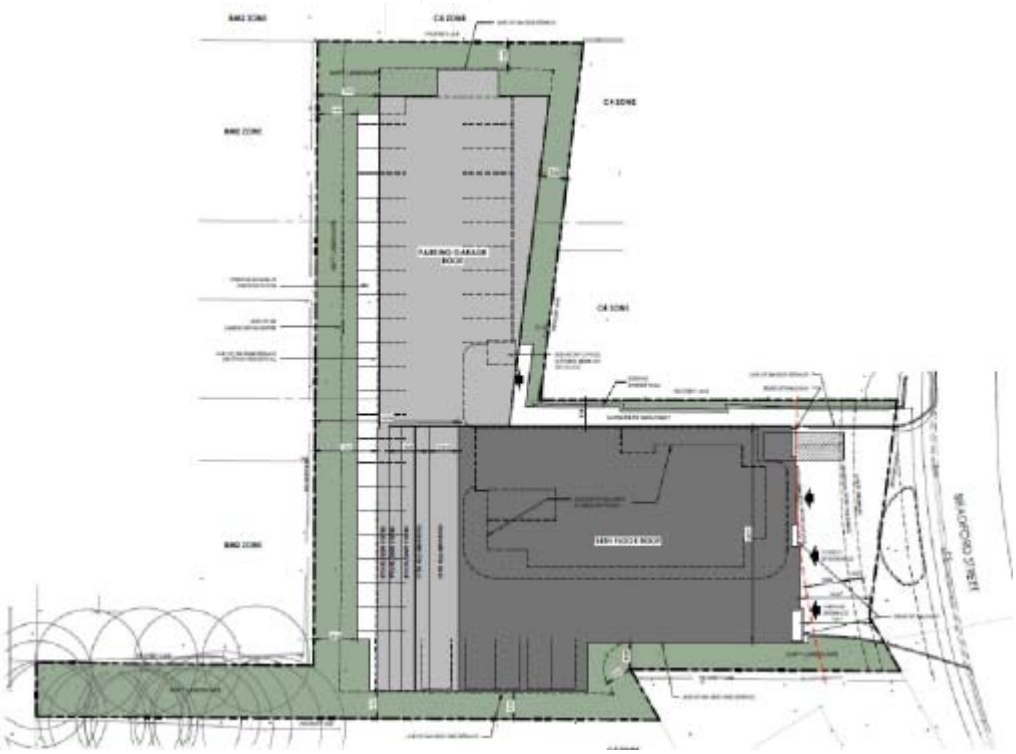

Stormwater Mangement Report
220 Bradford Street
Condominium Development

Chayell Hospitality Group

P/N 3266 | February7, 2020

Skelton Brumwell & Associates Inc.

ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

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City of Barrie
220 Bradford Street

Table of Contents

Drawings

3266 – SG Site Grading Plan

3266 – SS Site Servicing Plan

3266 – SWM2 Proposed Drainage Catchments

3266 – ESC Erosion and Sediment Control

3266 – DET4 Details

Stormwater Management Report

220 Bradford Street Condominium Development

City of Barrie

P/N 19-3266 February 7, 2020

1.0 INTRODUCTION

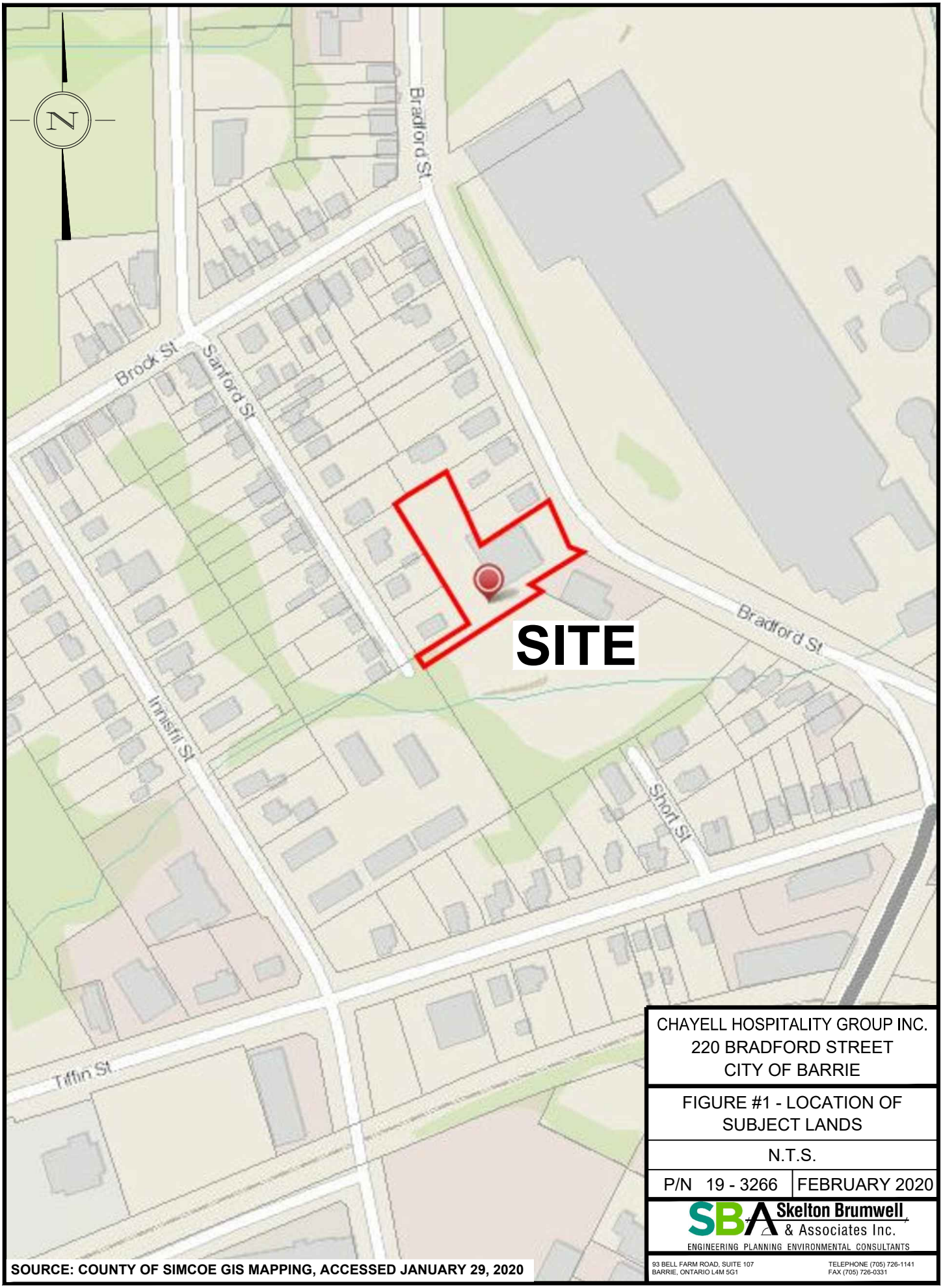
Chayell Hospitality is proposing to develop an existing vacant lot located at 220 Bradford Street, in the City of Barrie, into a fourteen (14) storey mixed use building containing one hundred twenty-one (121) condominium units (17,291 sq.ft), four thousand and fourteen square feet (4014 sq.ft.) of commercial space and with four (4) levels of parking containing one hundred and fifty-nine (159) parking stalls. The subject property is located on the west side of Bradford Street, northwest of the intersection of Bradford Street and Essa Road/Tiffin Street.

The property is irregular in shape and comprises an area of approximately 3317 m^2 (0.33 ha), and the proposed building is approximately 1,915 m^2, which provides 58% lot coverage. The noted site area excludes the portion of the property that is to be dedicated to the City of Barrie for future widening of Bradford Street.

The site meets the definition of a "Major Development" under the Lake Simcoe Protection Plan (LSPP), which requires the development to mitigate impacts on water balance and phosphorous loading from site runoff.

The subject property is legally described as Part of Lot 26, Concession 5, Geographic Township of Vespra, County of Simcoe, now in the City of Barrie. They are further described as Part of Lot 15, Lots 16, 17, and 18 on the west side of Bradford Street, Plan 15, and as Part 5 of Registered Plan 51R–7586, all in the City of Barrie. The location is shown on Figure #1 – Location of Subject Lands.

Skelton, Brumwell & Associates Inc. (SBA) has been retained to provide consulting engineering services in support of the redevelopment of the subject property. This Stormwater Management report has been prepared to support of the Site Plan Approval application.



SOURCE: COUNTY OF SIMCOE GIS MAPPING, ACCESSED JANUARY 29, 2020

CHAYELL HOSPITALITY GROUP INC.
220 BRADFORD STREET
CITY OF BARRIE

FIGURE #1 - LOCATION OF SUBJECT LANDS

N.T.S.

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2.0 EXISTING SITE DRAINAGE CONDITIONS

The subject lands have been primarily used for commercial purposes from at least 1949 until 2012. The lands operated as a used car dealership and body shop until 2012, at which time the existing used car dealership/body shop building, as well as an existing residence, were torn down.

The lands to the east of the subject lands, east of Bradford Street, are owned by the City of Barrie, which operates the Water Pollution Control Centre at this location. The adjacent lands to the north and west are residential, while the property to the south east is occupied by an auto repair business. A municipal stormwater management dry pond identified as Hotchkiss Creek Pond 4 is located immediately south of the property.

Drainage from the existing site flows generally southward towards Hotchkiss Creek through Pond 4 and via Bradford Street. From here runoff flows directly to Lake Simcoe which is located approximately 275m downstream of the pond outlet under Bradford Street.

Based on the previous use of the subject property it can be assumed that much of the site was impervious or gravel covered with a high runoff co-efficient. Figure 2 illustrates the usage and surface cover of the site 2002.

DEVELOPMENT SITE CIRA 2002

SOURCE: VUMAP, ACCESSED JANUARY, 2020

CHAYELL HOSPITALITY GROUP INC.
220 BRADFORD STREET
CITY OF BARRIE

FIGURE #2
PRE-DEVELOPMENT SITE

N.T.S.

P/N 19 - 3266 | FEBRUARY 2020

Skelton Brumwell & Associates Inc.
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3.0 HOTCHKISS CREEK POND 4

Skeleton Brumwell & Associates were responsible for the design of Hotchkiss Creek Pond 4, completed as part of the Hotchkiss Creek Master Drainage Plan. The pond provides an area for peak flows to backup and be contained as they are restricted by the recently completed culvert under Bradford Street at this location. The pond consists of a low flow channel sized to contain base flows approximated by a 15mm rainfall event, and a "flood plain" to provide a degree of detention for flow passing through the culvert under Bradford Street during a Regional Storm event. The aim of this facility is to prevent flows overtopping Bradford Street and flooding of the Water Pollution Control Plant during a severe storm.

4.0 PROPOSED DRAINAGE CONDITIONS

4.1 Flow Conveyance – Storm Sewers

It is proposed to drain the entire developed site directly south to Pond 4 with the exception of the front entrance area. This will drain via sheet flow to Bradford Street. The portion of the site largely consists of the land to be provided to the City of Barrie for future widening of Bradford Street.

The rear yard area, west of the building will be allowed to drain via overland sheet flow consistent with existing conditions.

The building roof, parking area and driveway will be drained via an on-site storm sewer system which will include a treatment unit. The site sewer will outlet to Pond 4, and will be sized for the peak 1 in 5-year flow rate as calculated for the contributing drainage area. Please refer to the Storm Sewer sizing sheet in Appendix A. Skelton Brumwell drawing 3266-SWM illustrates the contributing catchment areas collected by this sewer. Runoff from larger storm events will be allowed to drain uncontrolled to Pond 4 and Bradford Street as sheet flow.

The majority of storm sewer drainage area on the site consists of the building roof. Drainage for the upper floor parking areas will be contained in the building mechanical design. While the majority of the ground floor parking area is covered by the building, the sizing of these storm sewers has been completed assuming conventional open-air conditions to be conservative.

The storm sewer has been designed with a minimal slope of 0.3% throughout and minimal drops across manholes. This is necessary due to the relatively shallow depth of the outlet point compared the development site. Where required due to lack of cover, storm sewers will be insulated to prevent frost heaving and freezing of water in the pipes.

Site storm sewers are illustrated on Skelton Brumwell drawing 3266-SS.

The proposed sewer outlet will require a 10m long shallow channel be constructed in Pond 4 to convey flows to the low flow channel in the facility. This will be lined with rip rap over top of filter fabric for the full length to provide immediate and long-term erosion protection.

It is recommended that the swale be constructed and immediately armoured with stone so as to limit the time that works are ongoing in the pond and to ensure there is no discharge of sediment to the low flow channel in the facility.

4.2 Flow Conveyance – French Drains

Due to the low elevation of the ground level parking compared to the property line grades at the north side of the site, retaining walls will be required around the perimeter of the parking. Grade will fall from the property line inward toward the walls. In order to collect this drainage, a French drain system will be installed around the perimeter. The drain will consist of a 300mm wide x 600mm channel lined with filter fabric and filled with clear stone. The stone will be drained via a 150mm perforated subdrain which is connect to site catch basins.

A schematic detail for the French drain is included in Skelton Brumwell drawing 3266-DET4.

4.3 Major Storm Flow Route

The site grading design has been completed such that in the event of major storm events that exceed the capacity of the on-site storm sewer system, the majority of site flows will be conveyed overland to Hotchkiss Creek Pond 4. A small portion of the property consisting of the north sidewalk and front entryway will sheet flow to the Bradford Street right-of-way.

The intent is to ensure that during major rainfall events, runoff can drain from the site safely and not adversely impact the building.

Skelton Brumwell drawing 3266-SWM2 illustrates the major storm outfall routes.

4.4 Water Balance

The LSPP requires that a water balance calculation be completed and mitigation methods be employed to maintain groundwater recharge as much as possible. A hydrological study has been completed by Cambium Inc. and summarized in a report dated February 5, 2020. Relevant excerpts from this report are included in Appendix B.

The Cambium report recommends that pre-post development water balance be achieved by infiltrating 92 cu.m. of rainfall runoff annual from proposed impervious surfaces of the site. We have calculated that this can be accomplished through collection of runoff from the 271 sq.m.

balcony area in the south west corner of the building. This will provide for a clean source of runoff to be infiltrated from a location that is close by to the most feasible area to install infiltration features which is to the south west of the proposed building. This has been selected as it is one of the few locations on site that is more than 5 metres from the proposed foundations in the project and 5 metres away from foundations on neighboring properties.

