	235	0.0235	0.008	0.002	2
Treed	650	0.065	0.035	0.023	23
Medium Density Residential/Commercial	2550	0.255	0.035	0.089	89
Asphalt Parking	1280	0.128	0.62	0.794	794
Commerical Building	315	0.0315	0.04	0.013	13
Multi-Unit	450	0.045	0.04	0.018	18
Area Total	5480	0.548			
Wetlands Loss	475	0.0475	1.2	0.570	570
Total P Loading				**1.508**	**1508**
	Flow	**P Conc.**	**Phosphorus Loading**		
	l/d	**mg/L**	**mg/d**	**kg/yr**	
Onsite Septic System	3150	20	63000	23.01	
Total Loading				**24.52**	

Based on the model results shown above, it was determined that phosphorus reductions are warranted and that the onsite septic system is the largest contributor to phosphorus loadings. Even with the use of efficient phosphorus capture stormwater controls, the phosphorus loading from the new onsite plant is more than six times the existing phosphorus loadings from the existing on-site system.

In addition, the loss of 475 m^2 of wetlands due to the development, it is estimated that approximately an additional 570 g/yr of phosphorous will reach Thomas Lake from both on and offsite stormwater flow. This is based upon a median removal rate of phosphorous for created or restored wetlands of 1.2 g P/(m^2 yr) (Land *et. al*, 2016). This increase is offset by the

Given that the phosphorus loadings from the onsite wastewater system is more than an order of magnitude greater than land use related loadings, it is recommended that phosphorus removal be included within the onsite treatment train. Therefore, it is recommended that alum or ferric salts or electrochemical treatment technologies be used precipitate available phosphorus. These types of processes are capable of achieving final phosphorus concentrations of 0.5 mg/L and/or greater than 95% removal in higher strength wastewater. Assuming a final phosphorous concentration in the effluent of the onsite wastewater system of 0.5 mg/L a revised post-development loading was estimated and is outlined in the table below.

Table 6: Post Development Controlled Phosphorus Loadings – Wastewater P Treatment and Wetlands Loss

Land Use	**Area**	**Area (ha)**	**P Export Coefficient**	**Phosphorus Loading**	
	m^2	**ha**	**g/(m^2*yr)**	**kg/yr**	**g/yr**
Wetland	235	0.0235	0.008	0.002	2
Treed	650	0.065	0.035	0.023	23
Medium Density Residential/Commercial	2550	0.255	0.035	0.089	89
Asphalt Parking	1280	0.128	0.62	0.794	794
Commerical Building	315	0.0315	0.04	0.013	13
Multi-Unit	450	0.045	0.04	0.018	18
Area Total	5480	0.548			
Wetlands Loss	475	0.0475	1.2	0.570	570
Total P Loading				**1.506**	**1506**
	Flow	**P Conc.**	**Phosphorus Loading**		
	l/d	**mg/L**	**mg/d**	**kg/yr**	
Onsite Septic System	3150	0.5	1575	0.58	
Total Loading				**2.08**	

Alum reacts with phosphorous to create an aluminum phosphate precipitate. By mass, 9.6 mg of alum is required for each mg of phosphorus. Typical dosing is 1.5 to 2.0 times this ratio to accommodate reactions with other competing reactions with other organics (humics) or metals. Alum dosing would be accomplished via a small chemical feed pump and a stock solution of alum. We would recommend that the dosing system be installed in the commercial building's mechanical room. In terms of the impact to operations of the onsite system, the alum sludge would build up along with the biosolids in the primary tank. A similar sludge buildup would occur if the system utilized an electrochemical precipitation system. The sludge would typically be composed of iron phosphate salts. Commercial septic tanks are normally pumped every one

or two years as part of normal maintenance, so the alum sludge would be removed at the same time.

4.2 ACTIVITIES DURING CONSTRUCTION

Prior to construction, the Owner and Engineer should ensure that all erosion and sediment control measures are installed correctly. The Contractor should understand and expect the sensitive nature of the nearby receiving waters and should therefore expect routine visits by the Engineer to ensure compliance and construction activities are not creating situations that could lead to sediment discharge. Three construction activities of particular concern are outlined below:

- Controlling the extent and exposure time of any exposed areas. Construction activities should be scheduled to minimize the open time of all excavated areas.
- Controlling the size, location and protection of exposed soil stockpiles.
- Proper ongoing maintenance of all erosion control measures.

