SERVICING & STORMWATER MANAGEMENT REPORT
BUCKHORN YACHT HARBOUR EXPANSION

Project No.: CCO-23-3258

Prepared for:

Ontario Ltd. 1000037246
Lucas Fuderer and Marcus Fuderer
Fire Route 25
Adam and Eve Road, Buckhorn, ON

Prepared by:

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Submission 1 - April 29, 2024

egis

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TABLES

APPENDICES

1.0 INTRODUCTION

Egis was retained by Ontario Ltd. 1000037246 has prepared this Servicing and Stormwater Management Report in support of a Site Plan Application for the proposed marina storage lot which will consist of warehouse buildings and surrounding gravel driving areas, located at A-14 Adam & Eve Road in Buckhorn, ON.

The main purpose of this report is to provide servicing and stormwater management design details in accordance with the recommendations and guidelines provided by the Ministry of the Environment, Conservation and Parks (MECP) and the Municipality of Trent Lakes (Municipality). These guidelines encourage the implementation of Best Management Practices (BMPs) for treating and controlling stormwater runoff.

The proposed works will be developed in a previously wooded area of the subject property, north of and adjacent to the current propellor shop on Fire Route 25 (Kawartha Propellor), approximately 100m west of Buckhorn Lake. The area is proposed to include two new pre-engineered warehouse buildings with a footprint of 1,486m^2 each in area and a height of 6.7m and associated gravel driving area. It is anticipated that typical access to the site will be through a pre-existing gravelled opening in the southeast corner of the subject property. A relatively significant portion of the subject property in the northeast corner is proposed to remain undeveloped.

The MECP and Municipality will be reviewing and approving this report as part of the Site Plan Approval process. It is noted that the subject property does not fall within the boundary of any Conservation Authority and is not anticipated to be reviewed by Conservation Authority staff.

This report should be read in conjunction with the following drawings:

- Grading & Servicing Plan by Egis
- Pre- and Post-Development Drainage Plan

2.0 SITE CONTEXT & TOPOGRAPHY

The subject property is wooded and is bounded by similar wooded area to the north, Adam & Eve Road to the west, Fire Route 25 to the east and the existing commercial business to the south. See Location Plan in Appendix A for more details.

The topography of the site varies and consists of two local high points near the northwest corner and northeast corner of the site and several localized low points throughout the site. The northeast corner of the site ultimately appears to drain east towards Fire Route 25. A portion of the site appears to drain directly to the Adam & Eve Road ROW, while most of the site appears to drain toward a low point adjacent to an existing rock wall along the south side of the property, with an overland flow route toward Adam & Eve Road. In addition, some of the wooded area directly north of the site appear to drain south through the subject site.

3.0 BACKGROUND STUDIES

The following background studies, reports and other relevant material have been reviewed and utilized in the design where appropriate:

- Plan of survey with topographic detail of Part of Lot 8 Concession 9, Geographic Township of Harvey, Municipality of Trent Lakes, County of Peterborough by McIntosh Perry Surveying Inc. dated August 15, 2023.
- Site Plan by Bel-Con Design-Builders Ltd.
- (Draft) Stage 1 Archaeological Assessment by Past Recovery Archaeological Services Inc.
- Ministry of Environment, Conservation and Parks (MECP) Stormwater Management Planning and Design Manual; Ministry of Transportation Ontario (MTO) Drainage Management Manual.
- Pre-consultation notes and other submission requirements from Township staff.

3.1 Pre-Consultation Summary

Pre-Consultation recommendations provided by Municipality of Trent Lakes staff in November 2022 included a description of the planning act applications and supporting documents required, which included a Storm Water Management Plan, Revised Site Plan and Lot Grading Plan, as well as recommended contacts and additional notes on what should be included in plans. Further communications with municipal staff refined the required studies, reaffirming that a storm water management report and associated plans would be required.

4.0 EXISTING SERVICES

The subject site is currently unserviced.

5.0 SERVICING PLAN

5.1 Proposed Servicing Overview

The subject site is proposed to consist of warehouse buildings that will not require water, sanitary, gas or telecommunications services. Electrical services for illumination will be coordinated with the utility provider for the area (Hydro One) as necessary.

6.0 STORMWATER MANAGEMENT

6.1 Proposed Storm Servicing

In the absence of a sub watershed plan for this area, the MTO Drainage Management Manual and the MECP Stormwater Management Planning and Design Manual were referenced, where applicable. This methodology promotes stormwater management from an environmentally sustainable perspective. The intent of the stormwater management plan is to provide adequate stormwater treatment for both quantity and quality control.

Stormwater (Best Management Practices) BMPs will be implemented at the "lot level" and "conveyance" locations. These concepts will be explained further in Section 6.5. To summarize, where runoff is to be unrestricted, it will be designed to sheet flow through wooded areas as in pre-development conditions.

The area of the site to be developed is proposed to drain directly to a SWM (Storm Water Management) facility where it is collected before outletting via a restricted outlet consisting of a pipe and riprap lined weir, to the Adam & Eve ROW. The SWM swale has been designed to restrict runoff to pre-development levels. Given that the stormwater management plan will require that post-development flow rates do not exceed pre-development levels, no downstream infrastructure is anticipated to be affected by the proposed works.

6.2 Runoff Calculations

The rational method has been employed for the stormwater management calculations using the following methodology.

$$Q = 2.78CIA \text{ (L/s)}$$

Where C = Runoff coefficient
I = Rainfall intensity in mm/hr (MTO IDF Curve Lookup (44.545833, -78.354167))
A = Drainage area in hectares

The following coefficients were used to develop an average C for each area:

Building roofs	0.90
Wooded Areas	0.18
Gravel Areas	0.60

As per the MTO Drainage Management Manual, the 5-year balanced 'C' value has been increased by 25% for a 100-year storm event to a maximum of 0.95. Rainfall intensities were derived from the Intensity-Duration-Frequency (IDF) curves for the site from the MTO IDF Curve Lookup (Appendix B).

A maximum value of 30 m (100 ft) was used in calculating the overland sheet flow time of concentration. The remaining overland sheet flow is assumed to form shallow concentrated flows after these conditions and was calculated as such. The velocity for the shallow concentrated flow was calculated using the following formula:

$$V = K(S)^{0.5} \text{ (m/s)}$$

Where K = Constant (Referenced from the National Engineering Handbook, Table 15-3)
V = Velocity of water (m/s)
S = Average watershed land slope (%)

The resulting time of concentration was then determined using the velocity method which "assumes the time of concentration is the sum of the travel times for segments along the hydraulically most distant flow path." (National Engineering Handbook, Page 15-6.

6.3 Pre-Development Drainage

In the pre-development condition, the area to be developed is comprised of three (3) drainage areas. Pre-development Drainage Area A1 drains directly to Adam & Eve Road, Pre-development Drainage Area A2 drains to Fire Route 25 and Pre-development Drainage Area A3 drains to the south of the subject site. The Pre- and Post-Development Drainage Areas plan (Appendix C) indicates the limits of the drainage area and drainage calculations. The pre-development drainage area calculations are summarized below. Further detailed calculations are available in **Appendix C**.

Table 1 - Pre-Development Drainage Summary

Drainage Area ID	Total Area (ha)	C (5-Yr)	C (100-Yr)	T_c	5-yr Peak Flow (L/s)	100-yr Peak Flow (L/s)
A1	0.13	0.18	0.23	15	5	10
A2	2.71	0.18	0.23	52	43	90
A3	1.88	0.18	0.23	33	41	86
Total	**4.73**				**89**	**186**

6.4 Post-Development Drainage

The post-development drainage scheme for the proposed development is comprised of three (3) drainage areas, similar to the pre-development areas. Post-development Drainage Area B1 is similar to A1 and will be partially developed with a gravel entrance off Adam & Eve Road and gravel driving areas west of the proposed buildings. Post-development Drainage Area B2 is identical to A2 and is proposed to remain undeveloped. Post-development Drainage Area B3 is similar to A3 and will contain the proposed buildings and the majority of the proposed gravel area. The Post- Development Drainage Areas plan (Appendix C) indicates the limits of the post development drainage areas and drainage calculations. The post-development drainage area calculations are summarized below. Further detailed calculations are available in **Appendix C**.

Table 2 - Post-Development Drainage Summary - Uncontrolled

Drainage Area ID	Total Area (ha)	C (5-Yr)	C (100-Yr)	T_c	5-yr Peak Flow (L/s)	100-yr Peak Flow (L/s)
B1	0.61	0.19	0.23	26	16	34
B2	2.71	0.18	0.23	52	43	90
B3	1.40	0.55	0.65	20	132	261
Total	**4.73**				**192**	**385**

Table 3 - Post-Development Drainage Summary – Controlled via Orifice

Drainage Area ID	Total Area (ha)	C (5-Yr)	C (100-Yr)	T_c	5-yr Peak Flow (L/s)	100-yr Peak Flow (L/s)
B1	0.61	0.19	0.23	26	16	34
B2	2.71	0.18	0.23	52	43	90
B3	1.40	0.55	0.65	20	30	62
Total	**4.73**				**89**	**186**

6.5 Best Management Practices

The entire site will employ BMPs wherever possible. The intent of implementing stormwater BMPs throughout the entire development is to ensure that water quality and quantity concerns are addressed at all stages of the development. Stormwater BMPs will be implemented at lot and conveyance levels.