It is proposed to drain the balconies to grade via a downspout discharging to a stone lined channel. This channel will then convey flows to the infiltration gallery. A 150mm high berm around the gallery will aid it containing flows and reducing incidences of over topping during short, intense rainfall events. This berm height is conservatively not included in the overall depth and volume of the feature for calculation purposes.

Based on monitoring completed to date by Cambium, the groundwater elevations in this general area are at 221.44m compared to an existing grade elevation of about 222.90m. In order to maintain the recommended clearance to groundwater, it was decided to collect runoff for infiltration in a shallow infiltration gallery with a depth of 300mm below surface grade. This will maintain a vertical clearance that is greater than 1 metre.

The total calculated size of the gallery is 3m x 6.4m x 0.3m deep which provides a storage volume of 2.6 cu.m. assuming a 40% void ratio in the clear stone fill of the feature. Based on the native soil infiltration rates determined by Cambium and after applying a conservative factor of safety, the drawn down time calculated for this 300mm deep feature is approximately 18 hours which is sufficiently short to capture a rapid succession of small rainfall events.

On an annual basis, this volume will be sufficient to capture runoff from approximately a 10mm rainfall event from the contributing balcony drainage catchment and this will achieve the target 87 cu.m. of annual infiltration.

Appendix B contains the calculations and rational for sizing of the infiltration feature along with the design detail. Skelton Brumwell drawings included with this report show the proposed location. A schematic detail for the infiltration gallery is included in Skelton Brumwell drawing DET4.

Additional monthly groundwater monitoring for the site is being conducted by Cambium to establish the seasonal high groundwater levels on the site. In addition, specific infiltration/percolation testing will need to be completed in the selected location of the infiltration feature once environmental conditions allow in the spring of 2020.

4.5 Stormwater Quantity Control

Because the site is located very close to the Hotchkiss Creek outlet to Lake Simcoe it is proposed to let site flows drain uncontrolled to Pond 4 so that the peak from the site can flush through the system before the larger upstream peak arrives. This way the site peak will not coincide with the upstream peak.

For this reason, this SWM analysis has not investigated pre-development peak flow rates to compare to post-development for control purposes.

4.6 Stormwater Quality Control

It is proposed to treat runoff collected in the site storm sewer system utilizing a Jellyfish Filter which provides for collection of sediments, oils and phosphorus particles. Sizing information for the treatment unit has been provided by Imbrum Systems and is included in Appendix C. The overall drainage catchment for the unit is 2714 sq.m and this is broken down as follows:

Roof Area: 71%
Pavement/Sidewalk: 16%
Landscaped Area: 14%

Of these land uses, only the pavement/sidewalk area is considered to produce runoff containing sediment and oils.

The specified Imbrium Jellyfish JF4-1-1 is credited with capturing 89% of the sediment load from the overall drainage area

The Jellyfish will be installed in an off-line configuration so that large storm event flows by-pass the unit, limiting risk of resuspension of collected sediment. A diversion weir will be installed in a manhole upstream of the unit which will direct minor flows to the Jellyfish. Larger flows will cause the weir to over top and flow directly to the manhole downstream of the unit.

The location for the Jellyfish has been selected to allow for maintenance access. There will not be sufficient clearance for a vacuum truck to access the ground floor parking so the Jellyfish has been located at the front of the property. This results in a longer overall run of storm sewers on the property than would otherwise be required, but cannot be avoided.

The proposed upstream diversion configuration is shown on the engineering details for the project and is included in Appendix D of this report.

Pre-treatment of site runoff draining to the Jellyfish will be provided using CB Shields to grade level catch basins and catch basin manholes. These devices act to increase the sediment retention capacity of drainage inlet structures, resulting in lower loading rates downstream.

These units are capable of capturing between 36-57% of suspended solids depending on the size and imperviousness of the contribution catchment areas. This will be further enhanced by the generally low flow rates to the grade level drainage structures in the parking area as these are mostly under cover, meaning the actual amount of rainfall draining to each will be quite small.

Calculations provided in Appendix B provide an area weighted estimation of the net removal efficiency of the CB Shields which has been determined to be 56%. Calculations for the net removal efficiency of the CB Shields is included in Appendix C.

The net removal efficiency of the CB Shields combined with the Jellyfish filter is calculated as follows:

CB Shields TSS removal: 56%
Remaining TSS: 44% x Jellyfish Removal (89%)= 39%. Remaining TSS = 5%
Total removal Efficiency is thus 100%-5% = 95%

Typical details are included on Skelton Brumwell DET4. Sizing calculation and standard drawings for the Jellyfish are included in Appendix D.

4.7 Phosphorous Removal

As per the LSPP the detailed design of the site will include the calculation of a phosphorous budget and recommendations to mitigate increases in discharge to Lake Simcoe. The previously mentioned Jelly Fish filter will form the bulk of the mitigation. The infiltration gallery also provides removal of phosphorous but only from the balcony area that drains to it.

The effect of the Jellyfish on Phosphorous loading has been modelled in the Low Impact Development Treatment Train Tool (LID TTT) produced by the Sustainable Technologies Evaluation Program and developed by the Lake Simcoe Region, Toronto and Region, and Credit Valley Conservation Authorities.

The following noted inputs were utilized in the LID TTT analysis

a) Jellyfish Filter: TSS Removal 89%, Phosphorous Removal 59%

b) Infiltration Gallery: TSS and Phosphorous Removal 100% (infiltrated water does not runoff and this does not contribute to TSS and TP Loadings.

c) Berm Height: 150 mm, consistent with design

LID TTT modelling shows that the net Phosphorous load from the site is reduced by 53.9% to 0.136 kg/year. Consistent with the LSRCA phosphorous mitigation policy (September 2017), this loading would make the project subject to following financial contribution to the LSRCA per the following calculation.

Load x offset ratio x offset value - 0.136 Kg/yr x 2.5 x $35,000 = $11,900.00

LID TTT modeling results are included in Appendix D.

5.0 Stormwater Management System Maintenance

Maintenance of the site stormwater management system will be key to the long-term performance of the system. In order to ensure the system continues to provide the necessary conveyance and control of stormwater runoff, Table 1 on the following page summarizes the recommended maintenance activities.

All accumulated sediment and vegetative debris removed from the site storm water management system is to be disposed of off site. Due to the efficiency of oil/grit separators in collecting pollutants, it is anticipated that material removed from this SWM control feature will be required to be disposed off at an MOE certified treatment facility. A specialize maintenance company will be required to complete inspections and cleaning of this device.

Table 1 – SWM System Maintenance Activities

Maintenance Operation	Frequency and Timing
Cleaning of all storm structures, Oil Grit Separator, storm sewer and pond.	After completion of construction works and once the site is stabilized.
Inspection and Cleaning of the site Jellyfish	Annual inspection by a specialist maintenance company and cleaning as recommend based on findings of these inspection (likely every 5 years)
Cleaning of site catch basins and catch basin manholes	Annual cleaning in spring is expected to be required to remove accumulated winter sand, silt and sediment
Cleaning of site catch basins and catch basin manholes in landscaped areas	Annual inspection is recommended. Sand/sediment loading is expected to be minimal however vegetative debris may need to be removed
Clearing of site catch basin and catch basin manhole grates.	Frequent inspection and clearing by site maintenance staff recommended. This is particularly important in catch basins located in the grade level parking areas.
Flushing of site storm sewers	Diligent attention to cleaning of catch basins and catch basin manholes should limit the need to flush site storm sewers, however it can be expected to be required every 10 -15 years.
Infiltration Gallery	Periodic inspection of the surface of the infiltration gallery required to remove debris that could clog the inlet surface, particularly leaves in the fall. Care must be taken to limit grass cuttings being discharged to the gallery as well.

6.0 Erosion and Sediment Control During Construction

The construction phase of the development will provide the greatest risk of erosion causing sediment to be deposited off site. The following measures are to be implemented to limit these impacts. Skelton Brumwell drawing 3266-ESC illustrates the proposed locations for the measures to be installed.

1) The boundary of the site is to have a sediment control fence installed prior the start of disturbance on the site. This fencing is to be regularly inspected and maintained as required throughout the duration of the project, until paving is and vegetative reinstatement is complete.

2) Additional fencing is to be installed around the swale works in Hotchkiss Creek Pond 4. It will be vital to the overall operation of the pond for the swale to be constructed and immediately reinstated with stone and filter fabric so that silt fencing can be removed so as not to impact the storage volume in the pond for longer than necessary.

3) Existing catch basins on the west side of Bradford Street in the vicinity of the site are to be fitted with Silt Sack sediment capture devices prior to the start of works on site.

4) All catch basin and catch basin manhole devices on the site are to be fitted with Silt Sack sediment capture devices as they are installed.

5) The membrane cartridges in the Jellyfish filter are not to be installed until after the site has been stabilized and all storm sewers and structures are flushed and cleaned.

6) The contractor is to regularly clean area roads of accumulated sediment as well as when directed by the project Engineer and/or City of Barrie staff.

7) Regular inspection of sediment control measures is to be conducted by the contractor. Maintenance is to be conducted as required which includes but is not limited to: removal of accumulated sediment from siltation fences and Silt Sacks, replacement of damaged fencing and Silt Sacks. To this end, the contractor is to retain at least 50m of spare siltation fence and one Silt Sack on site at all times to be able to rapidly respond when needed repairs are required.

8) Following the completion of site works and restoration, the contractor shall be responsible to removal all sediment control measures, flushing of storm sewers and cleaning of accumulated sediment in all storm structures. Once this is complete, the membrane cartridges can be installed in the Jellyfish filter.

7.0 Conclusions and Recommendations

Based on the analysis summarized in this report, we conclude that the proposed development at 220 Bradford Street can be completed with sound engineering principles and in accordance with the requirements of the City of Barrie, Lake Simcoe Conservation Authority and Lake Simcoe Protection Plan. To this end we recommend the following:

1) Site runoff be allowed to flow without quantity controls to Hotchkiss Creek.

2) A private on-site sewer be designed and installed to provide flow conveyance for the 1 in 5-year storm event.

3) Storm sewer and roof top flows be treated utilizing a Jellyfish Filter system.

4) Water balance be achieved though implementation of an infiltration gallery collecting flows from the balcony area on the west side of the building.

5) Maintenance activities as described in Section 6.0 be employed by the contractor and owner of the property once works are complete

6) Erosion and Sediment control measures described in Section 7.0 be employed through the construction phase of the project.

8.0 DISCLAIMER OF RESPONSIBILITIES TO THIRD PARTIES

This report was prepared by Skelton, Brumwell & Associates Inc. for the account of Chayell Developments Inc in support of site plan approval by the City of Barrie and the Lake Simcoe Conservation Authority

The material in it reflects Skelton, Brumwell & Associates Inc.'s best judgement in light of the information available to it at the time of preparation. Any use which a third party not named above, makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Skelton, Brumwell & Associates Inc. accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this report.

All of which is respectfully submitted,

SKELTON, BRUMWELL & ASSOCIATES INC.

per:

Bryan W. Bolivar, P.Eng

Senior Project Engineer, Partner

Appendix A

Rational Method Calculations

Storm Sewer Sizing

PN 19-3266
220 Bradford Street, Barrie

SBA Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE 5-Feb-20
CALCS NDK/BWB
Revised

Rational Method Storm Catchment Calculations

Site Soils - sand

Post-Development Site

Catchement 200		AREA =	0.022	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0002			0.009	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.0215			0.991	0.10	0.10	0.11	0.12	0.13
TOTAL	0.022	Ha		WEIGHTED C	0.11	0.11	0.12	0.13	0.13

Catchement 201		AREA =	0.035	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0352			1.000	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.000			0.000	0.10	0.10	0.11	0.12	0.13
TOTAL	0.035	Ha		WEIGHTED C	0.95	0.95	1.00	1.00	1.00

Catchement 202		AREA =	0.031	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0308			1.000	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.000			0.000	0.10	0.10	0.11	0.12	0.13
TOTAL	0.031	Ha		WEIGHTED C	0.95	0.95	1.00	1.00	1.00

Catchement 203		AREA =	0.036	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0006			0.016	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.035			0.984	0.10	0.10	0.11	0.12	0.13
TOTAL	0.036	Ha		WEIGHTED C	0.11	0.11	0.12	0.13	0.14

Catchement 204		AREA =	0.052	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0521			1.000	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.000			0.000	0.10	0.10	0.11	0.12	0.13
TOTAL	0.052	Ha		WEIGHTED C	0.95	0.95	1.00	1.00	1.00

Catchement 205		AREA =	0.023	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0231			1.000	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.000			0.000	0.10	0.10	0.11	0.12	0.13
TOTAL	0.023	Ha		WEIGHTED C	0.95	0.95	1.00	1.00	1.00

Catchement 206		AREA =	0.006	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0046			0.760	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.001			0.240	0.10	0.10	0.11	0.12	0.13
TOTAL	0.006	Ha		WEIGHTED C	0.75	0.75	0.79	0.79	0.79

PN 19-3266
220 Bradford Street, Barrie

SBA Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE 5-Feb-20
CALCS NDK/BWB
Revised

Rational Method Storm Catchment Calculations

Catchement 207		AREA =	0.006	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0047			0.781	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.001			0.219	0.10	0.10	0.11	0.12	0.13
TOTAL	**0.006**	**Ha**		**WEIGHTED C**	**0.76**	**0.76**	**0.81**	**0.81**	**0.81**

Catchement 208		AREA =	0.011	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0108			0.950	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.001			0.050	0.10	0.10	0.11	0.12	0.13
TOTAL	**0.011**	**Ha**		**WEIGHTED C**	**0.91**	**0.91**	**0.96**	**0.96**	**0.96**

Catchement 209		AREA =	0.006	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0058			1.000	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.000			0.000	0.10	0.10	0.11	0.12	0.13
TOTAL	**0.006**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

Catchement 210		AREA =	0.001	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0013			1.000	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.000			0.000	0.10	0.10	0.11	0.12	0.13
TOTAL	**0.001**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

ROOF		AREA =	0.165	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.1653			1.000	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.000			0.000	0.10	0.10	0.11	0.12	0.13
TOTAL	**0.165**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

BALCONY		AREA =	0.027	Ha					
GROUND COVER TYPE				PROPORTION	C 2-5 YR	C 10 YR	C 25 YR	C 50 YR	C 100 YR
IMPERVIOUS	0.0274			1.000	0.95	0.95	1.00	1.00	1.00
LANDSCAPED	0.000			0.000	0.10	0.10	0.11	0.12	0.13
TOTAL	**0.027**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