Short-term erosion control measures are intended to minimize the amount of surface water that flows onto in within the construction site and to utilize measures to capture and or settle particulate material. The short-term measures are to be properly removed and/or cleaned once vegetative cover has been established and long-term measures are in place. The use of fertilizers including organics amendments (manure) should be avoided unless control measures are in place and/or approval is obtained from HRM for their use as appropriate for phosphorous sensitive water sheds.

5 CONCLUSIONS

Based on the modelling results outlined in this assessment the onsite wastewater system is the largest source of phosphorous potentially impacting Thomas Lake. It is therefore recommended that the onsite treatment plant utilize phosphorous removal technologies to achieve the site's overall goal of no net phosphorus leaving the site. This will be accomplished through the use of tertiary treatment technology for phosphorus removal within the overall onsite treatment system which could include chemical precipitation via chemical additives (e.g. ferric salts) or electrochemical process equipment. A conventional onsite wastewater treatment system utilizing just primary treatment will not remove sufficient phosphorous from its effluent to meet the phosphorous net loading goal for the property.

Given the small size of the site, the existing (to be decommissioned) and proposed onsite wastewater system is the largest contributor to phosphorous loading to Thomas Lake by an order of magnitude. The property is located on a waterfront parcel so controlling the mass flow of phosphorous into the disposal bed is the main and key element in the pre- and post-balancing/reduction of phosphorous release to Lake Thomas.

As the phosphorous loading on the site is highly dependent on the ongoing successful operation of the onsite treatment plant, any proposed tenants for the building should be assessed for their impact on the onsite treatment system. Any tenants that propose to discharge overstrength, toxic or excess wastewater should be closely reviewed. and additional pre-treatment be considered. The Owner of the property should also engage a qualified operator to assess the treatment system performance at least quarterly via wastewater effluent sampling.

Fully designed Stormwater Management and Erosion and Sediment Control Plans will be developed and submitted for review by the relevant agencies as part of the civil site design of the property. During construction, a site engineer/inspector should be present to monitor

construction activities and to ensure that all designed erosion control measures are installed and maintained properly.