Lot level BMPs include the directing of runoff toward undeveloped wooded or grassed areas where possible. All surface drainage from the proposed works will flow onto wooded or grassed areas, which will provide an opportunity for initial filtration of any sediment and provide an opportunity for absorption and ground water recharge. Recent recommendations by a number of Conservation Authorities and the MECP suggest that yard grading as flat as 0.5% be implemented to promote infiltration. The target range for finished ground slopes will be 1% - 5% where possible. This range of slope will still provide an opportunity for the absorption and filtration process. The conveyance system to be employed within the site is a combination of sheet drainage and a grassed swales located around the perimeter of the proposed works. The conveyance system includes a SWM facility with restricted outlet to provide quantity control.

6.6 Stormwater Quantity Control

Detailed stormwater peak flow rates and storage calculations have been provided in Appendix D. As seen in the calculations provided, the post-development flow rates will need to be restricted in order to match the pre-development levels. The proposed stormwater management design will examine both the 5- and 100-year storm events.

Post-development drainage area B3 flows overland via sheet flow to a proposed SWM facility, ultimately outletting to the Adam & Eve Road ROW. The facility will be restricted by use of a riprap lined weir and restricted pipe at its downstream end, in order to meet total pre-development flow rates for the site. The restriction will cause runoff to back up into the SWM swale area, which will provide the necessary storage to meet pre-development flow rates due to the grading of the area. Please see Appendix C for detailed calculations showing how flow rates are restricted to match pre-development and how the necessary storage is achieved.

6.7 Stormwater Quality Control

The entire development will employ BMPs wherever possible. A "normal" quality treatment for the site, requiring 70% TSS removal has been targeted for the site. Outflow from the site will be controlled through the use of a riprap lined weir and restricted pipe at the downstream end of an SWM facility in the southwest corner of the property, which will restrict flows leaving the site, causing temporary ponding in the SWM facility. There will be an opportunity for particle settlement during this process. Temporary erosion and sediment control will be utilized during construction, and riprap will be placed at the outlet of the storm system to provide further quality control.

The enhanced grassed swale has been designed in accordance with the MECP Manual. The enhanced grassed swale will accept flow primarily from the buildings and surrounding gravel areas. The swale will have a continuous

slope of 0.3% with a length of 100 m. The grass within the swale will be kept at a length greater than 75 mm to enhance the filtration of suspended solids.

The table below outlines MECP design requirements for an enhanced grass swale. Flow depth is listed based on the 100-year storm event. Soil percolation and bedrock depth are approximated based on publicly available tools and will be updated as more studies are complete on site.

Table 4 – SWM Swale Design Criteria

No.	Design Element	Criteria	Proposed Works
1	Drainage Areas	Less than 2 hectares	Area B3 – 1.40 hectares
2	Soils Type	Soil percolation rate should be greater than 15mm/hr	The soil percolation rate is expected to be greater than 15mm/hr.
3	Water Table Depth	The seasonally high water depth should be greater than 1m below the bottom of the enhanced swales	High water depth is anticipated to be >1.0m below the swale bottom.
4	Bedrock Depth	The depth to bedrock should be greater than 1m below the bottom of the enhanced swales	Depth to bedrock is anticipated to be >1.0m below the swale bottom.
5	Cross-Section	Bottom width: >0.75m Side slopes: 2.5:1 (Typical) Maximum Depth of Flow: <0.5m (Typical) Channel Slope: <4%	Bottom widths: 0.75m (min) Side slopes: 3:1 Max Depth of Flow: 0.7m Channel Slope: 0.30%
6	Flow Velocity	Convey the peak flow from a 4 hour 25mm Chicago storm with a velocity <0.5m/s	The velocity within the ditch was calculated to be <0.5m/s.
7	Swale Length	>5m	100m
8	Permanent Check Dams	To promote infiltration of stormwater and the settling of pollutants, permanent check dams can be constructed at intervals along the swale systems	The outlet of the swale is equipped with a riprap weir which is anticipated to act similarly to a check dam.
9	Major System Events	Grassed swales must be evaluated under major system and minor system events to ensure that swales can convey these storms effectively	The swale has been designed to convey the 100-year storm without overtopping its banks, including 0.3m freeboard.

7.0 EROSION AND SEDIMENT CONTROL

7.1 Temporary Measures

Before construction begins, temporary silt fence, straw bales or rock flow check dams will need to be installed at all-natural runoff outlets from the property. It is crucial that these controls be maintained throughout construction and inspection of sediment and erosion control will be facilitated by the Contractor or Contract Administration staff throughout the construction period.

The Contractor, at their discretion or at the instruction of the Municipality or the Contract Administrator shall increase the quantity of sediment and erosion controls on-site to ensure that the site is operating as intended and no additional sediment finds its way into the storm sewer network on site. The straw bales and silt fences shall be inspected weekly and after rainfall events. Care shall be taken to properly remove sediment from the fences and check dams as required.

Work through winter months shall be closely monitored for erosion along sloped areas. Should erosion be noted, the Contractor shall be alerted and shall take all necessary steps to rectify the situation. Should the Contractor's efforts fail at remediating the eroded areas, the Contractor shall contact the Conservation Authority to review the site conditions and determine the appropriate course of action.

7.2 Permanent Measures

Rip rap will be placed at all locations that have the potential for concentrated flow. It is crucial that the Contractor ensure that the geotextile is keyed in properly to ensure runoff does not undermine the rip rapped area. Additional rip rap is to be placed at erosion prone locations as identified by the Contractor / Contract Administrator or Municipality.

It is expected that the Contractor will promptly ensure that all disturbed areas receive topsoil and seed/sod, and that grass be established as soon as possible. Any areas of excess fill shall be removed or levelled as soon as possible and must be located a sufficient distance from any outlet to ensure that no sediment is washed out into the existing storm sewer network. As the vegetation growth provides a key component to the control of sediment for the site, it must be properly maintained once established.

8.0 SITE MAINTENANCE

During construction for the site and stormwater features, the contractor should review the site regularly while the vegetation is becoming established and after large rainfall events (over 10 mm) to ensure that any issues are identified and repaired. Upon completion of the site, the owner should note, repair and monitor the site for erosion and long term ponding.

Re-vegetation of the site is a key concern as sediment deposition and erosion become increased concerns with the absence of vegetation. Every effort should be made by the Contractor to reseed all disturbed areas as soon as work has been completed. Should the Contractor experience erosion concerns making it difficult to re-vegetate, it is recommended that an experienced and qualified professional be consulted to provide recommendations on additional measures that could be taken to promote vegetation growth.

8.1 Swale

The proposed enhanced swale will convey runoff from the site to the site outlet in the southwest corner of the site. This feature will be accessible from both sides along its length, excepting where it is directly adjacent to a a building. Regular cleaning of the swale will be required throughout the life span of the project and should be reviewed on a regular basis. It is recommended that the Contractor perform an inspection of the swale at the completion of construction and perform any maintenance required at that time.

The swale should be maintained to ensure it continues to function as intended. This includes regular grass cutting and removal of debris and sediment as required, particularly from the outlet pipe. A minimum annual review of sediment accumulation within the swale should be performed, particularly during the first 2-3 years of operation.

8.1.1 Cleanout Frequency

Estimated cleanout requirements have been provided in Appendix D. Please note that the calculations have been estimated based on a 5% decrease in the required quality control storage volume/available storage, referencing the annual sediment loading from the MECP Design Manual – Table 6.3. Timelines provided assume the site is fully vegetated.

Sediment loading within the drainage area has been estimated through extrapolation of Table 6.3 of the MECP Design Manual. Removal efficiency has been selected based on the feature, referencing the MECP Design Manual – Table 3.2.

Please note that the purpose of this equation at a high level is to determine the cleanout frequency in an urban setting. Given the non-urban nature of the site and the lack of sediment loading (winter sand and salt on roads) it is very likely that these features will not require significant maintenance, however, it is recommended that the owner monitor the features and outlets to ensure they are operating as intended, and perform maintenance as required to ensure their continued function. Cleanouts and routine maintenance periods can be determined based on site conditions and performance. Particularly for the stormwater swale, the need for maintenance will be indicated by visual inspection as noted in Section 6.4.2.2 of the MECP Design Manual, and the above estimate is included only as reference.

9.0 PROVINCIAL POLICY STATEMENT, 2020

The Provincial Policy Statement was issued under Section 3 of the Planning Act and came into effect May 1, 2020. It replaces the Provincial Policy Statement issued April 30, 2014. It notes that Planning authorities shall protect, improve or restore the quality and quantity of water by:

a) using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;
b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;
c) evaluating and preparing for the impacts of a changing climate to water resource systems at the watershed level;
d) identifying water resource systems consisting of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, which are necessary for the ecological and hydrological integrity of the watershed;
e) maintaining linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas;
f) implementing necessary restrictions on development and site alteration to:
    1. protect all municipal drinking water supplies and designated vulnerable areas; and
    2. protect, improve or restore vulnerable surface and ground water, sensitive surface water features and sensitive ground water features, and their hydrologic functions;
g) planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality;
h) ensuring consideration of environmental lake capacity, where applicable; and
i) ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces.