PN 19-3266
220 Bradford Street, Barrie

Rational Method Storm Sewer Design

(NEW STORM SEWERS ONLY)

5 year STORM FLOWS - SEWER SIZING

Q = 0.00278 C.I.A. - IN C.M.S. (CUBIC METRES /SEC)
C =RUNNOFF COEFFICIENT
A = AREA - IN HECTARES
i = RAINFALL INTENSITY (mm/hr) = A / (t+B)^C

A (idf) = 856.608
B (idf) = 4.699
C (idf) = 0.766
t = flow time

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE February 5, 2020
CALCS BWB/NDK
Revised

intial t = 10 minutes

AREA	LOCATION		PIPE LENGTH (METRES)	INCREMENT		CA	TOTAL CA	FLOW TIME (MIN)		I	TOTAL PEAK Q (CMS)	S (%)	D (mm)	Mannings 'n' for pipe	Q PIPE FULL (CMS)	V PIPE FULL (m/sec)	REMARKS	PIPE CAPACITY GREATER THAN FLOW RATE?
	FROM	TO		C	A			TO SECTION	IN SECTION									
200	CB#1	CBMH#1	14.5	0.11	0.022	0.002	0.002	10.00	0.36	109.30	0.000	0.30	250	0.013	0.033	0.663	PVC 5 YR FLOW	OK
201	CBMH#1	CBMH#2	15.6	0.95	0.035	0.033	0.036	10.36	0.39	107.27	0.011	0.30	250	0.013	0.033	0.663	PVC 5 YR FLOW	OK
202	CBMH#2	CBMH#3	27.3	0.95	0.031	0.029	0.065	10.76	0.69	105.18	0.019	0.30	250	0.013	0.033	0.663	PVC 5 YR FLOW	OK
203	CB#3	CBMH#3	8.5	0.11	0.036	0.004	0.004	10.00	0.21	109.30	0.001	0.30	250	0.013	0.033	0.663	PVC 5 YR FLOW	OK
204	CBMH#3	STMMH#2	12.6	0.95	0.052	0.049	0.118	11.44	0.28	101.74	0.034	0.30	300	0.013	0.053	0.749	PVC 5 YR FLOW	OK
Roof	BLDG	STMMH#2	4.5	0.95	0.165	0.157	0.157	10.00	0.10	109.30	0.048	0.30	300	0.013	0.053	0.749	PVC 5 YR FLOW	OK
	STMMH#2	CBMH#4	16.2				0.275	11.72	0.31	100.40	0.077	0.30	375	0.013	0.096	0.869	PVC 5 YR FLOW	OK
205	CBMH#4	CBMH#5	11.6	0.95	0.02	0.022	0.297	12.03	0.22	98.97	0.082	0.30	375	0.013	0.096	0.869	PVC 5 YR FLOW	OK
206	CB#2	CBMH#6	21.8	0.75	0.006	0.005	0.005	10.00	0.55	109.30	0.001	0.30	250	0.013	0.033	0.663	PVC 5 YR FLOW	OK
207	CBMH#6	STMMH#1	10.6	0.76	0.006	0.005	0.009	10.55	0.27	106.28	0.003	0.30	250	0.013	0.033	0.663	PVC 5 YR FLOW	OK
	STMMH#1	CBMH#7	2.5				0.009	10.81	0.06	104.88	0.003	0.30	250	0.013	0.033	0.663	PVC 5 YR FLOW	OK
208	CBMH#7	CBMH#5	15.8	0.91	0.11	0.100	0.109	10.88	0.40	104.56	0.032	0.30	250	0.013	0.033	0.663	PVC 5 YR FLOW	OK
209	CBMH#5	DIVERSION MH	5.5	0.91	0.006	0.005	0.412	12.26	0.09	97.98	0.112	0.30	450	0.013	0.156	0.981	PVC 5 YR FLOW	OK
210	CB#4	DIVERSION MH	5.1	0.95	0.001	0.001	0.001	10.00	0.13	109.30	0.000	0.30	250	0.013	0.033	0.663	PVC 5 YR FLOW	OK
	DIVERSION MH	STMMH#3	1.2				0.413	12.35	0.02	97.57	0.112	0.30	450	0.013	0.156	0.981	PVC 5 YR FLOW	OK
	STMMH#3	STMMH#4	21				0.413	12.37	0.36	97.48	0.112	0.30	450	0.013	0.156	0.981	PVC 5 YR FLOW	OK
	STMMH#4	HEADWALL	11.7				0.413	12.73	0.20	95.94	0.110	0.30	450	0.013	0.156	0.981	PVC 5 YR FLOW	OK

3.2.1 Service Area

The drainage system shall be designed to accommodate all upstream drainage areas plus any external area tributary to the system for the existing, interim and ultimate development conditions, as determined by the delineation of appropriate topographic mapping and the preparation of drainage plans.

3.2.2 Design Flow

Storm sewer systems with a drainage area ≤ 50 ha shall be designed to convey the 1:5 year (minimum) design storm using the Rational Method and the City's IDF regression equation for rainfall intensity unless otherwise approved or directed by the City. Storm sewer systems with a drainage area > 50 ha shall be designed using an approved computer program and verified with the Rational Method. The storm sewer design shall be based on the larger of the two flows calculated using the computer model and the Rational Method. Under no circumstances shall the storm system be designed in a surcharged condition.

The design of the storm sewers shall be computed using the City of Barrie's Storm Sewer Design Sheet as provided in **Appendix A.**

All storm sewers shall be designed according to the Rational Formula where:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow in (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

The rainfall intensity shall be calculated in accordance with the following table and equation:

Table 3.1: Barrie WPCC IDF Curve Parameters - Adjusted to Account for Climate Change

Parameter	Return Period					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
A	678.085	853.608	975.865	1146.275	1236.152	1426.408
B	4.699	4.699	4.699	4.922	4.699	5.273
C	0.781	0.766	0.760	0.757	0.751	0.759

Rainfall Intensity, I (mm/hr) = $A/(t+B)^C$, where t is time duration in minutes
Parameters based on rain gauge data for the period 1979 – 2003 for the Barrie WPCC Station #6110557
Based on a review of the literature, the IDF intensity values for Barrie WPCC Station were increased by 15% before calculating a, b, c values to account for climate change.

$$i = \frac{A}{(t_d + B)^C}$$

where,

i = the rainfall intensity (mm/hr)
t_d = the storm duration (minutes)
A, B, C = a function of the local intensity-duration data.

The storm duration is set to the time of concentration (i.e. the sewer inlet time plus the time of travel in the pipe or channel) for the total cumulative drainage area to the node of interest. The maximum inlet time for the first pipe of a storm sewer system is 10 minutes.

The runoff coefficient shall be calculated in accordance with the following table:

Table 3.2: Runoff Coefficients (Rational C) (5-yr to 10-yr) Based on Hydrologic Soil Group

Land Use	Runoff Coefficient "C"		
	A-AB	B-BC	C-D
Cultivated Land, 0 - 5% grade	0.22	0.35	0.55
Cultivated Land, 5 - 10% grade	0.30	0.45	0.60
Cultivated Land, 10 - 30% grade	0.40	0.65	0.70
Pasture Land, 0 - 5% grade	0.10	0.28	0.40
Pasture Land, 5 - 10% grade	0.15	0.35	0.45
Pasture Land, 10 - 30% grade	0.22	0.40	0.55
Woodlot or Cutover, 0 – 5% grade	0.08	0.25	0.35
Woodlot or Cutover, 5 - 10% grade	0.12	0.30	0.42
Woodlot or Cutover, 10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands	0.05	0.05	0.05
Impervious Area (i.e., buildings, roads, parking lots, etc.)	0.95	0.95	0.95
Gravel (not to be used for proposed parking or storage areas)	0.40	0.50	0.60
Residential – Single Family	0.30	0.40	0.50
Residential – Multiple (i.e., semi, townhouse, apartment)	0.50	0.60	0.70
Industrial – light	0.55	0.65	0.75
Industrial – heavy	0.65	0.75	0.85
Commercial	0.60	0.70	0.80
Unimproved Areas	0.10	0.20	0.30
Lawn, < 2% grade	0.05	0.11	0.17
Lawn, 2 - 7% grade	0.10	0.16	0.22
Lawn, > 7% grade	0.15	0.25	0.35

Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual," MTO. (1997)

An approximation of the runoff coefficient can be calculated based on the following relationship with:

$$c=(0.7)(TIMP)+0.2$$

where,

c = the runoff coefficient

TIMP = total impervious fraction (dimensionless)

The runoff coefficient shall be adjusted for return period events greater than the 10-yr storm per the following table:

Table 3.3: Runoff Coefficient Adjustment for 25-yr to 100-yr Storms

Return Period	Runoff Coefficient "C"
25 years	$C_{25} = 1.1*C_5$
50 years	$C_{50} = 1.2*C_5$
100 years	$C_{100} = 1.25*C_5$

Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual," MTO. (1997).
Note: When applying the runoff coefficient adjustment, the maximum c-value should not exceed 1.0.

Given that the direct connection of foundation drains to the storm sewer is not permitted, a detailed HGL analysis is typically not required unless deemed otherwise by the City due to special circumstances. Refer to **Section 7.3** for details regarding HGL analysis requirements.

The calculation of total percent impervious (TIMP) values for modeling shall be in accordance with **Section 7.2.5** (**Table 7.6**).

3.2.3 Pipe Capacity and Size

The storm sewer capacity shall be calculated using the Manning's equation assuming the pipe is flowing full as follows:

$$Q=\left[\frac{1}{n}\right]A(R)^{\frac{2}{3}}(S)^{\frac{1}{2}}$$

where,

Q = the pipe capacity (m3/s)
n = the Manning roughness value
R = the hydraulic radius (m)
S = the sewer pipe slope (m/m).

A maximum inlet time of 10 minutes shall be used for the first pipe of a storm sewer system.

The velocity of flow in the storm sewer (assuming pipe flowing full) shall be calculated as follows:

$$v=\left[\frac{Q}{A}\right]$$

where,

Q = flow in the pipe when flowing full (m3/s)
A = cross sectional area of the pipe (m2)

The appropriate roughness coefficients shall be used as identified in **Table 3.4.**
The minimum size for a storm sewer (within a street) shall be 300 mm in diameter. No decrease of pipe size from a larger size upstream to a smaller size downstream shall be allowed regardless of the increase in grade.

Appendix B

Water Balance Calculations

3266 – 220 Bradford Street Condominiums February 6, 2020

INFILTRATION FEATURE SIZING

According to the Hydrogeological Assessment by Cambium Inc. (2019 –12-03), the site will be required to infiltrate at least 87 cu.m. of runoff annual from impervious surfaces on the developed site.

Annual rainfall = 933 mm

Capture of rainfall event up to 25mm rainfall events represents approximately 90% annual rainfall amounts. 90% x 933mm = 844mm =0.84m

87 cu.m. ÷ 0.84m = 103.6 sq.m. capture area of clean runoff from impervious surfaces

Building Patio Area = 271 sq.m. which is 2.6 times the capture area we require. As such, we can capture a small magnitude rainfall event to achieve the necessary annual capture 25mm ÷ 2.61 = 9.6mm. Thus, the total infiltration volume required will be: 271 sq.m. x 9.6mm = 2.6 cu.m.

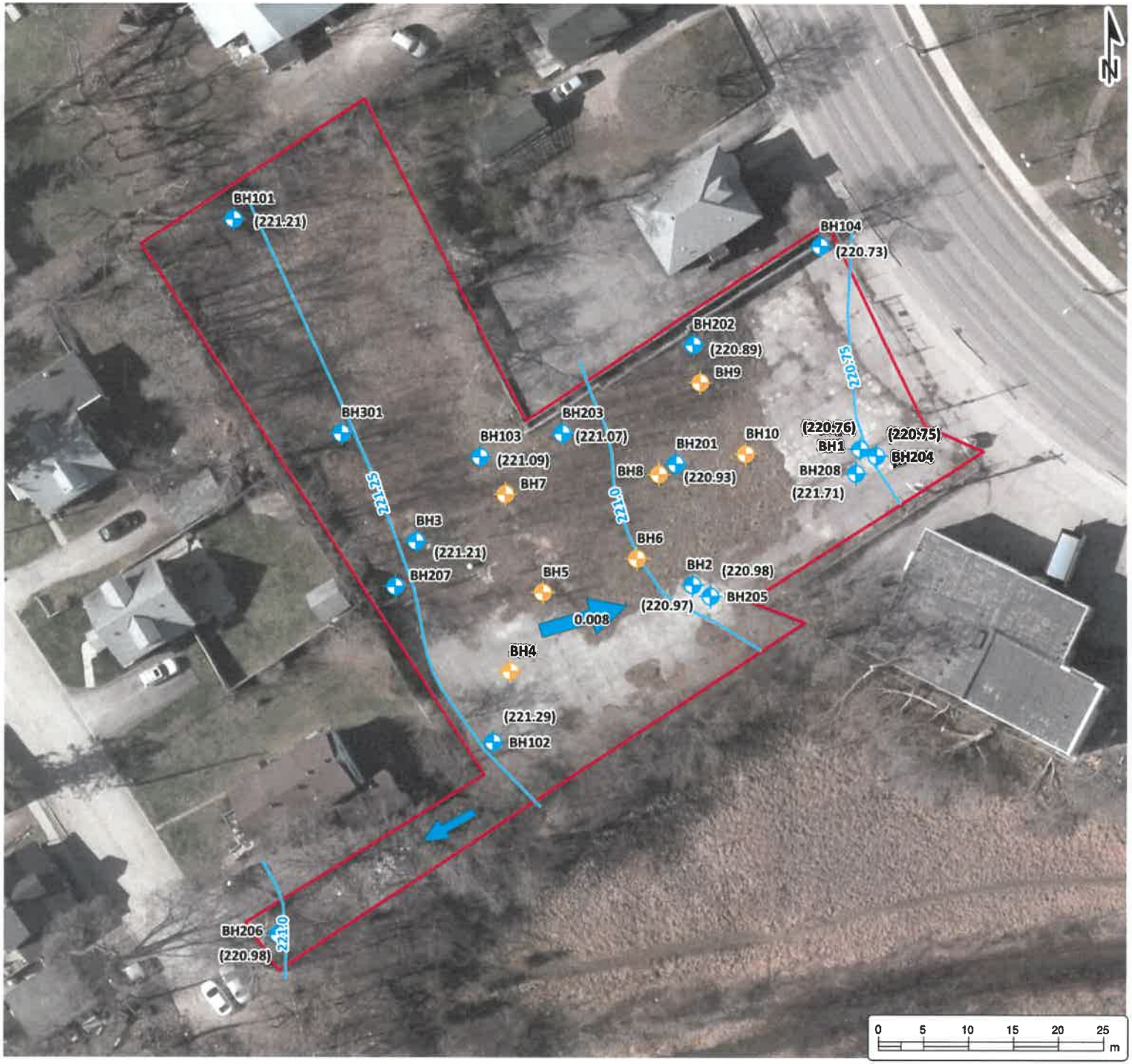
Infiltrate features must be located a minimum of 5 metres away from foundations. Reviewing the site plan, most likely area to able to site a feature that will collect drainage from the balconies is to the west of the building near the south property line. This location nearest to Borehole 102. Based on the most conservative water levels noted at these locations, we see that the groundwater level is at an approximate elevation of about 221.50m compared to an existing grade elevation of about 222.90m at the selected infiltration gallery location.