BIBLIOGRAPHY

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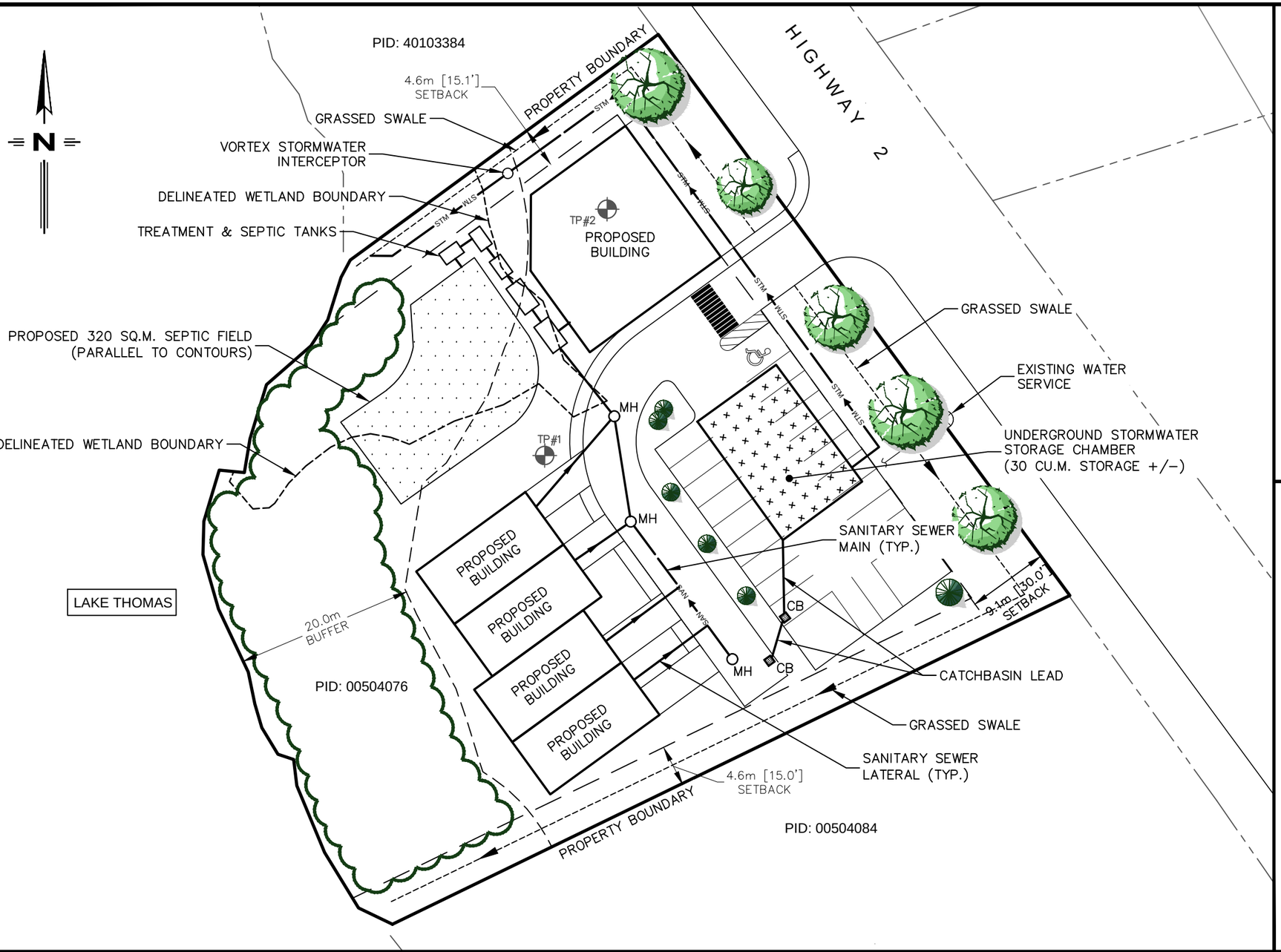
Brylinsky, M. (2004). User's Manual for Prediction of Phosphorous Concentration In Nova Scotia Lakes: A Tool for Decision Making. The Nova Scotia Water Quality Objectives and Model Development Steering Committee. Nova Scotia Department of Environment and Labour.

Land, M., Granéli, W., Grimvall, A. *et al.* How effective are created or restored freshwater wetlands for nitrogen and phosphorus removal? A systematic review. Environ Evid 5, 9 (2016). https://doi.org/10.1186/s13750-016-0060-0

APPENDIX

A SERVICING SCHEMATIC & WETLAND DELINEATION



SITE SUMMARY:

- PID: 00504076
- LAND AREA – 5,480 m²
- EXISTING ZONE – VMS (VILLAGE MAIN STREET ZONE)

NOTES:

- PROPERTY LINES BASED ON PLAN OF SURVEY OF LOT 7A, BY WSP CANADA INC., DATED MAY 11, 2021.
- COMMUNITY ON CENTRAL DRINKING WATER. ANY USE OF WELLS AT ADJACENT PROPERTIES TO BE CONFIRMED DURING DESIGN.
- ANTICIPATED FLOW: 6,200 LPD.
- SOIL TYPE TO BE CONFIRMED; ASSUMING SANDY SILT.
- VERTICAL LOADING: 15 LPD / SQ.M.
- AREA: 418 SQ.M. (4,500 SQ.F.)
- TREATMENT TO INCLUDE SECONDARY FOR BOD & TSS REDUCTION AND UV FOR FECAL REDUCTION TO <200 CFU PER 100mL.
- 3.0m BOUNDARY ON ROAD FRONTAGE AND SOUTHERN PROPERTY BOUNDARY ARE NOT SHOWN.