With regards to the stormwater management plan for the proposed site, subsections (e), (g) and (i) of the above directly apply. With respect to subsection (e), the stormwater management plan provides that post-development drainage patterns will be consistent with pre-development patterns such that natural features existing within the site are not negatively impacted by altered drainage flows. With respect to subsection (g), quality control of runoff leaving the site is anticipated to be improved by the proposed quality control measures at concentrated outlet points. With respect to subsection (i), stormwater runoff is proposed to be controlled via a stormwater management facility providing both quality and quantity control.

10.0 SUMMARY

- The proposed development of the Buckhorn Yacht property will require stormwater restriction due to the replacement of wooded area with buildings and gravel over a significant portion of the development area;
- Rainfall will be conveyed by overland sheet flow towards a proposed SWM facility where it will be restricted in order to meet pre-development flow rates prior to outletting toward the Adam & Eve Road ROW west of the site; and
- BMPs will be implemented to meet Municipal requirements for quality control.

11.0 RECOMMENDATIONS

Based on the information presented in this report, we recommend that the Municipality of Trent Lakes approve this Servicing and Stormwater Management Brief for engineering details in support of the proposed Buckhorn Yacht Harbour facility.

Sincerely,

Egis

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BUCKHORN YACHT HARBOUR EXPANSION

APPENDIX A

Location Plan

LEGEND

- Site Location
- Local Road
- Major Road
- Watercourse
- Waterbody
- Wooded Area

300 150 0 300

Scale 1:10,000 Metres

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2024.

CLIENT: ONTARIO LTD. 1000037246

PROJECT: BUCKHORN YACHT HARBOUR EXPANSION

TITLE: SITE LOCATION

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A1L0
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PROJECT NO: CCO-23-3258		FIGURE:
Date	Mar., 04, 2024	1
GIS	SW	
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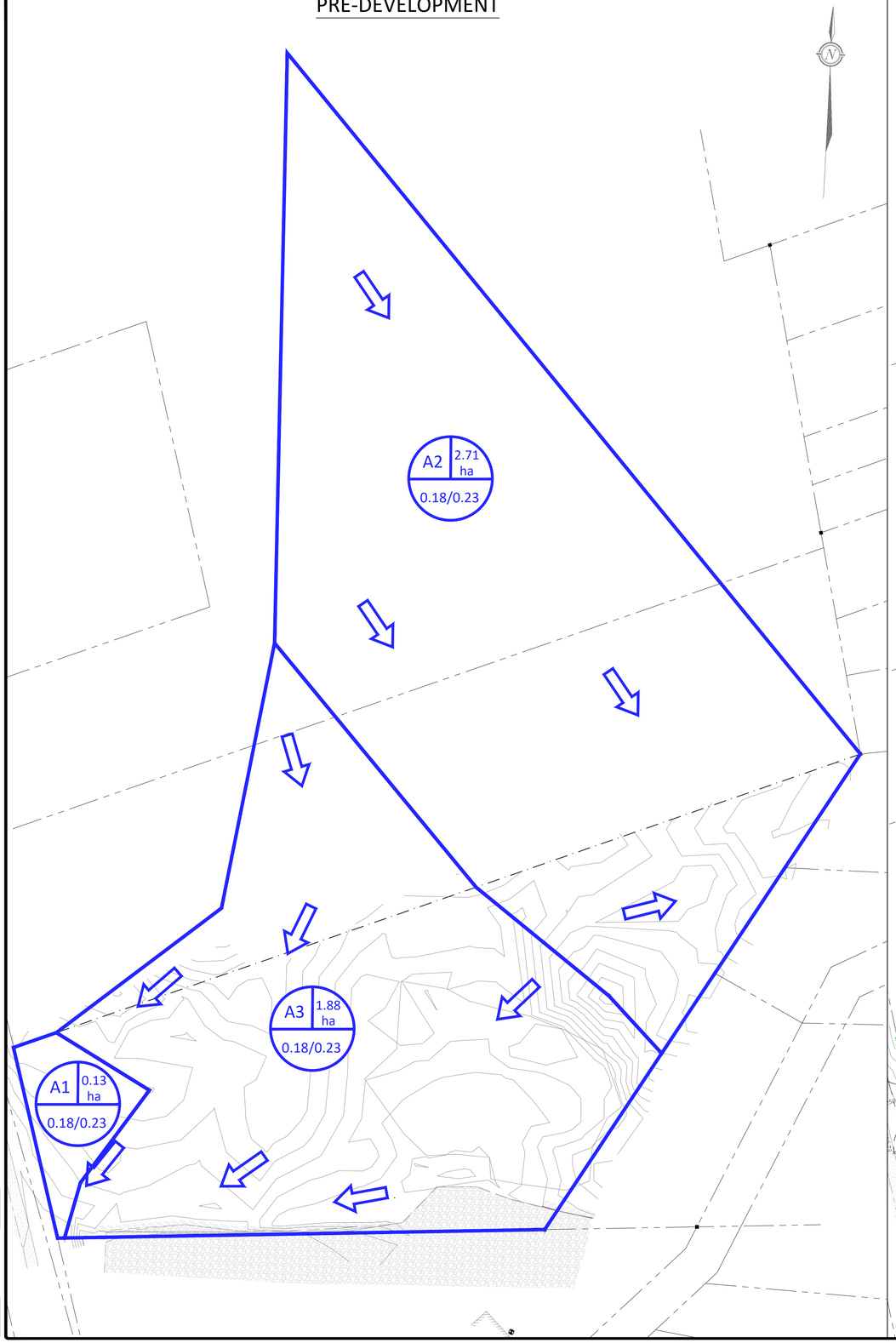
BUCKHORN YACHT HARBOUR EXPANSION

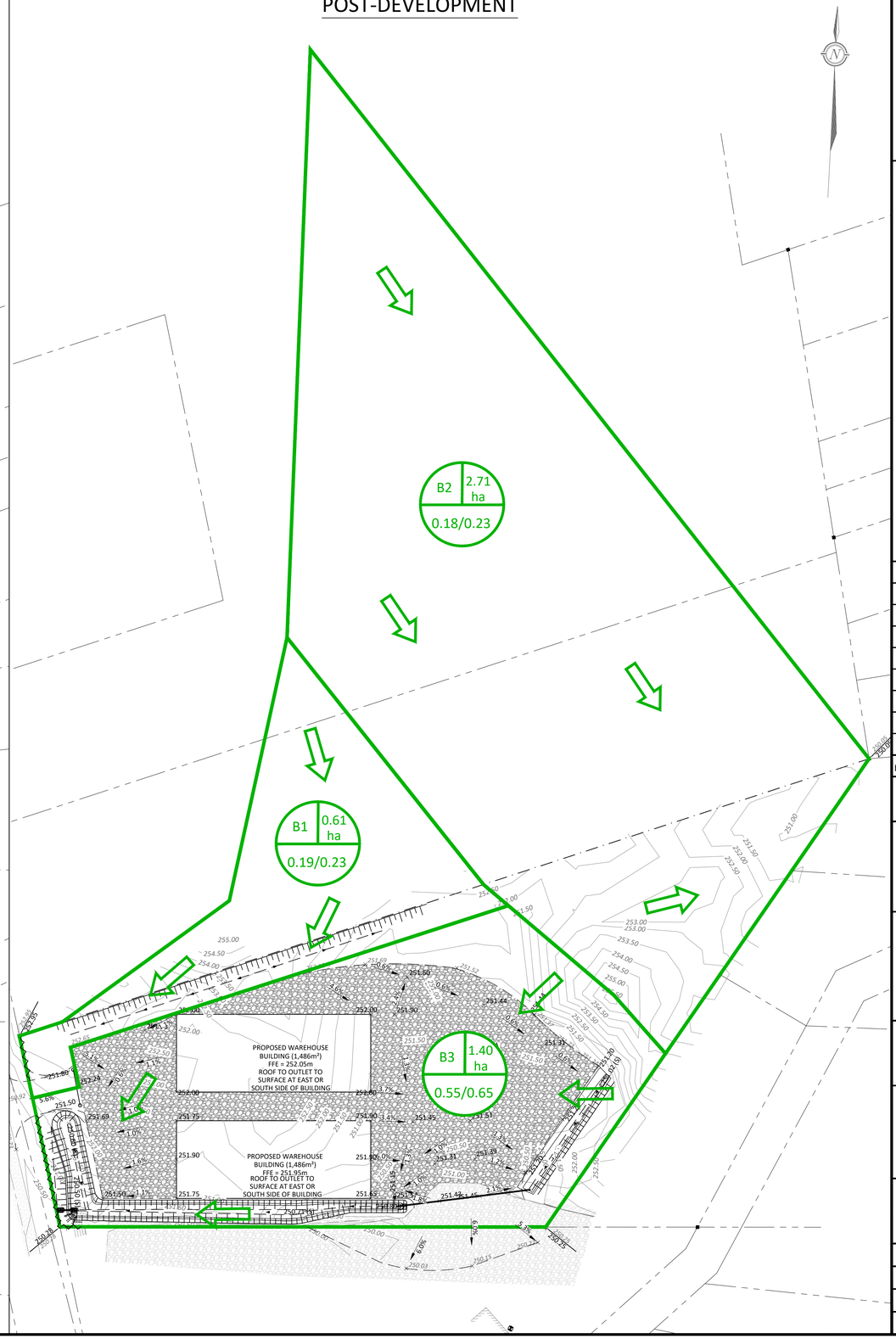
APPENDIX B

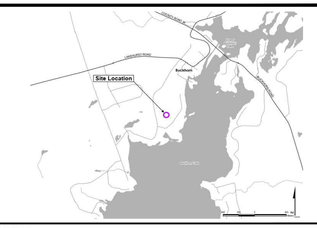
Pre- and Post-Development Drainage Areas Plan & Calculations