Using a storage depth of 300mm, the bottom of the feature will be at 222.60m which is 1.10m above the estimated groundwater level, exceeding the recommended minimum separation of 1m.

Cambium estimates the soils on site have an infiltration rate between 141-182mm/hr. Further testing at the proposed infiltration feature location will be required to verify. In the interim, we have applied a worse case safety factor (per CVCA /TRCA LID Design guide 2010) of 8.5. This results in an infiltration rate of 16.6 mm/hr. This means a 300mm depth of collected runoff would be expected to soak away fully in about 18 hours.

For safety and aesthetic considerations, the infiltration feature will not simply be an open ponding area. Instead the feature will be filled with river stone (50-150mm diameter) with an assumed void ratio of 40%. Given this void ratio, a depth of 300mm and a required storage volume of 2.6 cu.m. we calculate that required area of the infiltration feature is 19.2 sq.m. This area can be achieved with plan dimension of 3m x 6.4m.

Drainage from the building balcony areas will be directed to grade via downspout located in the southwest corner of the building, (elevation 233.36) the exact location of same will be determined with the building mechanical design. The downspout will discharge to a 150mm deep swale lined with river stone over top of filter fabric which will serve to protect from erosion and convey flows to the infiltration feature. The swale will discharge to the top of the gallery, allowing for runoff to percolate down through the stone. To ensure containment of the incoming flow of runoff, the gallery will feature a 150mm high grassed berm around it. The volume inherent in this berm has not be accounted for in the sizing which is conservative. When the infiltration feature receives more runoff that it's capacity, flows will simply spill to the south property line an into the adjacent municipal storm pond on Hotchkiss Creek.



HYDROGEOLOGICAL ASSESSMENT
CHAYELL HOTELS LTD.
220 Bradford Street,
Barrie, Ontario

LEGEND

- Borehole
- Borehole with Monitoring Well
- Groundwater Contours (October 3, 2019)
- Site (approximate)
- (220.75) Groundwater Elevation (October 3, 2019)
- Groundwater Flow Direction (October 3, 2019)

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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SITE PLAN

Project No.: 9326-002		Date: November 2019	
		Rev.:	
Scale: 1:600		Projection: NAD 1983 UTM Zone 17N	
Created by: TLC	Checked by: CM	Figure: 1	

O:\GIS\project_MXD\data\9326-9399\9326-002 Chayell Hotels Ltd. - Geotech & Hydro-G - 220 Bradford Street, Barrie\2019-11-20 HydroG FIG 1 - Site Plan.mxd

Table 1: Water Levels and Elevations

Installed By	Monitoring Well	Ground Surface Elevation (masl)	Top of Pipe Elevation (masl)	Riser Stickup (m)	Water Level (mbtop)	Water Level (mbgs)	Groundwater Elevation (masl)	Water Level (mbtop)	Water Level (mbgs)	Groundwater Elevation (masl)
					10-Dec-19			10-Jan-20		
THEM	BH1	222.52	222.43	-0.10	1.47	1.57	220.96	1.52	1.62	220.91
	BH2	222.83	222.73	-0.09	-	-	-	-	-	-
	BH3	-	-	-	-	-	-	-	-	-
Pinchin	BH101	225.12	225.79	0.67	4.41	3.74	221.38	4.36	3.69	221.43
	BH102	222.87	222.85	-0.08	1.36	1.44	221.49	1.35	1.43	221.50
	BH103	224.45	225.06	0.61	3.79	3.19	221.27	3.75	3.15	221.31
	BH104	222.76	222.62	-0.13	1.71	1.84	220.91	1.80	1.93	220.82
Cambium	BH201	223.02	222.88	-0.14	1.76	1.90	221.12	1.73	1.87	221.15
	BH202	223.95	223.82	-0.14	2.74	2.88	221.08	2.72	2.86	221.10
	BH203	224.11	223.97	-0.13	2.74	2.87	221.23	2.77	2.90	221.20
	BH204	222.46	222.26	-0.20	1.32	1.52	220.94	1.34	1.54	220.92
	BH205	222.79	222.71	-0.09	1.52	1.61	221.19	1.52	1.61	221.19
	BH206	222.05	221.91	-0.14	0.66	0.80	221.25	0.81	0.95	221.10
	BH207	224.26	224.16	-0.09	2.77	2.87	221.39	2.72	2.82	221.44
	BH208	222.51	222.44	-0.08	0.59	0.67	221.85	0.63	0.71	221.81
	BH301-19	224.91	226.10	1.19	4.45	3.26	221.65	4.40	3.21	221.70

Notes: The top of pipe elevation for well BH301-19 is approximate. Corresponding groundwater elevations for well BH301-19 are also approximate.

Executive Summary

Chayell Hotels Ltd. retained Cambium Inc. to complete a hydrogeological assessment at 220 Bradford Street in Barrie, Ontario. The client intends to redevelop the Site as a condominium structure with residential units above four levels of parking. All levels will be developed above ground. The hydrogeological assessment yielded the following conclusions:

- The overburden consisted of sand. Groundwater was encountered within 1 mbgs and 4 mbgs. The direction of groundwater flow in the shallow overburden aquifer was eastward, with a minor component to the west.
- The hydraulic conductivity of the sand was typical of those reported in literature.
- Shallow surficial infiltration rates ranged between 141 mm/hr and 182 mm/hr, and were considered typical of sand sediments. A safety correction factor was not incorporated into the infiltration rates. The infiltration rates outlined herein should be used to screen for applicable Low Impact Development features and not for detailed design. Additional infiltration testing may be required at a later date for detailed design of any Low Impact Development features.
- Due to the shallow groundwater level in some areas of the Site and the relatively coarse grained, highly permeable soil, potential dewatering rates could be in excess of 50 m^3/day if the construction excavation is extended a significant depth into the water table. Dewatering rates should be monitored to determine if water taking permitting (i.e., registration on the Environmental Activity and Sector Registry or procurement of a Permit To Take Water) is required. Dewatering and discharge plans should be prepared, as required, which outline potential influences and mitigation measures for dewatering activities. The fate and treatment of discharge water should also be discussed, as required.
- Groundwater quality reported some exceedances of the City of Barrie Sewer Use Bylaw. If groundwater discharge to sewers occurs, treatment of discharge water for total suspended solids, trichloroethylene, and copper will be required. A sample of the discharge water, after treatment, should be collected and analysed to determine treatment efficacy. The treatment

and discharge plan (if required) should be discussed with the City of Barrie and the Lake Simcoe Region Conservation Authority.

- Comparisons of the pre- and post-development water balances indicate that there will be an infiltration deficit upon development of the Site. If runoff generated from the balconies is returned to the subsurface via Low Impact Development features then the pre-development infiltration rate can be maintained (at least). The post-development runoff rate was anticipated to reduce by 17%. A large portion of the runoff deficit is due to the loss of Site area that will be conveyed to the City of Barrie for the widening of Bradford Street. The runoff reduction is not anticipated to influence downstream surface water receivers.

Respectfully submitted,

Cambium Inc.

Cameron MacDougall, P.Geo.
Project Coordinator

CJM

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6.0 Water Balance

Cambium completed pre- and post-development water balances to assess the potential impact of the development on local groundwater and surface water resources. The following equations were utilized.

$$QI = A \times S \times I$$

Where:
- QI - Infiltration Volume (m^3/yr)
- A - Area (m^2)
- S - Water surplus (m/yr)
- I - Infiltration factor (dimensionless)

$$QR = A \times S \times (1-I)$$

Where:
- QR - Runoff Volume (m^3/yr)
- A - Area (m^2)
- S - Water surplus (m/yr)
- I - Infiltration factor (dimensionless)

The pre-development area of the Site is 3,555 m^2. At the time this document was prepared, ground surfaces at the Site consisted of a concrete pad and vegetated areas. The area of the existing concrete pad was estimated to be 2,197 m^2. The remaining vegetated areas were 1,358 m^2.

The proposed development must account for road widening. The road widening will include approximately 180 m^2 of land that will be conveyed to the City of Barrie. It is assumed that these lands will be constructed as impervious surfaces. The post-development area of the Site is 3,370 m^2. The roof area of the proposed development will be approximately 1,642 m^2 and balconies will be 271 m^2. Asphalt and sidewalk areas will be 430 m^2. Pervious landscaped areas will be 1,027 m^2. A summary of the water balance calculations is outlined in the following sections of this report. A detailed analysis of the pre- and post-development water balance of the Site is attached as Appendix H.

6.1 Surplus Water

To determine the pre-development water balance, the volume of water that is typically available as a surplus to the on-Site hydraulic system must be calculated. For the calculations outlined herein, surplus water is defined as being the difference between precipitation and evapotranspiration. Once calculated, the volume of surplus water is further sub-divided into portions that infiltrate into the soil on-Site and are directed off-Site as runoff.

According to the Environment Canada Climatic Normals (1981-2010) for the Barrie WPCC (Water Pollution Control Centre) station the average annual precipitation depth was recorded as 933 mm/year. A copy of the long-term climatic normal data is attached in Appendix H.

To determine the amount of evapotranspiration that will occur at the Site, the Thorthwaite method was used, as described in *Physical Hydrology, Second Edition* (S. Lawrence Dingman, 2008). The calculated equivalent depth of evapotranspiration was 557 mm/year. The evapotranspiration calculations are attached as Appendix H. The calculated water surplus of the Site (i.e., the difference between annual precipitation and evapotranspiration) was 376 mm/year.

6.2 Infiltration Factor

To determine the fraction of surplus water that infiltrates into the soil on-Site, the volume of surplus water was multiplied by an infiltration factor. The infiltration factor varies between zero and one and can be estimated based on topography, soils and cover, as per the *Stormwater Management Planning and Design Manual* (MOE, 2003).

The southern portion of the Site is flat, but mostly covered in impervious surfaces. The northern portion of the Site is vegetated but exhibits a hilly slope. Upon development of the Site, the structures and paved areas will be considered impervious surface. The landscaped areas will allow infiltration of the water surplus. The calculations for the infiltration factor of the pre- and post- development conditions of the Site have been outlined in Embedded Table 4. The estimated infiltration factor of the landscaped and existing vegetated areas was 0.7.

Embedded Table 4 Infiltration Factor

Infiltration Factor Calculations			
	Pre-Development Vegetated Surfaces	Post- Development	
		Landscaped Areas	Impervious Surfaces
Topography	Hilly – 0.1	Assumed to be the same a pre-development conditions	-
Soil	Sandy Soil – 0.4		-
Cover	Vegetated – 0.2		-
Infiltration Factor (I)	**0.7**	**0.7**	**0**

6.3 Pre-Development Water Balance

The results of the pre-development water balance are included in Embedded Table 5. It was assumed that 10% of precipitation falling on impervious surfaces (i.e., asphalt/paved/roof areas) is lost directly to evaporation. The remaining depth (i.e., 90% of precipitation) was considered surplus and converted to infiltration and/or runoff. The estimated equivalent surplus depth from impervious surfaces was 840 mm/yr. The pre-development water balance conditions result in 357 m³/year of infiltration and 1,998 m³/year of runoff.

Embedded Table 5 Pre-Development Conditions

Portion	Area (m^2)	Surplus (m/yr)	Infiltration Factor (dimensionless)	Groundwater Infiltration (QI) (m^3/yr)	Surface Water Runoff (QR) (m^3/yr)
Vegetated Areas	1,358	0.376	0.7	357	153
Impervious Surfaces	2,197	0.840	0.0	0	1,845
Total	3,555	-	-	357	1,998
				Sum of QI and QR (m^3/year)	2,355

6.4 Post-Development Water Balance

The results of the post-development water balance are included in Embedded Table 6. It was assumed that 10% of precipitation falling on rooftops and paved areas is lost directly to evaporation. The remaining depth (i.e., 90% of precipitation) was considered surplus and converted to infiltration and/or runoff. The estimated equivalent surplus depth from impervious surfaces was 840 mm/yr. The post-development water balance conditions result in 270 m³/year of infiltration and 1,856 m³/year of runoff.

The runoff generated from the land conveyed to the City of Barrie for the road widening was calculated to be 151 m³/year. It was assumed that the runoff from these lands will be managed by the City of Barrie storm sewer infrastructure (and is therefore not included in the post-development water balance).

Embedded Table 6 Post-Development Water Balance

Portion	Area (m^2)	Surplus (m/yr)	Infiltration Factor (dimensionless)	Groundwater Infiltration (QI) (m^3/yr)	Surface Water Runoff (QR) (m^3/yr)
Landscaped Areas	1,027	0.376	0.7	270	116
Roof Areas	1,642	0.840	0.0	0	1,379
Balconies	271	0.840	0.0	0	228
Paved Surfaces	430	0.376	0.0	0	361
Total	3,370	-	-	270	1,856
				Sum of QI and QR (m^3/year)	2,126

6.5 Water Balance Comparison

The water balances of the pre-development and post-development scenarios are summarized in Embedded Table 7.

Embedded Table 7 Water Balance Comparison

Scenario	QI (m^3/yr)	QI Difference From Pre-Development Scenario	QR (m^3/yr)	QR Difference From Pre-Development Scenario
Pre-Development	357	-	1,998	-
Post-Development	270	-24% (-87 m^3/yr)	1,856	-7% (-142 m^3/yr)

Upon development, groundwater infiltration and runoff will decrease by approximately 24% and 7%, respectively. The water balance described above did not incorporate improvements from stormwater management or LID features.