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Dartmouth, Nova Scotia, Canada B3B 1X7
T 902-835-9955 F 902-835-1645 www.wsp.com

PROJECT:

3195 HIGHWAY #2 (LOT 7A) – FALL RIVER, NS

TITLE:

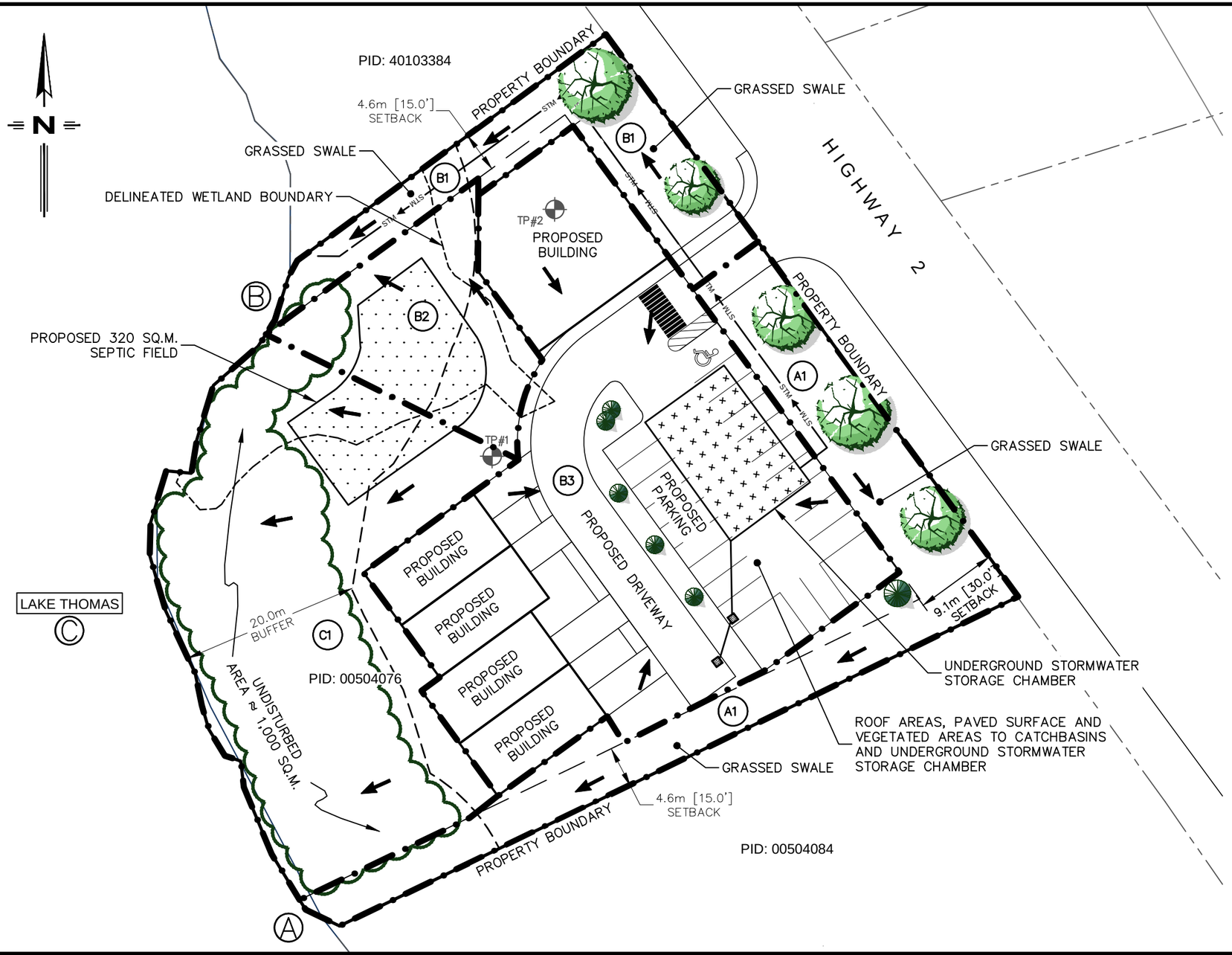
PRELIMINARY SERVICING SCHEMATIC

PROJECT NO:	191-12517-00
SCALE:	1:500
DRAWN BY:	C. LUTZ
CHECKED BY:	K. O'LEARY

SUPPLEMENTAL:

ADDENDUM:	ADD_# ☐
DIRECTIVE:	DIR_# ☐
CHANGE ORDER:	CHG_# ☐

REVISION:	0
DATE: (YYYY/MM/DD)	2021/05/27
SUPPLEMENTAL NO:	ISSUED FOR REPORT



SURFACE AREA CLASSIFICATIONS	
DESCRIPTION	AREA (m²)
TOTAL LOT AREA	5,480
BUILDINGS	763
ASPHALT & DRIVEWAYS	1,281
WETLAND	235
TREED & GRASSED AREAS	3,201