PRE-DEVELOPMENT



POST-DEVELOPMENT





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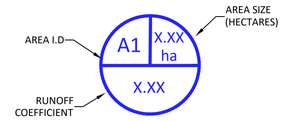

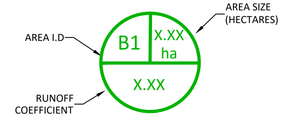

FOR REVIEW ONLY
NOT FOR CONSTRUCTION

No.	Revisions	Date
1	ISSUED FOR REVIEW	APR/29/2024

Check and verify all dimensions before proceeding with the work

Do not scale drawings

SCALE 1 : 500

0 10 20 30 40 50 Metres

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C. A. MACLEOD
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APR 29/2024
PROVINCE OF ONTARIO

Client:

ONTARIO LTD. 1000037246
FIRE ROUTE 25
BUCKHORN, ON

Project:

BUCKHORN YACHT HARBOUR EXPANSION
A-14 ADAM & EVE ROAD
BUCKHORN, ON

Drawing Title:

PRE- AND POST-DEVELOPMENT DRAINAGE PLAN

Scale:	1:500	Project Number:	CCO-23-3258
Drawn By:	DL		
Checked By:	AM	Drawing Number:	C200
Designed By:	DL		

FILENAME: U:\Infrastructure\2023\CCO-23-3258 - Ontario Ltd. 1000037246 - Buckhorn Yacht Harbour\12 - Drawings\CCO-23-3258 Buckhorn Yacht Harbour.dwg
LAST SAVED: Friday, April 26, 2024 LAST SAVED BY: d.langmuir
LAST PLOTTED: Monday, April 29, 2024 CTB FILE USED: —

CCO-23-3258 - BUCKHORN YACHT HARBOUR - DRAINAGE AREAS

Pre-Development - 5-YR

Outlet	Drainage AreaID	Area (m^2)	Impervious (m^2)	C	Forested (m^2)	C	Impervious %	Average C
Adam and Eve Road	A1	1299	0	0.9	1299	0.18	0	**0.18**
Fire Route 25	A2	27133	0	0.9	27133	0.18	0	**0.18**
Site	A3	18829	0	0.9	18829	0.18	0	**0.18**
	Total	**47261**						

All impervious areas shown have been measured in the drawings.

Pre-Development - 100-YR

Outlet	Drainage AreaID	Area (m^2)	Impervious (m^2)	C	Forested (m^2)	C	Impervious %	Average C
Adam and Eve Road	A1	1299	0	0.95	1299	0.23	0	**0.23**
Fire Route 25	A2	27133	0	0.95	27133	0.23	0	**0.23**
Site	A3	18829	0	0.95	18829	0.23	0	**0.23**
	Total	**47261**						

All impervious areas shown have been measured in the drawings.

Post-Development - 5-YR

Outlet	Drainage AreaID	Area (m^2)	Impervious (m^2)	C	Forested (m^2)	C	Gravel	C	Impervious %	Average C
Adam and Eve Road	B1	6147	0	0.9	6063	0.18	84	0.6	1	**0.19**
Fire Route 25	B2	27133	0	0.9	27133	0.18	0	0.6	0	**0.18**
SWM Management	B3	13981	2972	0.9	3875	0.18	7134	0.6	72	**0.55**
	Total	**47261**								

All impervious areas shown have been measured in the drawings.

Post-Development - 100-YR

Outlet	Drainage AreaID	Area (m^2)	Impervious (m^2)	C	Forested (m^2)	C	Gravel	C	Impervious %	Average C
Adam and Eve Road	B1	6147	0	0.95	6063	0.23	84	0.75	1	**0.23**
Fire Route 25	B2	27133	0	0.95	27133	0.23	0	0.75	0	**0.23**
SWM Management	B3	13981	2972	0.95	3875	0.23	7134	0.75	72	**0.65**
	Total	**47261**								

All impervious areas shown have been measured in the drawings.

Runoff Coefficients as per MTO Drainage Management Manual, MNRF Agmaps and site topography

Time of Concentration

Drainage Area ID	Overland Flow Distance (m)	Slope of Land (%)	Sheet Flow Distance (m)	Sheet Flow Tc	Shallow Concentrated Flow Distance (m)	Shallow Concentrated Flow Velocity (m/s)	Shallow Concentrated Tc (min)	Flow Distance in Ditch (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)	Total Tc
A1	55	4.9	30	10	25	0.16	3	n/a				**12**
A2	350	3.4	30	11	320	0.13	41	n/a				**52**
A3	203	3.4	30	11	173	0.13	22	n/a				**33**
B1	98	5.4	30	9	68	0.16	7	120	0.2	0.2	10	**26**
B2	350	3.4	30	11	320	0.13	41	n/a				**52**
B3	84	1.2	30	9	54	0.23	4	100	0.3	0.3	7	**20**

Land Use	5-Year	100-Year
Impervious	0.9	0.95
Gravel	0.6	0.75
Grass	0.18	0.23

Sources:

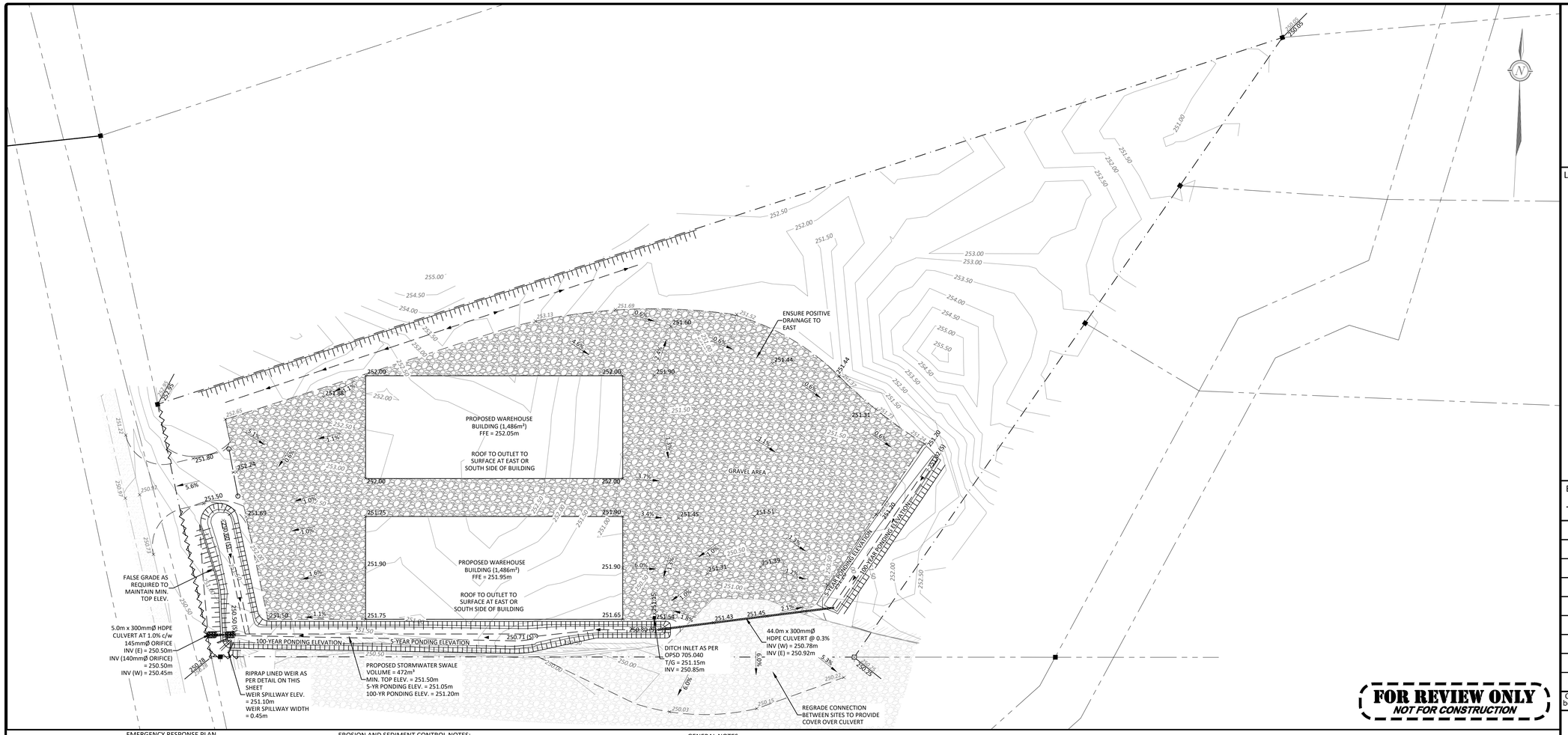
1: MTO Drainage Manual, Appendix A, Design Chart 1.07