Roof runoff is considered "clean" and can, therefore, be re-infiltrated into the subsurface to compensate for the infiltration deficit. Runoff generated from balconies was calculated to be 228 m^3/year. If roof runoff is captured and re-infiltrated (and assuming an efficiency of 90%), the groundwater recharge rate will increase by 205 m^3/year. The corresponding runoff rate will decrease by this same amount. The influence that re-infiltration of balcony runoff will induce of the post-development water balance is summarized below in Embedded Table 8.

Embedded Table 8 Water Balance Comparison (Including LID)

Scenario	QI (m^3/yr)	QI Difference From Pre-Development Scenario	QR (m^3/yr)	QR Difference From Pre-Development Scenario
Pre-Development	357	-	1,998	-
Post-Development	475	+30% (+118 m^3/yr)	1,651	-17% (-347 m^3/yr)

If all runoff generated from balconies is returned to the subsurface via LID measures, the post-development infiltration rate could increase by 30%, when compared with pre-development

conditions. These results indicate that the pre-development infiltration rate can be maintained (at least) if runoff generated from the balconies is re-infiltrated into the subsurface.

The Site runoff rate was 17% less than pre-development rates. A large portion of the runoff deficit was due to the loss of Site area to account for the widening of Bradford St. A runoff rate reduction of 17% will not likely influence down-stream surface water receivers.

All LID and stormwater management features should be designed by a qualified individual. The document titled "Low Impact Development Stormwater Management Planning and Design Guide" (Credit Valley Conservation, 2010), should be referenced during the design stage of the LID features.

Figure C.1 Annual Precipitation Event Distribution

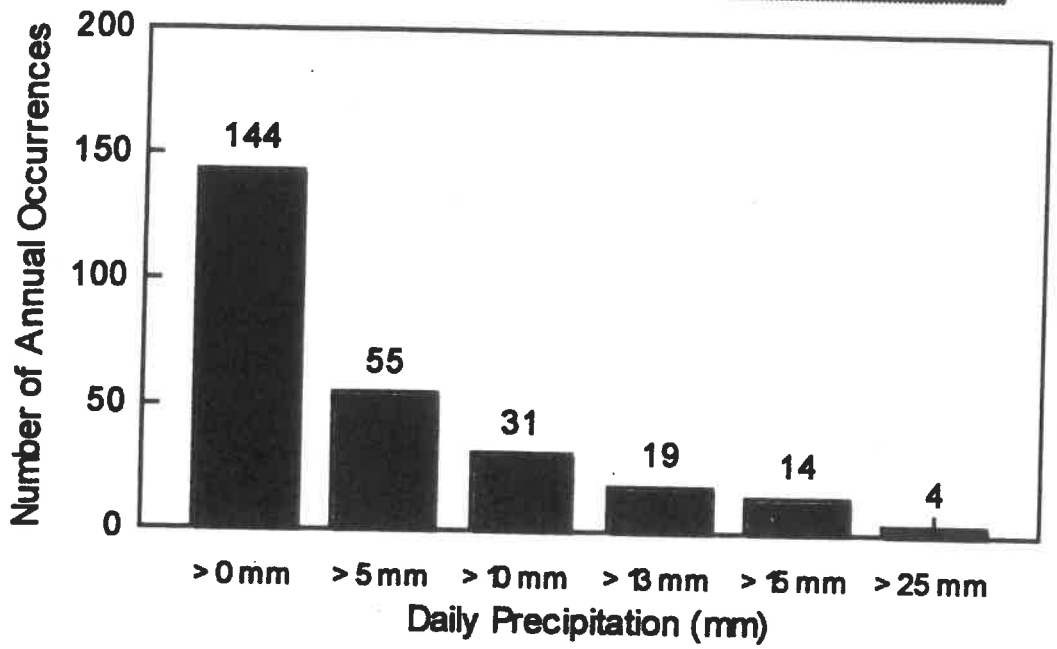
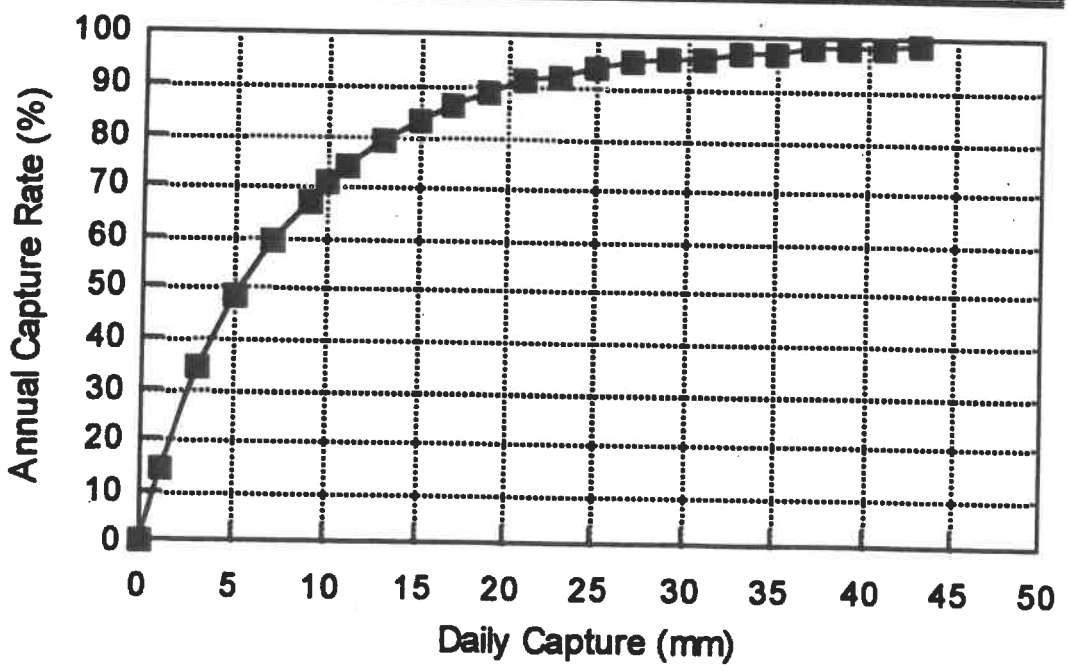


Figure C.2 Annual Capture Rate for Daily Capture Amounts



Appendix C

CB Shield Removal Efficiency Calculations

PN 19-3266
220 Bradford Street, Barrie

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE 6-Feb-20
CALCS BWB
Revised

Composite Site TSS Removal Efficiency

CATCHMENT 200		AREA =	**0.022**	Ha		
GROUND COVER TYPE			area	PROPORTION	CB Shield	57%
IMPERVIOUS	0.0002			1%		
GRASS (2-7% grade)	0.022			99%	Area x Removal	0.013
TOTAL	**0.02**	**Ha**				

CATCHMENT 201		AREA =	**0.035**	Ha		
GROUND COVER TYPE				PROPORTION	CB Shield	55%
IMPERVIOUS	0.0352			100%		
VEGETATED	0.000			0%	Area x Removal	0.019
TOTAL	**0.04**	**Ha**				

CATCHMENT 202		AREA =	**0.03**	Ha		
GROUND COVER TYPE				PROPORTION	CB Shield	55%
IMPERVIOUS	0.0308			100%		
GRASS (2-7% grade)	0.000			0%	Area x Removal	0.017
TOTAL	**0.03**	**Ha**				

CATCHMENT 203		AREA =	0.036	Ha		
GROUND COVER TYPE				PROPORTION	CB Shield	57%
IMPERVIOUS	0.0006			2%		
VEGETATED	0.035			98%	Area x Removal	0.021
TOTAL	0.04	Ha				

CATCHMENT 204		AREA =	**0.052**	Ha		
GROUND COVER TYPE				PROPORTION	CB Shield	54%
IMPERVIOUS	0.0521			100%		
VEGETATED	0.000			0%	Area x Removal	0.028
TOTAL	**0.05**	**Ha**				

PN 19-3266
220 Bradford Street, Barrie

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE 6-Feb-20
CALCS BWB
Revised

Composite Site TSS Removal Efficiency

CATCHMENT 205		AREA =	**0.023**	Ha			
GROUND COVER TYPE				PROPORTION	CB Shield		
						56%	
IMPERVIOUS	0.0231			100%			
VEGETATED	0.000			0%	Area x Removal		0.013
TOTAL	**0.02**	**Ha**					

CATCHMENT 206		AREA =	**0.006**	Ha			
GROUND COVER TYPE				PROPORTION	CB Shield		
						56%	
IMPERVIOUS	0.0046			82%			
VEGETATED	0.001			18%	Area x Removal		0.003
TOTAL	**0.006**	**Ha**					

CATCHMENT 207		AREA =	**0.006**	Ha			
GROUND COVER TYPE				PROPORTION	CB Shield		
						56%	
IMPERVIOUS	0.0047			82%			
VEGETATED	0.001			18%	Area x Removal		0.003
TOTAL	**0.01**	**Ha**					

CATCHMENT 208		AREA =	**0.011**	Ha			
GROUND COVER TYPE				PROPORTION	CB Shield		
						56%	
IMPERVIOUS	0.0108			92%			
VEGETATED	0.001			8%	Area x Removal		0.006
TOTAL	**0.01**	**Ha**					

CATCHMENT 209		AREA =	**0.006**	Ha			
GROUND COVER TYPE				PROPORTION	CB Shield		
						56%	
IMPERVIOUS	0.0058			100%			
VEGETATED	0.000			0%	Area x Removal		0.003
TOTAL	**0.01**	**Ha**					

CATCHMENT 210		AREA =	**0.001**	Ha			
GROUND COVER TYPE				PROPORTION	CB Shield		
						56%	
IMPERVIOUS	0.0013			100%			
VEGETATED	0.000			0%	Area x Removal		0.001
TOTAL	**0.00**	**Ha**					

Total Area x Removal	0.127
Total Area	0.229
Composite Removal	56%

PN 19-3266
220 Bradford Street, Barrie

SBA Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE 6-Feb-20
CALCS BWB
Revised

Composite Site TSS Removal Efficiency

Drainage Catchment to Jellyfish Filter

Total Drainage Area	2714 sq.m.	%
Roof Area	1915 sq.m	71%
Pavement/Sidewalk	425 sq.m.	16%
Landscaped Area	374 sq.m.	14%
		100%
Treatment Efficiency	89%	

CB Shield TSS Removal	56%		Remainder		44%			
Stormceptor Removal	89%	x	44%	=	39%			
			44%	-	39%	=	5%	Remainder

Remainder = **5%** **so that removal =** **95%**

Calculations ignore landscaped area, balcony areas and roof areas that are not considered to produce sediment

Note: Parking area is under the building so total drainage catchments are overlapping and sum is greater than site area

Average Annual Sediment Removal Rates (%) using a CB Shield (based on ETV Sediment - 1 to 1000 micron Particle Size Distribution)						
Area to CB (ha)	**Imperviousness[1] (%)**					
	20%	35%	50%	65%	80%	100%
0.02	57%	57%	57%	57%	56%	56%
0.05	56%	56%	56%	55%	55%	54%
0.10	56%	55%	54%	53%	52%	51%
0.20	54%	53%	51%	49%	48%	46%
0.30	53%	50%	48%	46%	45%	43%
0.40	51%	48%	46%	44%	42%	40%
0.50	50%	47%	44%	42%	40%	38%
0.60	49%	45%	43%	40%	39%	36%

Notes:

1. Runoff Coefficient 'C' is approximately equal to 0.05 + 0.9*Impervious Fraction.
2. Above chart is based on long term continuous hydrologic analysis of Toronto, Ontario (Bloor St) rainfall data.
3. Assumes 0.6 m sump in CB and that maintenance is performed (i.e. CB cleaning) when required by sediment/pollutant build-up or otherwise.
4. See accompanying chart for suggested maintenance scheduling - AND - get CB Shield Inc. to monitor it for you in field.
5. Sediment/Pollutant removal rates based on third party certified laboratory testing using ETV sediment (PSD analysis available on request).
6. See additional discussion regarding scour protection from CB Shield during more infrequent runoff events.

Appendix D

LID TTT model results: Phosphorous

Jellyfish Sizing Information

Loading Summary TP | Post Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m^3)	Total Flow (m^3)
			Average Concentration (mg/l)	Average Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
Catchment 1	53.883 %	0.040 m^3/s	2,089.447 m^3	1,872.000 m^3
			0.141 mg/l	0.073 mg/l
			0.295 kg	0.136 kg
Total	**53.883 %**	**0.040 m^3/s**	**2,089.447 m^3**	**1,872.000 m^3**
			0.141 mg/l	**0.073 mg/l**
			0.295 kg	**0.136 kg**

Loading TP | Post Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Catchment A	0 %	0.03 m^3/s	2,248.386 m^3 0.145 mg/l 0.326 kg	1,630.000 m^3 0.145 mg/l 0.236 kg
Catchment B	0 %	0 m^3/s	245.622 m^3 0.090 mg/l 0.022 kg	200.000 m^3 0.090 mg/l 0.018 kg
Catchment C	0 %	0.01 m^3/s	946.313 m^3 0.158 mg/l 0.149 kg	250.000 m^3 0.158 mg/l 0.039 kg
Infiltration	100 %	0 m^3/s	209.447 m^3 0.095 mg/l 0.020 kg	200.000 m^3 0.000 mg/l 0.000 kg
Jellyfish	59 %	0.031 m^3/s	1,620.000 m^3	1,620.000 m^3

			0.146 mg/l	0.060 mg/l
			0.236 kg	0.097 kg
Outlet sewer	0 %	0.031 m^3/s	1,620.000 m^3	1,620.000 m^3
			0.060 mg/l	0.060 mg/l
			0.097 kg	0.097 kg
Hotckhiss Pond 4	0 %	0.04 m^3/s	1,872.000 m^3	1,872.000 m^3
			0.073 mg/l	0.073 mg/l
			0.136 kg	0.136 kg

Detailed Report Parameters | Post Development

Hotckhiss Pond 4

Field	Value
Name	Hotckhiss Pond 4
Catchment	1
Outfall Elevation (m)	221.5

Catchment A

Field	Value
Subcatchment name	Catchment A
Catchment	1
Total AREA (HA)	0.238
Impervious area (HA)	0.043078000000000005
Roof area (HA)	0.164458
Landscaped area (HA)	0.030463999999999998
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0

Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Catchment B

Field	Value
Subcatchment name	Catchment B
Catchment	1
Total AREA (HA)	0.026
Impervious area (HA)	0
Roof area (HA)	0.026
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1

Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Infiltration

Field	Value
Name	Infiltration
LID type	infiltration
Catchment	1
Outlet (name)	8
% Imperv	100
Width (m)	2
Paved surface (HA)	0
Roof (HA)	0
Landscaped Area (HA)	0
Row Crop (HA)	0
Open Space/Parkland (HA)	0.001
Forest (HA)	0
Wetland (HA)	0
(HA)	0
Berm Height (mm)	150

Surface Slope (%)	0
Thickness (mm)	300
Void Ratio	0.4
Impervious Surface Fraction	
Permeability (mm/hr)	
Clogging Factor	0.5
Soil	
Porosity (Fraction)	
Field Capacity (Fraction)	
Wilting Point (Fraction)	
Conductivity (mm/hr)	
Conductivity Slope (Dimensionless)	
Suction Head (mm)	
Seepage Rate (mm/hr)	10
Flow Coefficient	0
Flow Exponent	0
Offset Height (mm)	0
Mannings Roughness	

Catchment C

Field	Value
Subcatchment name	Catchment C

Catchment	1
Total AREA (HA)	0.079
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0.079
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	65

Jellyfish

Field	Value
Name	Jellyfish
Junction Type	media-filter
Catchment	1

Invert Elevation (m)	221.75
Depth to Surface (m)	1.5

Outlet sewer

Field	Value
Name	Outlet sewer
Catchment	1
Upstream Node	Jellyfish
Downstream Node	Hotckhiss-Pond-4
Length (m)	17
Manning's Roughness	0.013
Upstream Invert (m)	221.75
Downstream Invert (m)	221.5
Pipe Diameter (m)	0.3

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Tuesday, February 04, 2020
Project Name	220 Bradford St
Project Number	PN 3266
Location	Barrie

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.

Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	7.6	85

The Jellyfish Filter System

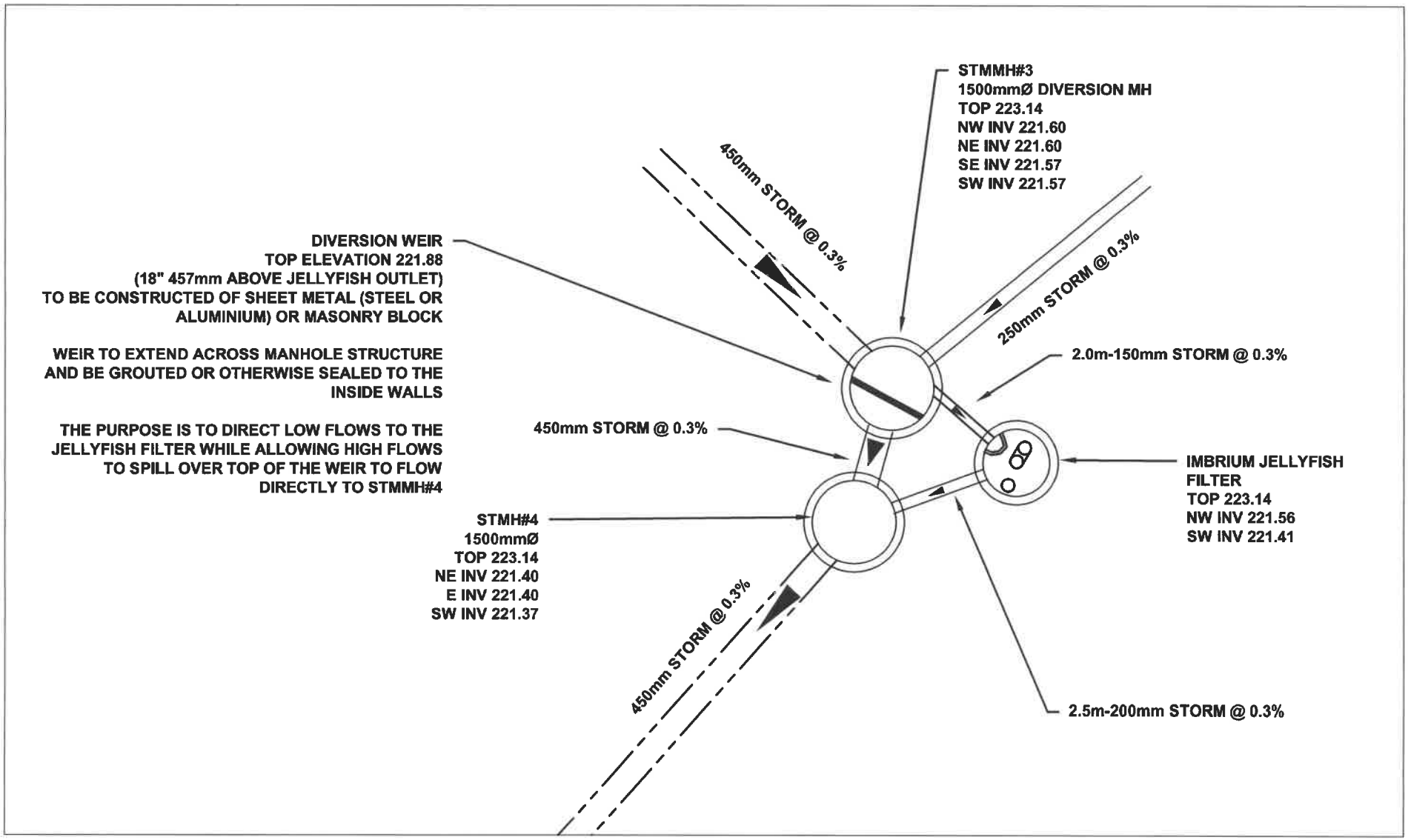
The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.



JELLYFISH DIVERSION CONFIGURATION
REFER TO DRAWING 3266-SS
SCALE 1:100

DRAWING NOT TO BE USED FOR CONSTRUCTION

GENERAL NOTES:

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. JELLYFISH STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE JELLYFISH SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

JELLYFISH STRUCTURE & DESIGN NOTES:

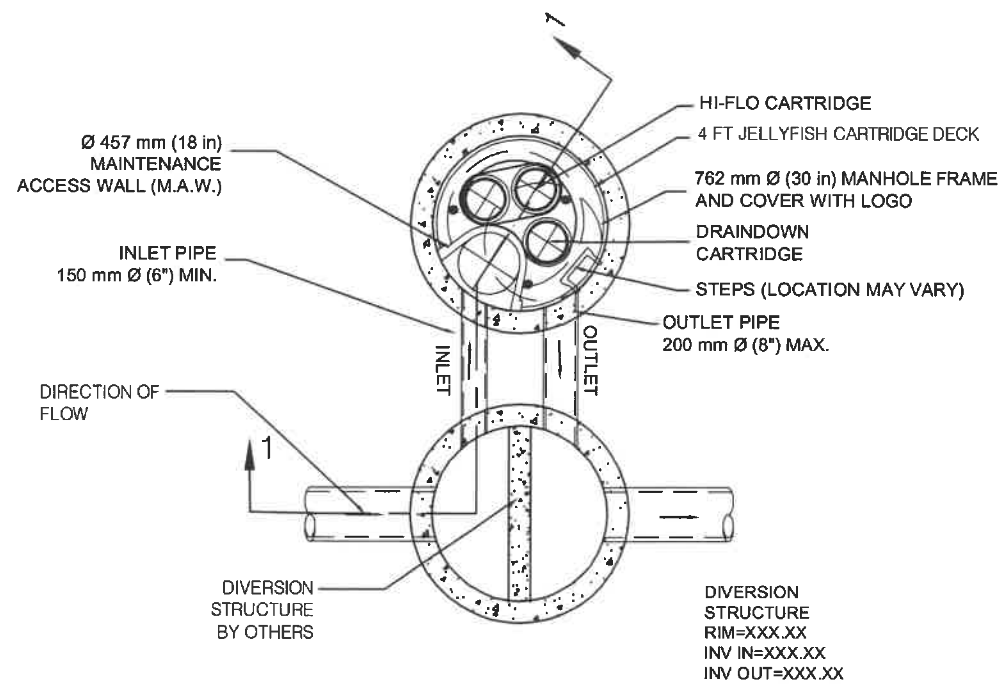
1. 457 MM Ø (18") MAINTENANCE ACCESS WALL TO BE USED FOR CLEANOUT AND ACCESS BELOW CARTRIDGE DECK.
2. CASTINGS OR DOORS OF THE JELLYFISH MANHOLE STRUCTURE TO EXTEND TO DESIGN FINISH GRADE. DEPTHS IN EXCESS OF 3.65 M (12') MAY REQUIRE THE DESIGN AND INSTALLATION OF INTERMEDIATE SAFETY GRATES OR OTHER STRUCTURAL ELEMENTS.
3. CASTINGS AND GRADE RINGS, OR DOORS AND DOOR RISERS, OR BOTH, SHALL BE GROUTED FOR WATERTIGHTNESS.
   STRUCTURE SHALL MEET AASHTO HS-20, ASSUMING EARTH COVER OF 0' - 3', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 LOAD RATING AND BE CAST WITH THE IMBRIUM LOGO.
4. ALL STRUCTURAL SECTIONS AND PARTS TO MEET OR EXCEED ASTM C-478, ASTM C-443, AND ASTM D-4097 CORRESPONDING TO AASHTO SPECIFICATIONS, AND ANY OTHER SITE OR LOCAL STANDARDS.
5. CONCRETE RISER SECTIONS FROM BOTTOM TO TOP WILL BE ADDED AS REQUIRED INCLUDING TRANSITION PIECES TO SMALLER DIAMETER RISERS FOR SURFACE ACCESSES WHERE WARRANTED BY SERVICING DEPTH.
6. IF MINIMUM DEPTH FROM TOP OF CARTRIDGE DECK TO BOTTOM OF STRUCTURAL TOP SLAB CANNOT BE ACHIEVED DUE TO PIPING INVERT ELEVATIONS OR OTHER SITE CONSTRAINTS. ALTERNATIVE HATCH CONFIGURATIONS MAY BE AVAILABLE. HATCH DOORS SHOULD BE SIZED TO PROVIDE FULL ACCESS ABOVE THE CARTRIDGES TO ACCOMMODATE MAINTENANCE.
7. STEPS TO BE APPROXIMATELY 330 MM (13") APART AND DIMENSIONS MUST MEET LOCAL STANDARDS. STEPS MUST BE INSTALLED AFTER CARTRIDGE DECK IS IN PLACE.
8. CONFIGURATION OF INLET AND OUTLET PIPE CAN VARY TO MEET SITE'S NEEDS.
9. IT IS THE RESPONSIBILITY OF OTHERS TO PROPERLY PROTECT THE TREATMENT DEVICE, AND KEEP THE DEVICE OFFLINE DURING CONSTRUCTION. FILTER CARTRIDGES SHALL NOT BE INSTALLED UNTIL THE PROJECT SITE IS CLEAN AND FREE OF DEBRIS, BY OTHERS. THE PROJECT SITE INCLUDES ANY SURFACE THAT CONTRIBUTES STORM DRAINAGE TO THE TREATMENT DEVICE. CARTRIDGES SHALL BE FURNISHED NEW, AT THE TIME OF FINAL ACCEPTANCE.
10. THIS DRAWING MUST BE VIEWED IN CONJUNCTION WITH THE STANDARD JELLYFISH SPECIFICATION, AND STORMWATER QUALITY FILTER TREATMENT JELLYFISH DOCUMENTS.

INSTALLATION NOTES

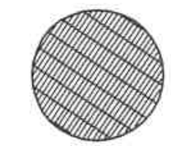
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. CARTRIDGE INSTALLATION, BY IMBRIUM, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE JELLYFISH UNIT IS CLEAN AND FREE OF DEBRIS. CONTACT IMBRIUM TO COORDINATE CARTRIDGE INSTALLATION WITH SITE STABILIZATION.

STANDARD OFFLINE JELLYFISH RECOMMENDED PIPE DIAMETERS			
MODEL DIAMETER (m)	MINIMUM ANGLE INLET/OUTLET PIPES	MINIMUM INLET PIPE DIAMETER (mm)	MINIMUM OULTET PIPE DIAMETER (mm)
1.2	62	150	200
1.8	59	200	250
2.4	52	250	300
3.0	48	300	450
3.6	40	300	450
CONTACT IMBRIUM SYSTEMS FOR ALTERNATE PIPE DIAMETERS			

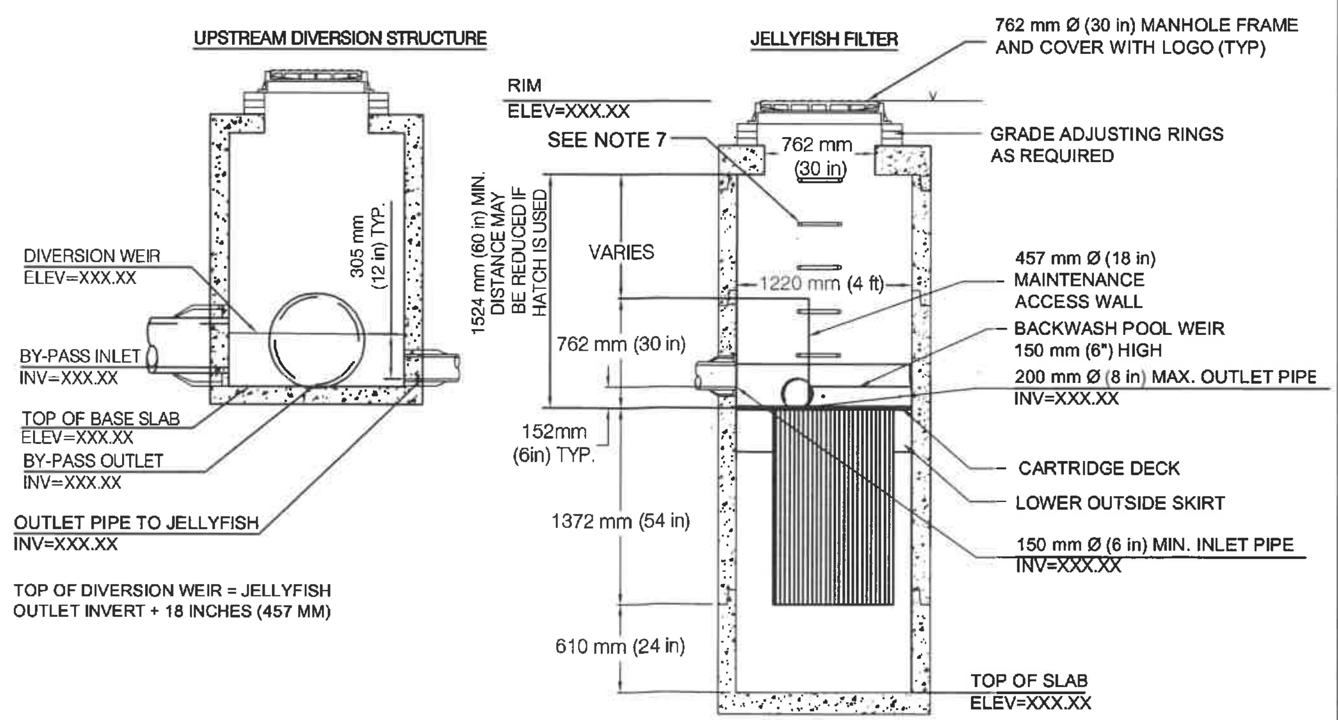
FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL JELLYFISH FILTER REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE.