POST DEVELOPMENT SUBCATCHMENT AREAS		
SUBCATCHMENT	AREA (m²)	DISCHARGE TO
A1	875	A
B1	457	B
B2	442	B
B3	2,185	B
C1	1,521	C

LEGEND:	
DRAINAGE AREA	
APPROX. 5 YR FLOOD LIMIT	5 YR
APPROX. 100 YR FLOOD LIMIT	100 YR
MAJOR DRAIN	
FLOW FROM POINT	X 1
FLOW TO POINT	A
DRAINAGE AREA	A1

WSP Canada Inc.
1 Spectacle Lake Drive
Dartmouth, Nova Scotia, Canada B3B 1X7
T 902-835-9955 F 902-835-1645 www.wsp.com

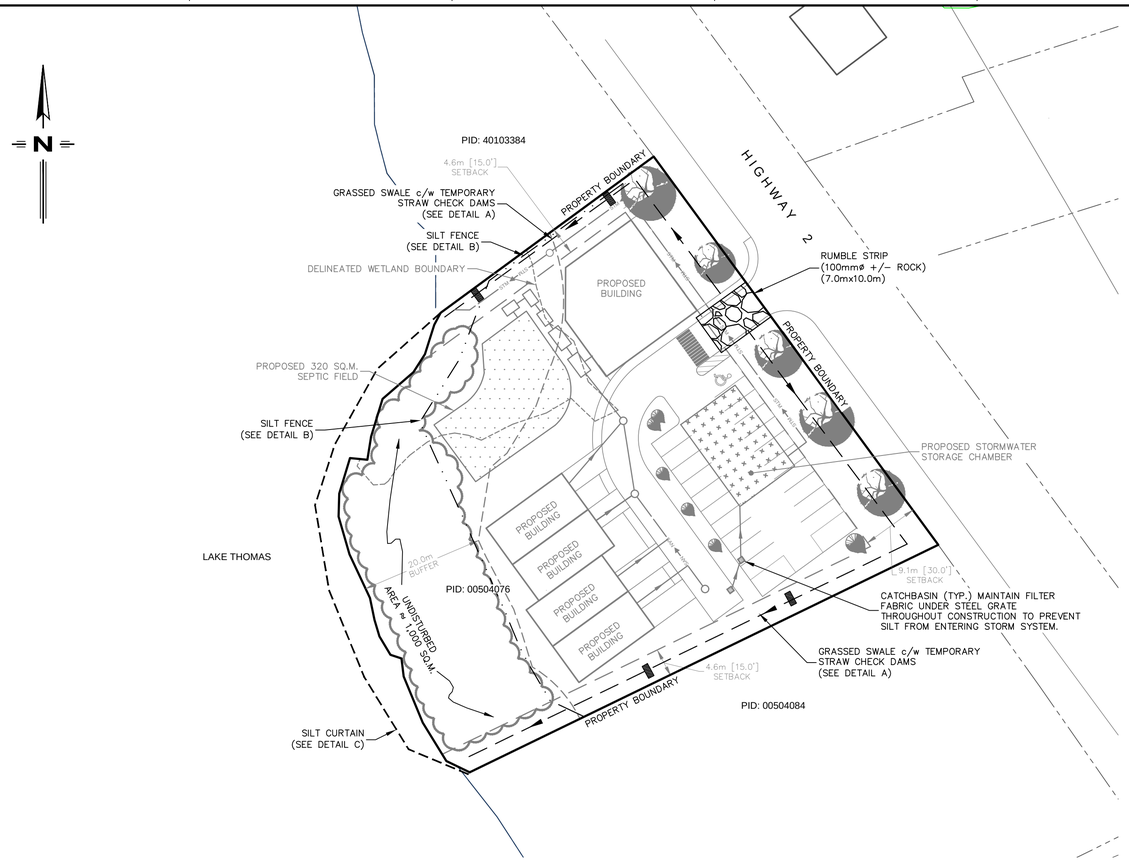
PROJECT:
3195 HIGHWAY #2 (LOT 7A) – FALL RIVER, NS