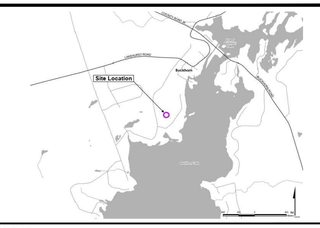
2: OMAFRA AgMaps

BUCKHORN YACHT HARBOUR EXPANSION

APPENDIX C

Stormwater Management Design





LEGEND

PROPERTY BOUNDARY
LEGAL BOUNDARY
EX. ASPHALT
EX. GRAVEL
LOT CORNER GRADE 100.00
EX. GRADE 100.00
PROPOSED GRAVEL
PROPOSED DITCH
PROPOSED FENCE
PROPOSED CULVERT
PROPOSED RIPRAP
PROPOSED TOP OF SLOPE
PROPOSED SPOT GRADE 100.00
PROPOSED SWALE GRADE 100.00 (S)
BUILDING ENTRANCE
PROPOSED ROOF DRAIN
EXISTING BOREHOLE
PROPOSED SILT FENCE
PROPOSED UTILITIES HBCG HBCG

BENCHMARKS:

No.	DESCRIPTION	ELEVATION
TBM#1	CUT CROSS ON NE CORNER OF CONCRETE PAD	249.87m

No.	Revisions	Date
1	ISSUED FOR REVIEW	APR/29/2024

FOR REVIEW ONLY
NOT FOR CONSTRUCTION

Check and verify all dimensions before proceeding with the work — Do not scale drawings

SCALE 1 : 500
0 10 20 30 40 50 Metres

EMERGENCY RESPONSE PLAN

THE EMERGENCY RESPONSE PLAN IDENTIFIES SITE REQUIREMENTS AND ACTIONS TO BE TAKE IN THE EVENT OF AN ENVIRONMENTAL EMERGENCY (SUCH AS A SPILL OF HAZARDOUS MATERIALS, DISCHARGE OF A DELETERIOUS SUBSTANCE (E.G. SEDIMENT) TO A WATERCOURSE OR OTHER ACCIDENT, ETC.). THIS PLAN IS TO BE IMPLEMENTED ON A CONTINUOUS BASIS AND UPDATED AS SITE CONDITIONS CHANGE.

SITE ENVIRONMENTAL INSPECTOR

A DESIGNATED SITE ENVIRONMENTAL INSPECTOR WILL BE APPOINTED BY THE CONTRACTOR. THIS PERSON WILL BE RESPONSIBLE FOR ENSURING THAT THE CONTRACTOR(S) HAS PREPARED A SPILL CLEAN-UP PROCEDURE/EMERGENCY RESPONSE PLAN AND APPROPRIATE EQUIPMENT, WITH ALL STAFF TRAINED IN THE RECOGNITION OF A SPILL AND PROPER IMPLEMENTATION IN THE EVENT OF A SPILL OR ACCIDENT ON-SITE. ALL SPILLS ARE TO BE RESPONDED TO, DOCUMENTED AND REPORTED TO THE OWNER AND MOECC AS REQUIRED BY LAW. THE INSPECTOR WILL ALSO BE RESPONSIBLE TO ENSURE THROUGH DOCUMENTED INSPECTIONS THAT, AMONGST OTHERS:

- EROSION AND SEDIMENT CONTROL WORKS ARE FUNCTIONAL AND EFFECTIVE (MINIMUM WEEKLY INSPECTION AND FOLLOWING PRECIPITATION EVENTS);
- PUMPED EXCESS STORMWATER IS DIRECTED PROPERLY TO VEGETATED AREAS AND EXCESSIVE WATER (>50,000 L) IS NOT TRANSFERRED WITHIN A 24 HOUR PERIOD UNLESS A PTTW IS AVAILABLE;
- WATER SETBACKS, OR OTHER SETBACKS, ARE MAINTAINED AT ALL TIMES DURING CONSTRUCTION;
- CEMENT/CONCRETE TRUCKS REMAIN 120 M AWAY FROM WATER;
- CONCRETE MIX (AND OTHER POTENTIALLY HAZARDOUS MATERIALS) ARE STORED PROPERLY;
- ALL PUBLIC COMPLAINTS, AS A RESULT OF CONSTRUCTION, ARE DOCUMENTED AND THE OWNER NOTIFIED;
- COMPLAINTS MADE TO THIRD PARTIES (E.G. MOECC, MNRF) ARE ALSO DOCUMENTED AND THE OWNER NOTIFIED.

SITE REQUIREMENTS

EMERGENCY CONTACTS SHALL BE POSTED IN A CONSPICUOUS SPACE ON SITE, INCLUDING 911, POLICE, FIRE DEPARTMENT, MOECC SPILLS ACTION CENTRE, AND THESE ORGANIZATIONS SHOULD BE CONTACTED AS REQUIRED. THE FOLLOWING IS A NON-EXHAUSTIVE LIST OF PHONE NUMBERS:

EMERGENCY - POLICE, FIRE, AMBULANCE	911
ONTARIO PROVINCIAL POLICE	1 888 310-1122
OFFICE OF THE FIRE MARSHAL	1 800 565-1842
MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE (MOECC) SPILLS ACTION CENTRE	1 800 268-6060
MOECC EMERGENCY MANAGEMENT COORDINATOR	1 416 325-1995
ENVIRONMENT CANADA*	1 416 739-4826
SITE/PROJECT DEPENDENT EMERGENCY CONTRACTOR	X XXX XXX-XXXX

*SHOULD BE CONTACTED WHEN ON FEDERAL LANDS OR IF THE CONTAMINATION COULD AFFECT A FEDERAL LAND OR NAVIGABLE WATER AND FISH HABITAT.

SPILL CONTAINMENT AND CLEAN-UP SUPPLIES ARE TO BE MAINTAINED ON SITE AT ALL TIMES. THESE "SPILL KITS" GENERALLY COME IN TRANSPORTABLE BAGS OR PLASTIC CONTAINERS DEPENDING ON SIZE. A TYPICAL SPILL KIT SHOULD INCLUDE:

- VARIOUS SIZES AND LENGTHS OF ABSORBENT SOCKS;
- VARIOUS SIZES OF ABSORBENT PADS OR CUSHIONS (10-18"x18" PADS MINIMUM);
- GRANULAR ABSORBENT MATERIAL (5 lb. MINIMUM);
- DRAIN MATS;
- WASTE BAGS AND TIES, AND;
- GLOVES AND PROTECTIVE EYEWEAR.

A SHOVEL OR OTHER HAND DEVICE SHOULD ALSO BE INCLUDED OR EASILY AVAILABLE ON THE WORK SITE TO ASSIST WITH THE CLEAN UP OR CONTROL OF A SMALL SPILL/RELEASE. THESE MATERIALS SHOULD BE USED DURING INTERVENTIONS/CLEANUPS FOLLOWING SMALL SPILLS OR LEAKS, HOWEVER IF A MAJOR INCIDENT OCCURS, A SPECIALIZED COMPANY WITH APPROPRIATE EQUIPMENT SHOULD BE CONTACTED (SEE LIST ABOVE).

ACTIONS

SPILLS MUST BE CLEANED UP IMMEDIATELY AND REPORTED ACCORDINGLY. IN THE EVENT OF A REPORTABLE SPILL, THE MOECC SPILLS ACTION CENTRE IS TO BE CONTACTED IMMEDIATELY, AS REQUIRED BY PROVINCIAL REGULATIONS. ALL SPILLS MUST BE DOCUMENTED AND REPORTED TO THE OWNER, FORTHWITH. THESE INCLUDE DISCHARGES OF ANY TURBID WATER FROM THE SITE AND/OR TO WATERCOURSES.