OFFLINE LAYOUT



XXX.XX INFORMATION TO BE SUPPLIED BY ENGINEER OF RECORD



TOP OF DIVERSION WEIR = JELLYFISH OUTLET INVERT + 18 INCHES (457 MM)

CROSS SECTION 1-1

JELLYFISH DESIGN NOTES

JELLYFISH TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD MANHOLE STYLE IS SHOWN. Ø1220 mm (48") MANHOLE JELLYFISH PEAK TREATMENT CAPACITY IS 12.7 L/s (0.54 CFS). TREATMENT FLOW RATE IS BASED ON 457 mm (18") OF HEAD PRESSURE.

CARTRIDGE SELECTION				
CARTRIDGE DEPTH	54"	40"	27"	15"
OUTLET INVERT TO STRUCTURE BASE SLAB	90"	76"	63"	51"
FLOW RATE HIGH-FLO / DRAINDOWN (L/s) (per cart)	5.09 / 2.55	3.68 / 1.84	2.55 / 1.27	1.41 / 0.71
SEDIMENT CAPACITY HIGH-FLO / DRAINDOWN (kg) (per cart)	57 / 28	42 / 21	28 / 14	16 / 8
MAX. CARTS HIGH-FLO/DRAINDOWN	2 / 1			
MAX. SEDIMENT CAPACITY (kg)	142	105	70	40
MAX. TREATMENT (L/s)	12.7	9.3	6.2	3.4

SITE SPECIFIC DATA REQUIREMENTS

JELLYFISH MODEL	*				
STRUCTURE ID					*
WATER QUALITY FLOW RATE (L/s)					*
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
# OF CARTRIDGES REQUIRED (HF / DD)					*
CARTRIDGE SIZE (inches)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
0	10/01/2014	INITIAL RELEASE	BSF
1	08/01/2015	NOTES	BSF
#	#	#	#
#	#	#	#
#	#	#	#

Jellyfish® JF4 STANDARD Scale = 1:50

imbrium® Jellyfish® Filter

DATE: #####
DESIGNED: DRAWN: BSF
CHECKED: BSF APPROVED: SP
PROJECT #: ##### PROJECT NAME: #####
SHEET: 1 OF 2

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

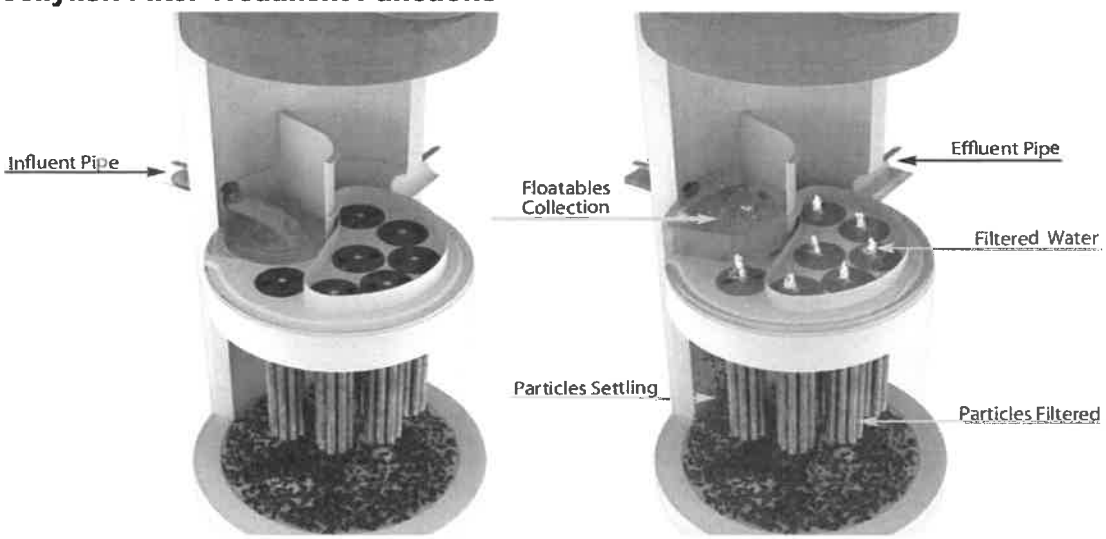
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 59%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Tuesday, February 04, 2020
Project Name:	220 Bradford St
Project Number:	PN 3266
Location:	Barrie

Designer Information

Company:	Skelton Brumwell & Assocs
Contact:	Bryan Bolivar
Phone #:	

Notes

Rainfall

Name:	TORONTO CENTRAL
State:	ON
ID:	100
Record:	1982 to 1999
Co-ords:	45°30'N, 90°30'W

Drainage Area

Total Area:	0.2714 ha
Imperviousness:	86%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 18 years of TORONTO CENTRAL rainfall data:	**7.2 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 1373 m^3, with a suspended sediment concentration of 60 mg/L.	**82 kg**

Recommendation

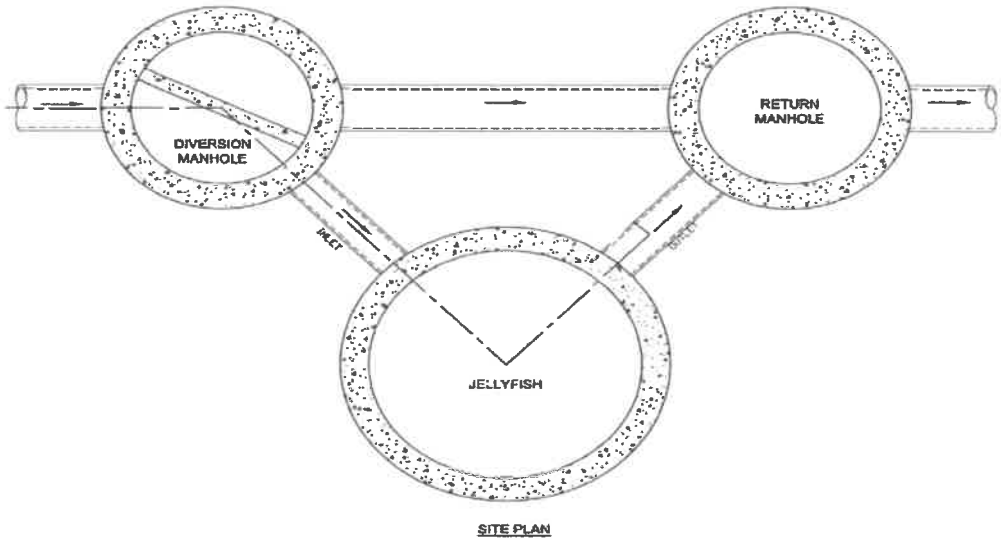
The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m^3)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	**1**	**1**	**1.2**	**2313**	**0.34**	**379**	**7.6**	**85**
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish® Filter

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	62°	150	200
1.8	59°	200	250
2.4	52°	250	300
3.0	48°	300	450
3.6	40°	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass – The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft² (0.142 lps/m²).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

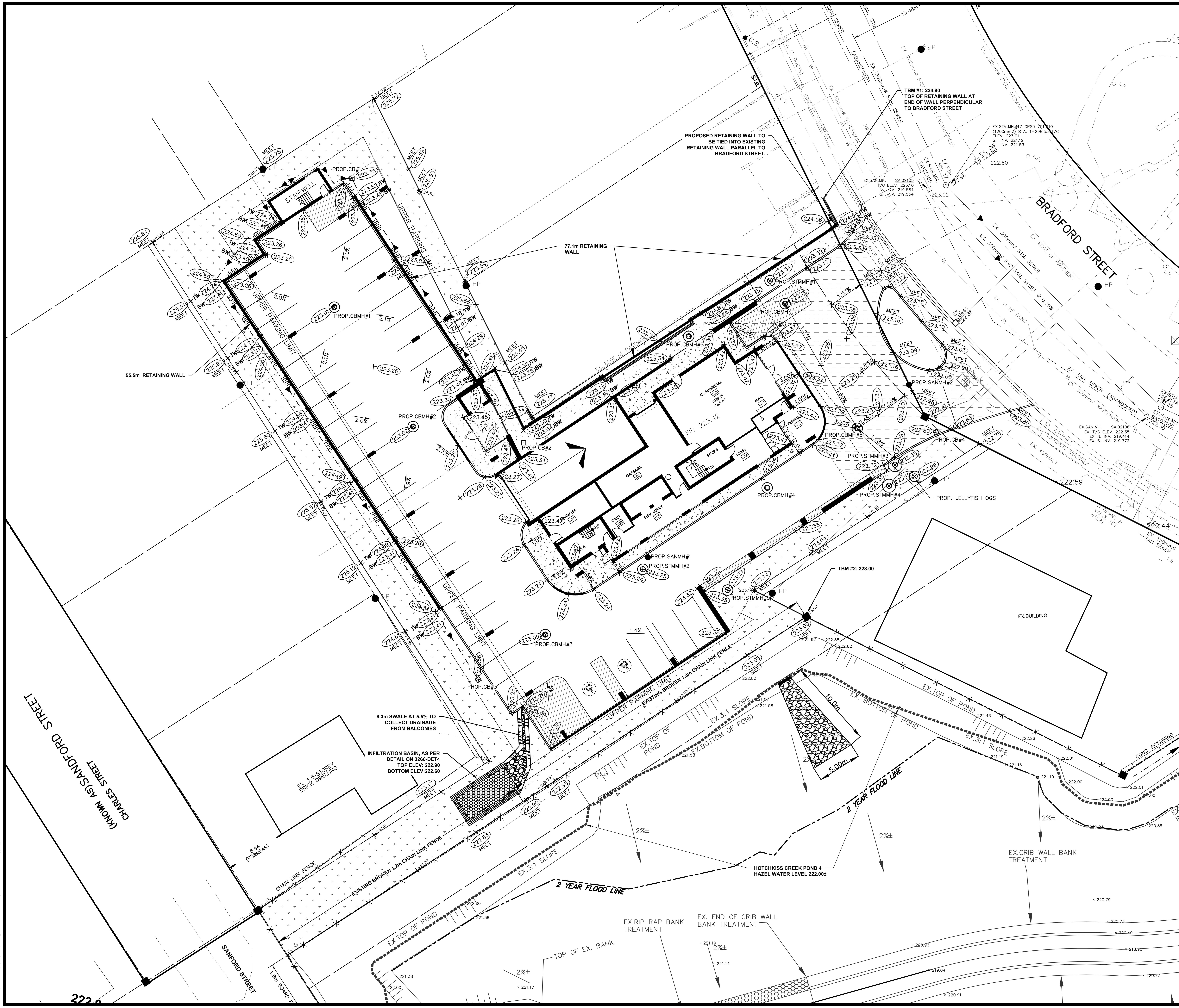
5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

3266 – SG



KEY MAP
N.T.S.

LEGEND

MEET 225.59	MATCH EXISTING ELEVATION
223.35	PROPOSED ELEVATION
PROP. CB	PROPOSED CATCH BASIN
PROP. STMMH	PROPOSED MAINTENANCE HOLE
PROP. CBMH	PROPOSED CATCH BASIN MAINTENANCE HOLE
PROP.SANMH	PROPOSED SANITARY MAINTENANCE HOLE
	PROPOSED HEAVY DUTY ASPHALT
	EXISTING CURB
	EXISTING PAVEMENT
X	EXISTING FENCE
	EXISTING LOT
	EXISTING BUILDINGS
	EXISTING SIDEWALK
	EXISTING TREE LINE
EX.SAN.MH.	EXISTING SANITARY MAINTENANCE HOLE
	EXISTING SANITARY SEWER
EX.STM.	EXISTING STORM MAINTENANCE HOLE
EX. CB	EXISTING STORM CATCH BASIN
	EXISTING STORM SEWER
W	EXISTING WATER MAIN
WS	EXISTING WATER SERVICE
	EXISTING UNDERGROUND BELL
	EXISTING UNDERGROUND CCTV
	EXISTING UNDERGROUND GAS
	EXISTING UNDERGROUND HYDRO
	EXISTING UNDERGROUND CONDUIT
	EXISTING ABOVEGROUND BELL
	EXISTING ABOVEGROUND CCTV
	EXISTING ABOVEGROUND HYDRO

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1.	2020 02 07	SITE PLAN APPLICATION	BWB

LICENSED PROFESSIONAL ENGINEER
Feb 7, 2020
B. W. BOLIVAR
100017873
PROVINCE OF ONTARIO

CHAYELL HOSPITALITY GROUP
220 BRADFORD STREET
CITY OF BARRIE

SITE GRADING

PROJECT NO. 3266		DRWG NO. 3266-SG	
DATE: NOV. 2019		SCALE: 1:200	
DRAWN:	CHECKED:	APPROVED:	

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS
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FAX (705) 726-0331
TOLL FREE (877) 726-1141

3266 – SS

PROP.C.B. 1
TOP: 223.30
S INV: 222.06
SE INV: 222.09
(FRENCH DRAIN)

26.5m - 100mm Ø
PERFORATED FRENCH DRAIN
TIED INTO PROP. CB#1

PROP. CBMH 1
TOP: 223.01
N INV: 222.02
SE INV: 221.99

55.5m RETAINING WALL

50mm RIGID BOARD INSULATION
1.6m WIDE, CENTERED OVER
PIPE, AS PER MOE FIG 3.1

PROP. CBMH 2
TOP: 223.02
NW INV: 221.95
SE INV: 221.92

STORM–WATER CROSSING
STORM INV 221.75
INSTALL W/M AT INV 221.05
EITHER VERTICALLY DEFLECT AT JOINTS OR WITH
VERTICAL BENDS AS PER BSD–518
CLEARANCE 0.5m

64.0m - 100mm Ø
PERFORATED FRENCH DRAIN
TIED INTO PROP.CB#3

PROP. CBMH 3
TOP: 223.09
NW INV: 221.84
NE INV: 221.81
SW INV: 221.84

PROP.C.B. 3
TOP: 223.55
NE INV: 221.87
NW INV: 221.90
(FRENCH DRAIN)

8.3m SWALE AT 5.5% TO
COLLECT DRAINAGE
FROM BALCONIES

INFILTRATION BASIN, AS PER
DETAIL ON 3266-DET4
TOP ELEV: 222.90
BOTTOM ELEV:222.60

EX.1.5-STOREY
BRICK DWELLING

6.9± (P3&MEAS)

CHAIN LINK FENCE

EXISTING BROKEN 1.2m CHAIN LINK FENCE

CHARLES STREET (KNOWN)

SANFORD STREET

1.8m BOARD FENCE

CREEK INV ELEVATION
INTERPOLATED BY SBA.
TO BE VERIFIED IN THE
FIELD.