TITLE:
PRELIMINARY STORM DRAINAGE PLAN

PROJECT NO: 191-12517-00
SCALE: 1:500
DRAWN BY: C. LUTZ
CHECKED BY: K. O'LEARY

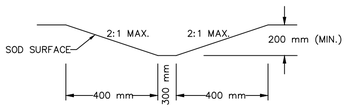
SUPPLEMENTAL:
ADDENDUM: ADD_#
DIRECTIVE: DIR_#
CHANGE ORDER: CHG_#
REVISION: 0
DATE: (YYYY/MM/DD) 2021/05/27
SUPPLEMENTAL NO: ISSUED FOR REPORT

WSP REF. NO.: ----- K:\DARTMOUTH\2019\191-12517_MICCO_COMPANIES_LTD_ FALL_RIVER_DEV\15-DWG\15.4-CIVIL\15.4.2-PRODUCTION_DWG\191-12517-00 - SDP.DWG N - ANSI B L SUP PRINTED: 2:57 PM 2021/05/27 BY: CRAIG.LUTZ



A GRASSED SWALE DETAIL

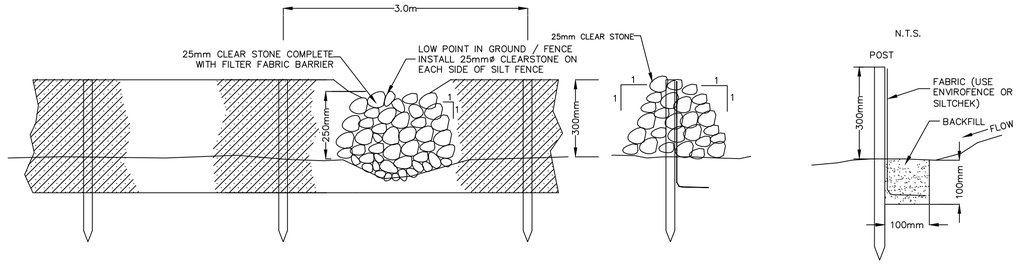
NTS



B SILT FENCE DETAIL

NTS

(USE THIS DETAIL FOR ANY LOCAL LOW POINTS IN THE SILT FENCE.)