EROSION AND SEDIMENT CONTROL NOTES:

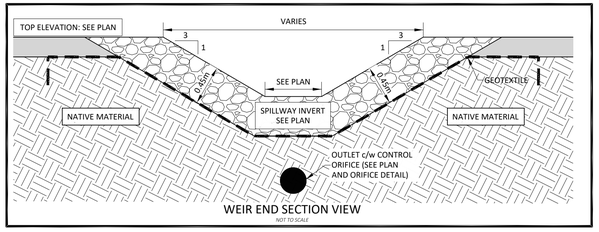
1. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL AND INSTALLING SILT FENCES AND OTHER SEDIMENT TRAPS.
2. AT THE DISCRETION OF THE CONTRACT ADMINISTRATOR, CONSERVATION AUTHORITY OR MUNICIPALITY, ADDITIONAL SILT CONTROL DEVICES SHALL BE INSTALLED AT DESIGNATED LOCATIONS.
3. FOR SILT FENCE BARRIER, USE OPSD 219.110. GEOTEXTILE FOR SILT FENCE SHALL BE ACCORDING TO OPSS 1860, TABLE 3.
4. EXCEPT AS PROVIDED IN PARAGRAPHS 4.(a), and (b) BELOW, STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS FEASIBLE IN PORTIONS OF THE SITE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED, BUT IN NO CASE MORE THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY HAS TEMPORARILY OR PERMANENTLY CEASED.
   a) WHERE THE INITIATION OF STABILIZATION MEASURES BY THE 14TH DAY AFTER CONSTRUCTION ACTIVITY TEMPORARILY OR PERMANENTLY CEASE IS PRECLUDED BY SNOW COVER, STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS FEASIBLE.
   b) WHERE CONSTRUCTION ACTIVITY WILL RESUME ON A PORTION OF THE SITE WITHIN 21 DAYS FROM WHEN ACTIVITIES CEASED, (E.G. THE TOTAL TIME PERIOD THAT CONSTRUCTION ACTIVITY IS TEMPORARILY CEASED IS LESS THAN 21 DAYS) THEN STABILIZATION MEASURES DO NOT HAVE TO BE INITIATED ON THAT PORTION OF SITE BY THE 14TH DAY AFTER CONSTRUCTION ACTIVITY TEMPORARILY CEASED.
5. SEDIMENT THAT IS ACCUMULATED BY THE TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED IN A MANNER THAT AVOIDS ESCAPE OF THE SEDIMENT TO THE DOWNSTREAM SIDE OF THE CONTROL MEASURE AND AVOIDS DAMAGE TO THE CONTROL MEASURE. SEDIMENT SHALL BE REMOVED TO THE LEVEL OF THE GRADE EXISTING AT THE TIME THE CONTROL MEASURE WAS CONSTRUCTED AND BE ACCORDING TO THE FOLLOWING:
   a) FOR LIGHT-DUTY SEDIMENT BARRIERS, ACCUMULATED SEDIMENT SHALL BE REMOVED ONCE IT REACHES THE LESSER OF THE FOLLOWING:
      i) A DEPTH OF ONE-HALF THE EFFECTIVE HEIGHT OF THE CONTROL MEASURE.
      ii) A DEPTH OF 300 MM IMMEDIATELY UPSTREAM OF THE CONTROL MEASURE.
   b) FOR ALL CONTROL MEASURES, ACCUMULATED SEDIMENT SHALL BE REMOVED AS NECESSARY TO PERFORM MAINTENANCE REPAIRS.
   c) ACCUMULATED SEDIMENT SHALL BE REMOVED IMMEDIATELY PRIOR TO THE REMOVAL OF THE CONTROL MEASURE.
   d) ACCUMULATED SEDIMENT IS TO BE REMOVED AND DISPOSED OF AS PER OPSS 180.
6. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE MONITORED TO ENSURE THEY ARE IN EFFECTIVE WORKING ORDER. THE CONDITION OF THE CONTROL MEASURES SHALL BE MONITORED PRIOR TO ANY FORECAST STORM EVENT AND FOLLOWING A STORM EVENT.
7. DUST CONTROL MEASURES SHOULD BE CONSIDERED PRIOR TO CLEARING AND GRADING. THE USE OF WATER, CALCIUM CHLORIDE FLAKES/SOLUTION OR MAGNESIUM CHLORIDE FLAKES/SOLUTION SHALL BE USED AS DUST SUPPRESSANTS AS PER OPSS 506. THIS IS TO LIMIT WIND EROSION OF SOILS WHICH MAY TRANSPORT SEDIMENTS OFFSITE, WHERE THEY MAY BE WASHED INTO THE RECEIVING WATER BY THE NEXT RAINSTORM.
8. STOCKPILED MATERIAL IS TO BE STORED AWAY FROM POTENTIAL RECEIVERS (E.G. WATERCOURSES), AND BE SURROUNDED BY EROSION CONTROL MEASURES WHERE MATERIAL IS TO BE LEFT IN PLACE IN EXCESS OF 14 DAYS.
9. IF REQUIRED, DEWATERING/SETTLING BASINS SHALL BE CONSTRUCTED AS PER OPSD 219.240 AND LOCATED ON FLAT GRADE UPSTREAM OF OTHER EXISTING MITIGATION MEASURES. WATERCOURSES SHALL NOT BE DIVERTED, OR BLOCKED, AND TEMPORARY WATERCOURSES CROSSINGS SHALL NOT BE CONSTRUCTED OR UTILIZED, UNLESS OTHERWISE SPECIFIED IN THE CONTRACT. IF CLOSURE OF ANY PERMANENT WATER PASSAGE IS NECESSARY, THE CONTRACTOR SHALL RELEASE ANY STRANDED FISH TO THE OPEN PORTION OF THE WATERCOURSE WITHOUT HARM.
10. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL CONFORM TO OPSS 805
11. WHERE DEWATERING IS REQUIRED, THE DISCHARGED WATER SHALL BE CONTROLLED IN ACCORDANCE WITH OPSS 518.
12. ALL SETTLING/FILTRATION BASINS SHALL BE EQUIPPED WITH TERRAFIX 270R GEOTEXTILE (OR APPROVED EQUIVALENT) AND SHALL BE CLEANED AND REPLACED AS REQUIRED.
13. FOR POTENTIAL SPILLS, THE CONTRACTOR SHALL HAVE ON SITE AT ALL TIMES AN EMERGENCY SPILL KIT THAT WILL INCLUDE AS A MINIMUM THE FOLLOWING ITEMS:
    - 10 - 18 in. X 18 in. ABSORBENT PADS, - 5 LBS ZORBAL ABSORBING MATERIAL, -1 PAIR GOGGLES, 1 PAIR PVC GLOVES.

GENERAL NOTES:

1. ALL DIMENSIONS AND INVERTS MUST BE VERIFIED PRIOR TO CONSTRUCTION, IF THERE IS ANY DISCREPANCY THE CONTRACTOR IS TO NOTIFY THE ENGINEER PROMPTLY.
2. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING AND PROTECTING ALL UTILITIES DURING CONSTRUCTION. GAS, HYDRO, TELEPHONE OR ANY OTHER UTILITY THAT MAY EXIST ON SITE OR WITHIN THE ROAD ALLOWANCE MUST BE LOCATED BY ITS OWN UTILITIES AND VERIFIED.
3. TOPSOIL TO BE STRIPPED AND STOCKPILED FOR REHABILITATION. CLEAN FILL TO BE PLACED IN FILL AREAS AND COMPACTED TO 95% STANDARD PROCTOR DENSITY.
4. ALL UNDERGROUND SERVICES, MATERIALS AND INSTALLATIONS TO BE IN ACCORDANCE WITH THE CURRENT STANDARDS AND CODES OF THE TOWN AND PROVINCE.
5. ALL DISTURBED AREAS TO BE RESTORED TO ORIGINAL CONDITION OR BETTER UNLESS OTHERWISE SPECIFIED.
6. CONTRACTOR IS RESPONSIBLE FOR ALL LAYOUT FOR CONSTRUCTION PURPOSES. THESE DRAWINGS ARE BASED ON LEGAL DRAWINGS PROVIDED BY THE TOWN OF CARLETON PLACE. LEGAL BOUNDARIES SHOWN ARE THE PLANS ARE APPROXIMATE ONLY AND MUST BE CONFIRMED BY THE CONTRACTOR.
7. THE ORIGINAL TOPOGRAPHY AND GROUND ELEVATIONS, SERVICING AND SURVEY DATA SHOWN ON THIS PLAN ARE SUPPLIED FOR INFORMATION PURPOSES ONLY. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE ACCURACY OF ALL INFORMATION OBTAINED FROM THESE PLANS.
8. CONNECT TO EXISTING SERVICES AS DETAILED. INCLUDE ALL RESTORATION WORK IF NECESSARY TO REINSTATE SURFACES TO THE CONDITION THAT EXISTED PRIOR TO CONSTRUCTION OR BETTER.
9. DETERMINE THE EXACT LOCATION, SIZE, MATERIAL AND ELEVATION OF ALL EXISTING UTILITIES PRIOR TO COMMENCING CONSTRUCTION. PROTECT AND ASSUME ALL RESPONSIBILITY FOR EXISTING UTILITIES WHETHER OR NOT SHOWN ON THESE DRAWINGS. IF THERE IS ANY DISCREPANCY THE CONTRACTOR IS TO NOTIFY THE ENGINEER PROMPTLY.
10. CONTRACTOR TO OBTAIN AND PAY FOR ALL NECESSARY PERMITS AND APPROVALS FROM THE TOWN BEFORE COMMENCING CONSTRUCTION.
11. RESTORE ALL TRENCHES AND SURFACES OF PUBLIC ROAD ALLOWANCES TO CONDITION EQUAL OR BETTER THAN ORIGINAL CONDITION AND TO THE SATISFACTION OF TOWN AUTHORITIES.
12. ALL EXCESS MATERIAL GENERATED DURING EXCAVATION ACTIVITIES SHALL BE STOCKPILED ON SITE AT AN APPROVED LOCATION. NO OFF-SITE HAULING OF EXCESS MATERIAL IS REQUIRED.
13. ALL ELEVATIONS ARE GEODETIC AND UTILIZE METRIC UNITS UNLESS OTHERWISE NOTED.
14. TEMPORARY SEDIMENT CONTROL (FILTER CLOTH UNDER GRATE OR COVER) TO BE IMPLEMENTED DURING CONSTRUCTION ON ALL PROPOSED ROAD CATCHBASINS, REARYARD CATCHBASINS AND CATCHBASIN MANHOLES. NO RECYCLED GEOTEXTILE MATERIAL SHALL BE PERMITTED FOR USE ON SITE.