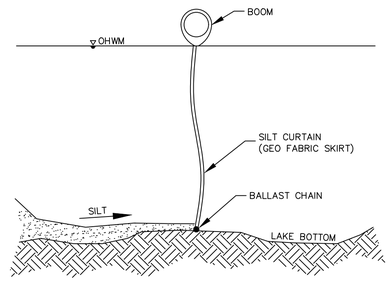


EROSION AND SEDIMENT CONTROL GENERAL NOTES

1. CONSTRUCTION ACTIVITY TO BE CARRIED OUT BASED ON THE PRINCIPLE THAT PREVENTION OF SEDIMENT LADEN RUN-OFF IS THE FOCUS RATHER THAN RELYING ON TREATMENT AT OUTFALL. THIS IS TO BE ACCOMPLISHED BY MINIMIZING EXPOSED SOIL. ONCE EXCAVATION HAS BEGUN IN A PARTICULAR AREA, THE WORK IS TO BE COMPLETED IN THAT AREA, INCLUDING FINAL GRADING AND STABILIZATION. ON THIS PROJECT IT WILL BE UNACCEPTABLE TO CONSTRUCT THE ENTIRE PROJECT AND THEN DO ALL STABILIZATION WORK. SOIL STABILIZATION WORK ON THIS PROJECT WILL BE AN ONGOING PROCESS HEAVILY INFLUENCED BY WEATHER FORECASTS. RECOMMENDED MAXIMUM AREA OF EXPOSED SOIL TO BE NO MORE THAN 15% OF THE TOTAL PROPOSED WORKING AREA OR 1 HECTARE WHICHEVER IS GREATER.
2. ALL WORKS TO BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT.
3. CONTRACTOR TO OBTAIN ALL NECESSARY PERMITS TO PERFORM WORKS, AND COMPLY WITH ALL PERMIT REQUIREMENTS AND CONDITIONS INCLUDING THE PROVISION OF SECURITY.
4. CONTRACTOR IS RESPONSIBLE FOR THE PROTECTION OF NATURAL WATERCOURSES FROM DAMAGE DUE TO SILTATION RUN-OFF FROM THE CONSTRUCTION SITE. ACCEPTABLE CONSTRUCTION PROCEDURES MAY BE OBTAINED FROM THE "EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES", CURRENT EDITION BY THE NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT.
5. IF THE PROJECT IS BEING CONSTRUCTED IN A PHASED APPROACH DIFFERENTLY THAN THE ORIGINALLY PROPOSED DESIGN, THE CONTRACTOR IS TO PROVIDE AN UPDATED PHASED EROSION AND SEDIMENTATION CONTROL PLAN.
6. CONTRACTOR TO HAVE AN APPOINTED EROSION AND SEDIMENTATION CONTROL PERSON. THIS PERSON IS RESPONSIBLE TO REVIEW, UPGRADE, AND MAINTAIN THE EROSION AND SEDIMENTATION CONTROL MEASURES FOR THE DURATION OF THE CONSTRUCTION UNTIL THE COMPLETE SITE IS STABILIZED.
7. CONTRACTOR TO MONITOR ENVIRONMENT CANADA'S 5 DAY FORECAST ON A DAILY BASIS. WHEN RAIN IS FORECAST, CONTRACTOR TO ENSURE THAT ALL EXPOSED AREAS ARE STABILIZED PRIOR TO RAINFALL EVENT. ENVIRONMENT CANADA'S WEATHER LINE 426-9090.
8. CONTRACTOR TO INSPECT SEDIMENT CONTROL STRUCTURES AND MAKE NECESSARY REPAIRS ON A DAILY BASIS AND BEFORE AND AFTER EACH RAINFALL EXCEEDING 10mm. CONTRACTOR TO KEEP A LOG DOCUMENTING INSPECTIONS, REMEDIATION ACTION AND WEEKLY REPORT OF EXPOSED AREAS.
9. TRIBUTARY STORMWATER FROM SITE TO BE DIRECTED TO SEDIMENTATION CONTROL DEVICES AT ALL TIMES DURING CONSTRUCTION.
10. CONTRACTOR TO INSTALL AND MAINTAIN DIVERSION DITCHES AROUND AND THROUGH THE SITE AS NECESSARY TO KEEP CLEAN WATER CLEAN.
11. CONTRACTOR TO HAVE ADDITIONAL SILT FENCE, BALED HAY AND LOOSE HAY AND/OR MULCH ON SITE FOR MAINTENANCE AND INSTALLATION OF ADDITIONAL MEASURES AS REQUIRED.
12. COVER EXPOSED SURFACES WITH HAY, MULCH OR WOOD CHIPS AS REQUIRED TO PREVENT SEDIMENT RUN-OFF. MAINTAIN COVERAGE THROUGHOUT CONSTRUCTION PERIOD.
13. WHERE SILT FENCE IS SHOWN AND GROUND IS TOO ROCKY TO INSTALL REGULAR SILT FENCE, CONTRACTOR MAY SUBSTITUTE WITH WOODCHIP BERM AS SHOWN IN DETAIL.
14. CONTRACTOR TO LEAVE SEDIMENTATION BERMS AND PONDS IN SERVICE UNTIL PROJECT ENGINEER REQUESTS THAT THEY BE TAKEN OUT OF SERVICE. BERMS AND PONDS TO REMAIN IN PLACE THROUGH LOT AND BUILDING CONSTRUCTION PERIOD.
15. THE CONTRACTOR SHALL DO THE FOLLOWING TO TAKE THE SEDIMENTATION BERMS AND PONDS OUT OF SERVICE:
    A. LEVEL OFF BERMS.
    B. HYDROSEED AND COVER ALL DISTURBED AREAS WITH HAY.
    C. FILL IN PONDS (WHERE REQUIRED)
16. ALL LOT DRAINAGE EASEMENTS TO BE HYDROSEEDED AND MULCHED AT COMPLETION OF GRADING ACTIVITY.
17. ALL EXPOSED AREAS NOT FINISHED WITH ASPHALT, CONCRETE, GRAVEL, OR SOD TO HAVE TOPSOIL AND BE HYDROSEEDED.
18. MAINTAIN CLEAN GRAVEL ACCESS ROAD TO SITE, PERIODICALLY APPLYING ADDITIONAL GRAVEL TO COVER MUD SURFACES. CONTRACTOR RESPONSIBLE TO CLEAN ADJACENT STREETS AS DIRECTED BY THE ENGINEER.
19. RESTRICT VEHICLE ACCESS TO SITE AT CONSTRUCTION ENTRANCES.
20. STOCKPILED MATERIALS ON-SITE MUST BE STABILIZED USING APPROPRIATE MEASURES INCLUDING SILT FENCE, HAY AND TARPS.
21. SITE ACTIVITY IS SUBJECT TO REQUIREMENTS OF HALIFAX REGIONAL MUNICIPALITY TOPSOIL BY-LAW.
22. ALL SEDIMENT CONTROL MEASURES TO BE FUNCTIONAL AT ALL TIMES DURING CONSTRUCTION.
23. CONTRACTOR TO LEAVE SEDIMENTATION CONTROL MEASURES IN SERVICE UNTIL ENGINEER OR THE MUNICIPALITY REQUESTS THAT THEY BE TAKEN OUT OF SERVICE.
24. THE SEDIMENTATION AND EROSION CONTROL MEASURES OUTLINED ON THIS PLAN ARE RECOMMENDATIONS ONLY. DEPENDING ON SITE CONDITIONS DURING CONSTRUCTION, ADDITIONAL MEASURES MAY BE REQUIRED.

C SILT CURTAIN DETAIL

NTS



KEY PLAN:

LEGEND:

SILT FENCE	
CHECK DAM	
HEADWALL	
CULVERT	
SWALE / DITCH	
RUMBLE STRIP	

SEAL:

REVISION:

NO.	DATE YYYY/MM/DD	DESCRIPTION
0	2021/05/27	ISSUED FOR REPORT

PROJECT NUMBER: 191-12517-00	DATE: (YYYY/MM/DD) 2021/05/20
ORIGINAL SCALE: HORIZONTAL: 1:500 VERTICAL: N/A	IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE. 25mm
DESIGNED BY: C. LUTZ	DRAWN BY: C. LUTZ
CHECKED BY: K. O'LEARY	APPROVED BY: K. O'LEARY

SCALE: 1:1000 METRIC
2016 12 8 4 0 20 40 60

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1 Spectacle Lake Drive
Dartmouth, Nova Scotia, Canada B3B 1X7
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CLIENT:
MICCO COMPANIES LTD.

PROJECT:
3195 HIGHWAY #2 (LOT 7A)
FALL RIVER, NOVA SCOTIA

TITLE:
PRELIMINARY EROSION AND SEDIMENTATION CONTROL PLAN

SHEET NUMBER: 1
SHEET #: 1 OF 1

ISSUE: ISSUED FOR REPORT
DATE OF: 2021/05/27
REV # 0

XREFS: \\15.4.1-XREFS\191-12517-00 - BASE.DWG \\15.1-CONCEPT PLANS\191-12517-103.DWG

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KEY MAP:

LEGEND:

SAMPLE LOCATION

- Upland Sample
- Wetland Sample
- Wetland Delineation (Outside PID 00504076) ~387 m^2
- Wetland Delineation (Inside PID 00504076) ~712 m^2
- Subject Area (PID 00504076)
- Property Boundary (Nova Scotia, 2017)

PROJECT:

PROJECT:
WETLAND DELINEATION FOR PID 00504076

PROJECT NO.: **191-12517-01**

CLIENT: **MICCO**

FIGURE:

TITLE: **WETLAND DELINEATION**

FIGURE NO.:	REVISION NO.:
1	0

SCALE: 1:500
0 5 10 20 Metres

DATUM:	PROJECTION:
NAD 83 CSRS	UTM ZONE 20 NORTH
DRAWN BY:	CHECKED BY:
T. MOREHOUSE	T. MacAULAY
CREATED DATE: (YYYY-MM-DD) 2020-07-16	REVISION DATE: (YYYY-MM-DD) 2020/07/16

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PATH: S:\GIS\2_PROJECTS\2019\191_12517_MICCO_WLDelineation_FallRiver_NS\8_MXD\20200716_191_12517_01_WetlandDelineation.mxd SOURCE: NSDNR Wetland Database, 2015; BING Background Imagery, 2016