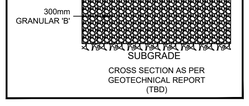
SITE GRADING NOTES:

1. DESIGN GRADES NOTED ARE MINIMUMS UNLESS OTHERWISE SPECIFIED.
2. CONTRACTOR TO CONFIRM LOT SERVICING WITH APPROPRIATE UTILITY COMPANIES PRIOR TO CONSTRUCTION.
3. CONTRACTOR TO ENSURE POSITIVE DRAINAGE AWAY FROM BUILDING.
4. CONTRACTOR SHALL MATCH APPROVED DESIGN GRADES AT PROPERTY BOUNDARY.
5. CONTRACTOR TO CONFIRM GROUNDWATER ELEVATION DURING EXCAVATION. IF GROUNDWATER IS ENCOUNTERED THE ENGINEER SHALL BE NOTIFIED PRIOR TO FOOTING CONSTRUCTION.
6. CONTRACTOR TO CONFIRM UNDERSIDE OF FOOTING ELEVATION IS MINIMUM 0.30m ABOVE ROADSIDE DITCH ELEVATION OR OTHER SUITABLE OUTLET POINT. GRADING SHALL BE RAISED ACCORDINGLY TO MAINTAIN MINIMUM SEPARATION.
7. CONTRACTOR TO CONFIRM ALL GRADING OF LOT ON-SITE PRIOR TO CONSTRUCTION.
8. PROPERTY LIMITS TO BE VERIFIED PRIOR TO CONSTRUCTION.



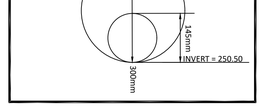
WEIR END SECTION VIEW
NOT TO SCALE

GRANULAR CROSS-SECTION
N.T.S

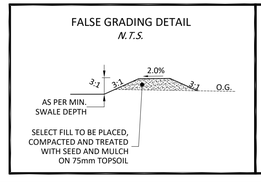


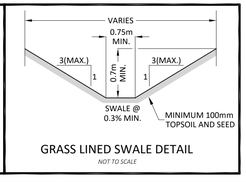
CROSS SECTION AS PER GEOTECHNICAL REPORT (TBD)

ORIFICE DETAIL
N.T.S.



FALSE GRADING DETAIL
N.T.S.





GRASS LINED SWALE DETAIL
NOT TO SCALE

egis
1-1329 Gardiners Road
Kingston, ON K7P 0L8
Tel: 613-542-3788
Fax: 613-542-7583
www.egis-group.com

LICENSED PROFESSIONAL ENGINEER
C. A. MACLEOD
100159100
APR 29/2024
PROVINCE OF ONTARIO

Client:
ONTARIO LTD. 1000037246
FIRE ROUTE 25
BUCKHORN, ON

Project:
BUCKHORN YACHT HARBOUR EXPANSION
A-14 ADAM & EVE ROAD
BUCKHORN, ON

Drawing Title:
GRADING & SERVICING PLAN

Scale: 1:500	Project Number: CCO-23-3258
Drawn By: DL	
Checked By: AM	Drawing Number: C100
Designed By: DL	

FILENAME: \\Infrastructure\2023\CCO-23-3258 - Ontario Ltd. 1000037246 - Buckhorn Yacht Harbour\12 - Drawings\CCO-23-3258 Buckhorn Yacht Harbour.dwg
LAST SAVED: Friday, April 26, 2024 LAST SAVED BY: dlangmuir
LAST PLOTTED: Monday, April 29, 2024 CTB FILE USED: ----

Active coordinate

44° 32' 45" N, 78° 21' 14" W (44.545833,-78.354167)

Retrieved: Mon, 25 Mar 2024 16:20:45 GMT

Location summary

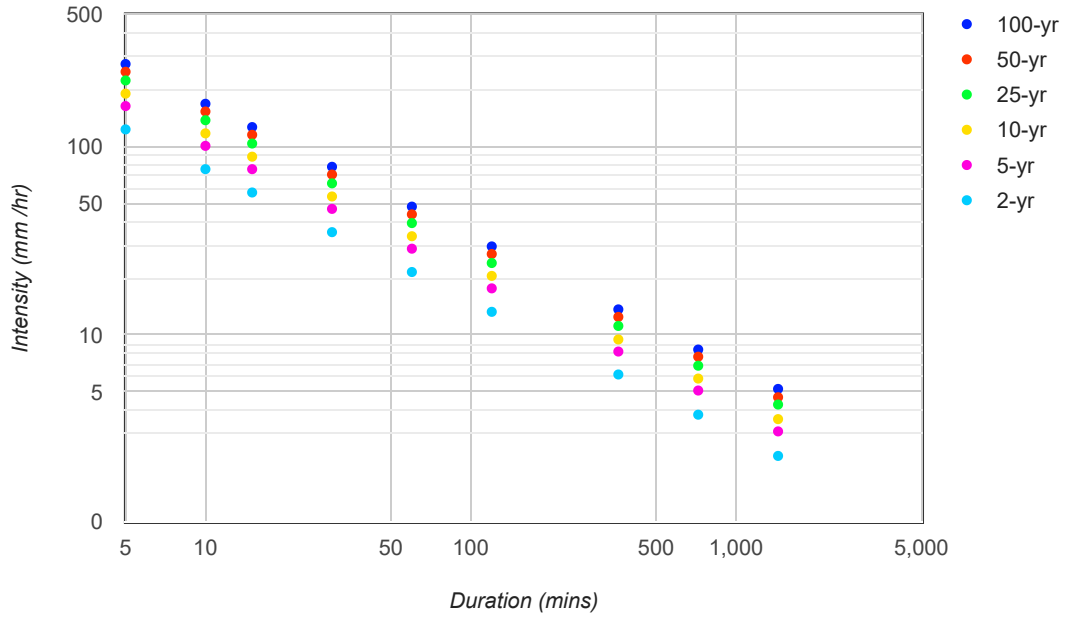
These are the locations in the selection.

IDF Curve: 44° 32' 45" N, 78° 21' 14" W (44.545833,-78.354167)

Results

An IDF curve was found.

Coordinate: 44.545833, -78.354167
IDF curve year: 2010



Coefficient summary

IDF Curve: 44° 32' 45" N, 78° 21' 14" W (44.545833,-78.354167)

Retrieved: Mon, 25 Mar 2024 16:20:45 GMT

Data year: 2010
IDF curve year: 2010

Return period	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
A	21.6	28.7	33.4	39.2	43.6	47.9
B	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699

Statistics

Rainfall intensity (mm hr^{-1})

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	122.7	75.6	56.9	35.1	21.6	13.3	6.2	3.8	2.3
5-yr	163.0	100.4	75.6	46.6	28.7	17.7	8.2	5.1	3.1
10-yr	189.7	116.9	88.0	54.2	33.4	20.6	9.5	5.9	3.6
25-yr	222.7	137.2	103.3	63.6	39.2	24.1	11.2	6.9	4.3
50-yr	247.6	152.6	114.9	70.8	43.6	26.9	12.5	7.7	4.7
100-yr	272.1	167.6	126.2	77.8	47.9	29.5	13.7	8.4	5.2

Rainfall depth (mm)

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	10.2	12.6	14.2	17.5	21.6	26.6	37.0	45.6	56.2
5-yr	13.6	16.7	18.9	23.3	28.7	35.4	49.2	60.6	74.7
10-yr	15.8	19.5	22.0	27.1	33.4	41.1	57.3	70.6	86.9
25-yr	18.6	22.9	25.8	31.8	39.2	48.3	67.2	82.8	102.0
50-yr	20.6	25.4	28.7	35.4	43.6	53.7	74.8	92.1	113.5
100-yr	22.7	27.9	31.6	38.9	47.9	59.0	82.1	101.2	124.7

Terms of Use

CCO-23-3258 - BUCKHORN YACHT HARBOUR - RUNOFF CALCULATIONS

Pre-Development Runoff Calculations					T_c (min)	I (mm/hr)		Q (L/s)	
Outlet	Basin	Area (ha)	C - 5	C - 100		5-year	100-year	5-year	100-year
Adam and Eve Road	A1	0.13	0.18	0.23	15	76	126	5	10
Fire Route 25	A2	2.71	0.18	0.23	52	32	53	43	90
Site	A3	1.88	0.18	0.23	33	44	73	41	86
	Total	**4.73**						**89**	**186**

Post-Development Runoff Calculations					T_c (min)	I (mm/hr)		Q (L/s)	
Outlet	Basin	Area (ha)	C - 5	C - 100		5-year	100-year	5-year	100-year
Adam and Eve Road	B1	0.61	0.19	0.23	26	52	86	16	34
Fire Route 25	B2	2.71	0.18	0.23	52	32	53	43	90
SWM Management	B3	1.40	0.55	0.65	20	62	104	132	261
	Total	**4.73**						**192**	**385**

		Allowable Release Rates							
Outlet	**Basin**	**Post-Devel. Unrestricted**		**Post-Devel. Actual**		**Restricted / Unrestricted**	**Storage Required**		**Restriction Method**
		5-year (L/s)	**100-year (L/s)**	**5-year (L/s)**	**100-year (L/s)**		**5-year**	**100-year**	
Adam and Eve Road	B1	16	34	16	34	**Unrestricted**			
Fire Route 25	B2	43	90	43	90	**Unrestricted**			
SWM Management	B3	132	261	30	61	**Restricted**	124	242	
	Total	**192**	**385**	89	185				
	PRE	**89**	**186**						

Note: Intensities derived from IDF Curve for the site from the MTO IDF Lookup

CCO-23-3258 - BUCKHORN YACHT HARBOUR - STORAGE CALCULATIONS

Storage Requirements for Area B3					
5 Year Storm Event					
Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
15	76	161	30	131	118
20	62	132	30	102	122
25	53	113	30	83	124
29	48	101	30	71	124
30	47	99	30	69	124
35	42	89	30	59	124
40	38	81	30	51	123
45	35	75	30	45	121
50	33	69	30	39	118
55	31	65	30	35	115
60	29	61	30	31	112
65	27	58	30	28	108
70	26	55	30	25	105
75	25	52	30	22	101

Maximum Storage Required 5-year	124	m^3

Storage Requirements for Area B3					
100 Year Storm Event					
Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
15	126	317	61	256	231
20	103	260	61	199	238
24	90	227	61	166	241
25	88	222	61	161	242
30	78	196	61	135	242
35	70	176	61	115	241
40	64	160	61	99	237
45	59	147	61	86	233
50	54	137	61	76	227
55	51	128	61	67	221
60	48	120	61	59	214
65	45	114	61	53	206
70	43	108	61	47	198
75	41	103	61	42	189

Maximum Storage Required 100-year	242	m^3

CCO-23-3258 - BUCKHORN YACHT HARBOUR - STORAGE CALCULATIONS

Storage Volume (Calculated in Civil3D)			
Water Level (m)	**Volume (Swale W) (m^3)**	**Volume (Swale E) (m^3)**	**Volume (Total) (m^3)**
250.50	0	0	0
250.55	1	0	1
250.60	3	0	3
250.65	8	0	8
250.70	15	0	15
250.75	25	0	25
250.80	37	0	37
250.85	51	0	51
250.90	67	0	67
250.95	86	1	87
251.00	106	3	109
251.05	129	8	137
251.10	154	15	169
251.15	181	25	206
251.20	211	37	248
251.25	242	37	279
251.30	276	37	313
251.35	313	37	350
251.40	351	37	388
251.45	392	37	429
251.50	435	37	472

CCO-23-3258 - BUCKHORN YACHT HARBOUR - ORIFICE CALCULATIONS

For Orifice Flow, C =	0.60
For Weir Flow, C =	1.84

	Orifice	Weir
Invert Elevation	250.50	251.10
Center of Crest Elevation	250.57	
Orifice Width/Weir Length	145 mm	0.45 m
Orifice Area (m^2)	0.017	n/a

Elevation	Orifice		Weir		Total
	H [m]	Q [l/s]	H [m]	Q [l/s]	Q [l/s]
250.50	x	x	x	x	x
250.55	x	x	x	x	x
250.60	0.03	7	x	x	7
250.65	0.08	12	x	x	12
250.70	0.13	16	x	x	16
250.75	0.18	18	x	x	18
250.80	0.23	21	x	x	21
250.85	0.28	23	x	x	23
250.90	0.33	25	x	x	25
250.95	0.38	27	x	x	27
251.00	0.43	29	x	x	29
251.05	0.48	30	x	x	30
251.10	0.53	32	x	x	32
251.15	0.58	33	0.05	9	43
251.20	0.63	35	0.10	26	61
251.25	0.68	36	0.15	48	84
251.30	0.73	37	0.20	74	111
251.35	0.78	39	0.25	104	142
251.40	0.83	40	0.30	136	176
251.45	0.88	41	0.35	171	213
251.50	0.93	42	0.40	209	252

Storage Volume (Calculated in		
Water Level	Volume (m)	
250.50	0	
250.55	1	
250.60	3	
250.65	8	
250.70	15	
250.75	25	
250.80	37	
250.85	51	
250.90	67	
250.95	87	
251.00	109	
251.05	137	5-year
251.10	169	
251.15	206	
251.20	248	100-year
251.25	279	
251.30	313	
251.35	350	
251.40	388	
251.45	429	
251.50	472	

Notes: 1. For Orifice Flow, User is to Input an Elevation Higher than Crown of Orifice.

*2. Orifice Equation: $Q = cA(2gh)^{1/2}$ (m^3/s *1000 = l/s)*

*3. Weir Equation: $Q = CLH^{3/2}$ (m^3/s *1000 = l/s)*

4. These Computations Do Not Account for Submergence Effects

5. H for orifice equations is depth of water above the centroide of the orifice.

6. H for weir equations is depth of water above the weir crest.

Reference: Urban Hydrology, Hydraulics and Stormwater Quality: engineering application and computer modeling / A. Akan, Robert J. Houghtalen, 2003.

CCO-23-3258 - BUCKHORN YACHT HARBOUR - ENHANCED SWALE

Exerpt from MOE Drainage Manual Pg. 4-119

4.9.8 Enhanced Grass Swales

Water Quality, Erosion and Flood Control Storage Requirements Based on Modelling
Enhanced grass swales have a permanent check dam to hold back water during small events. The check dam acts as a weir during larger events and can be modelled as a reservoir. The rating curve for the reservoir can be determined based on the stage storage relationship upstream of the check dam in the swale and the weir equation (Equation 4.4). Given the small storage volume contained in one swale, and the likelihood for numerous swale areas, the storage volume from several swales should be lumped together in this assessment (i.e., downstream check dam controls lumped storage).

In order to ensure that numerical instability does not occur in the routing routine, there should be a positive discharge from the swale as the storage increases (even below the elevation of the check dam). The discharge from the swale below the elevation of the check dam can be calculated using Equation 4.20 where the term LW represents the contact area between the water and the swale (i.e., the wetted perimeter of the swale below the check dam). The percolation rate (P) in Equation 4.20 should be assessed for the native soil material and the porosity should be set to 1.

The longevity factor for enhanced grass swales should be 1.0 since they are not directly dependent on infiltration for operational performance.

Water Quality Storage Requirements Based on Table 3.2
The effects of enhanced grass swales on the water quality storage requirements presented in Table 3.2 can be estimated by Equation 4.19. The term CBV would be replaced with the storage provided upstream of the enhanced grass swale at the elevation of the check dam.

Part of Table 3.2 MOE pg 3-10

Protection Level	TSS Removal Rate	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Basic	60%	20	20	20	20
Normal	70%	20	20	25	30
Enhanced	80%	25	30	35	40

Swale Outlet

V= (AxS) - (CBV x f) — MOE Equation 4.19: Pervious Catchbasin Adjustment - Altered for Enhanced Grass Swale As Per Section 4.9.8 of the MOE Manual

V =		m^3	Volume of Water Quality Storage Required (m^3)
A =	1.40	ha	Development Area Draining Towards Checkdam (ha)
S =	25	m^3/ha	Water Quality Requirement From Table 3.2 (m^3/ha)
CBV =	472	m^3	Storage provided Upstream of Check dam
f =	1		Longevity Factor (set to 1 as per Section 4.9.8)
%Imp=	72		S= 25
V =	-437	m^3	

As shown above, a negative required volume signifies that the storage available meets the requirements to achieve normal quality treatment as per Table 3.2 of the MOE Guidelines for the site.

Drainage ID	Opening Diameter (mm)	Pipe Slope (%)	Downstream Invert (m)	5-Year Storage (m^3)	5-Year Elevation (m)	5-Year Pond Depth (m)	100-Year Storage (m^3)	100-Year Elevation (m)	100-Year Pond Depth (m)
B3	145	1.00	250.50	137	251.05	0.55	248	251.20	0.70

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Catchment Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m^3)	Annual Loading (m^3/ha)
35%	770	1,230	0.6
55%	2,300	1,230	1.9
70%	3,495	1,230	2.8
85%	4,680	1,230	3.8

Table 6.3: Annual Sediment Loadings (SWM Design Manual)

Requirements		Swale	Units
Catchment Imperviousness	=	72%	
Sediment Loading Per 1-Year	=	2.8	m^3/ha
Total Area to Swale	=	1.4	ha
Yearly Sediment to Swale	=	3.9	m^3
Initial Removal Efficiency	=	70%	
Yearly Accumulation in Pond	=	2.7	m^3
Swale Volume Provided	**=**	**472**	**m^3**
Swale Volume @ 5% less Efficient	=	*448*	m^3
Total Sediment Accumlation Allowed Before Removal Required (Provided - Max Allowed 5% Reduction)	=	24	m^3
Total Approximate Number of Years Before Sediment Removal is Required	**=**	**9**	**years**