EX. 1.2m CHAIN LINK FENCE

PROP. CBMH 4
TOP: 223.21
NE INV: 221.67
SW INV: 221.70

PROP.SANMH 1
TOP: 223.26
NW INV: 221.76
SE INV: 221.61

3.9m – 200mm ø
SAN SEWER @ 2.0%

4.5m – 300mmø
STM SEWER @ 0.3%

90° BENDS

55.4m – 200mmø SAN SEWER @ 5.4%
16.2m – 375mmø STM SEWER @ 0.3%

150mmø WATER SERVICE (DOMESTIC)
200mmø WATER SERVICE (FIRE)

12.6m – 300mmø
STM SEWER @ 0.3%

8.5m – 450mmø
STM SEWER @ 0.3%

45° BENDS

PROP. CBMH 5
TOP: 223.23
NW INV: 221.64
SE INV: 221.61
SW INV: 221.64

PROP.C.B. 2
TOP: 223.30
NE INV: 221.88

STORM–WATER CROSSING
STORM INV 221.54
INSTALL W/M AT INV 220.84
VERTICALLY DEFLECT W/M WITH
BENDS PER BSD–518 TO PASS
UNDER STORM SEWER
CLEARANCE 0.5m

SIAMESE FIRE
CONNECTION

21.8m – 250mmø
STM SEWER @ 0.3%

FF: 223.42

25mm RIGID BOARD INSULATION
1.4m WIDE, CENTERED OVER
PIPE, AS PER MOE FIG 3.1

PROP. CBMH 6
TOP: 223.30
NE INV: 221.78
SW INV: 221.81

77.1m RETAINING
WALL

10.6m – 250mmø STM
SEWER @ 0.3%

2.5m – 250mmø
STM SEWER @ 0.3%

PROP.STMMH 1
TOP: 223.34
SW INV: 221.75
SE INV: 221.72

PROP. CBMH 7
TOP: 223.15
NW INV: 221.71
SE INV: 221.69

PROPOSED RETAINING WALL TO
BE TIED INTO EXISTING
RETAINING WALL PARALLEL TO
BRADFORD STREET.

TBM #1: 224.90
TOP OF RETAINING WALL AT
END OF WALL PERPENDICULAR
TO BRADFORD STREET

LIVE TAP TO EXISTING MUNICIPAL
WATER MAIN USING A LIVE TAP
AND SLEEVE.
TO BE COORDINATED WITH THE CITY
OF BARRIE WATER DEPARTMENT

SANITARY–WATER CROSSING
SANITARY INV 220.54
SANITARY OBV 220.74
FG 223.25±
W/M OBV 221.55
W/M INV 221.35
CLEARANCE 0.61m

CONNECT TO MAIN LINE MATCHING
SPRING LINE OF SERVICE TO SPRING
LINE OF MAIN
USING AN INSERTA–TEE OR SADDLE
PER COB APPROVED MATERIALS LIST
MAIN LINE INV 219.50±
SPRING LINE 219.65±
INV OF SERVICE LATERAL 219.55±

SANITARY–WATER CROSSING
SANITARY INV 219.76
SANITARY OBV 219.96
W/M INV 220.79
CLEARANCE 0.83m
BACKFILL TO WITHIN 300mm OF WATERMAIN WITH
COMPACTED GRANULAR 'B'
REMAINDER OF W/M BEDDING TO BE UNSHRINKABLE
FILL

SAN CROSSES UNDER BELL DUCT
CLEARANCE 1m±
BACKFILL TO WITHIN 500mm OF DUCT
WITH COMPACTED GRANULAR 'B'
REMAINDER OF BEDDING TO BE 500mm
UNSHRINKABLE FILL

BRADFORD STREET

PROP.SANMH 2
TOP: 223.00
SW INV: 220.40
NE INV: 220.37

PROP.C.B. 4
TOP: 222.89
SW INV: 221.60

5.3m – 450mmø
STM SEWER @ 0.3%

4–45° BENDS

6.1m – 250mmø
STM SEWER @ 0.3%

2.0m – 150mmø
STM SEWER @ 0.3%

1.9m – 450mmø
STM SEWER @ 0.3%

PROP. JELLYFISH OCS
TOP: 223.14
NW INV: 221.56
SW INV: 221.41

PROP. STMMH#3
TOP: 223.14
NW INV: 221.60
NE INV: 221.60
SE INV: 221.57
SW INV: 221.57
1500mmø W DIVERSION WEIR

2.5m – 200mmø
STM SEWER @ 0.3%

PROP. STMMH#4
TOP: 223.14
NE INV: 221.40
E INV: 221.40
SW INV: 221.37
1500mmø

TBM #2: 223.00

PROP. STMMH#5
TOP: 223.22
NE INV: 221.31
SE INV: 221.29

EXISTING FIRE
HYDRANT

EX.BUILDING

ARMTECH PRO–ECO–LITE™
SERIES 3 HEADWALL
INV: 221.60

16.0m² OF 100–150mmø RIP RAP

EXISTING 1.2m
CHAIN LINK
FENCE

PROP. CHAIN
LINK FENCE

CONC. RETAINING WALL

SOUTH FACE CONCRETE
RETAINING WALL ON

1.5m BERM

SWALE TO ROAD

EX.TOP OF POND

EX.BOTTOM OF POND

EX.3:1 SLOPE

PROP. STMMH 2
TOP: 223.14
NE INV: 221.74
N INV: 221.77
SW INV: 221.77

10.0m

5.00m

2%±

2 YEAR FLOOD LINE

HOTCHKISS CREEK POND 4
HAZEL WATER LEVEL 222.00±

EX.CRIB WALL BANK
TREATMENT

EX.RIP RAP BANK
TREATMENT

EX. END OF CRIB WALL
BANK TREATMENT

TOP OF EX. BANK

C/L LOW FLOW CHA

NOTE:
FOR JELLYFISH OIL/GRIT SEPARATOR AND DIVERSION MAINTENANCE HOLE ORIENTATION REFER TO DETAIL "JELLYFISH DIVERSION CONFIGURATION" ON SHEET 3266–DET3.

KEY MAP
N.T.S.

LEGEND

PROP. CB	PROPOSED CATCH BASIN
PROP. STMMH	PROPOSED MAINTENANCE HOLE
PROP. CBMH	PROPOSED CATCH BASIN MAINTENANCE HOLE
	PROPOSED STORM MAIN
PROP.SANMH	PROPOSED SANITARY MAINTENANCE HOLE
	PROPOSED SANITARY MAIN
	PROPOSED WATER MAIN
	EXISTING CURB
	EXISTING PAVEMENT
X	EXISTING FENCE
	EXISTING LOT
	EXISTING BUILDINGS
	EXISTING SIDEWALK
	EXISTING TREE LINE
EX.SAN.MH.	EXISTING SANITARY MAINTENANCE HOLE
	EXISTING SANITARY SEWER
EX.STM.	EXISTING STORM MAINTENANCE HOLE
EX. CB	EXISTING STORM CATCH BASIN
	EXISTING STORM SEWER
W	EXISTING WATER MAIN
WS	EXISTING WATER SERVICE
	EXISTING UNDERGROUND BELL
	EXISTING UNDERGROUND CCTV
	EXISTING UNDERGROUND GAS
	EXISTING UNDERGROUND HYDRO
	EXISTING UNDERGROUND CONDUIT
	EXISTING ABOVEGROUND BELL
	EXISTING ABOVEGROUND CCTV
	EXISTING ABOVEGROUND HYDRO

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1.	2020 02 07	SITE PLAN APPLICATION	BWB

LICENSED PROFESSIONAL ENGINEER
Feb 7, 2020
B. W. BOLIVAR
100017673
PROVINCE OF ONTARIO

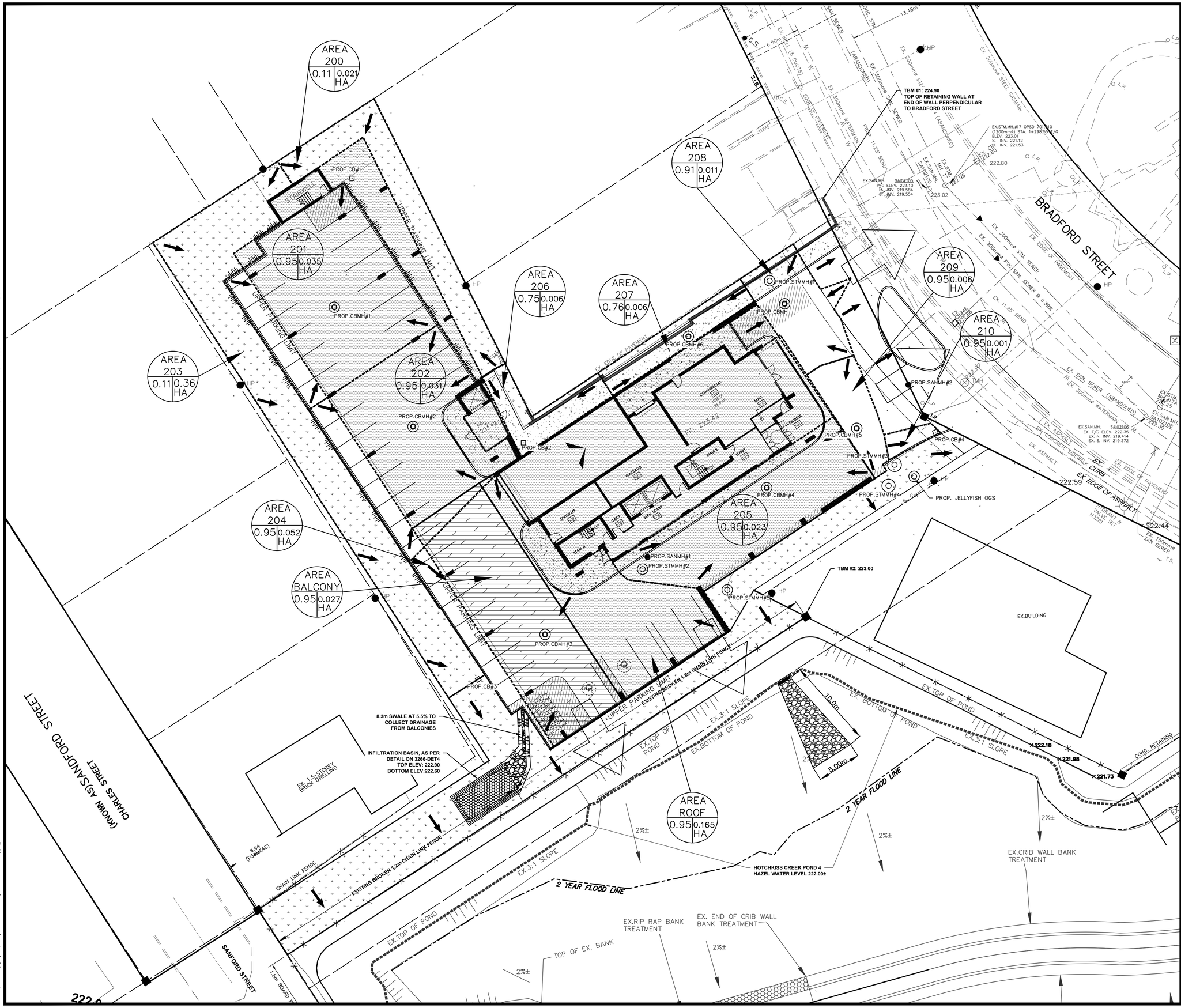
CHAYELL HOSPITALITY GROUP
220 BRADFORD STREET
CITY OF BARRIE

SITE SERVICING

PROJECT NO.	3266	DRWG NO.	3266-SS
DATE:	NOV. 2019	SCALE:	1:200
DRAWN:	CHECKED:	APPROVED:	

SBA Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS
93 BELL FARM ROAD, SUITE 107
BARRIE, ONTARIO L4M 5G1
www.skeltonbrumwell.ca
TELEPHONE (705) 726-1141
FAX (705) 726-0331
TOLL FREE (877) 726-1141

3266 – SWM2



KEY MAP
N.T.S.

LEGEND

- AREA 200 / 0.11 / 0.021 HA — CATCHMENT NUMBER; AREA IN HECTARES; RUNOFF COEFFICIENT
- MAJOR STORM FLOWS
- MINOR DRAINAGE DIRECTION
- GROUND CATCHMENT AREAS
- BUILDING CATCHMENT AREAS
- BALCONY AREA
- BUILDING ROOF AREA
- PROP. CB — PROPOSED CATCH BASIN
- PROP. STMMH — PROPOSED MAINTENANCE HOLE
- PROP. CBMH — PROPOSED CATCH BASIN MAINTENANCE HOLE
- EX.STM. — EXISTING STORM MAINTENANCE HOLE
- EX. CB — EXISTING STORM CATCH BASIN

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1.	2020 02 07	SITE PLAN APPLICATION	BWB

LICENSED PROFESSIONAL ENGINEER
B. W. BOLIVAR
100017673
PROVINCE OF ONTARIO

CHAYELL HOSPITALITY GROUP
220 BRADFORD STREET
CITY OF BARRIE

POST DEVELOPMENT STORM CATCHMENTS

PROJECT NO.	3266	DRWG NO.	3266-SWM2
DATE:	NOV. 2019	SCALE:	1:200
DRAWN:	NDK/BWB	CHECKED:	APPROVED:

Skelton Brumwell & Associates Inc.
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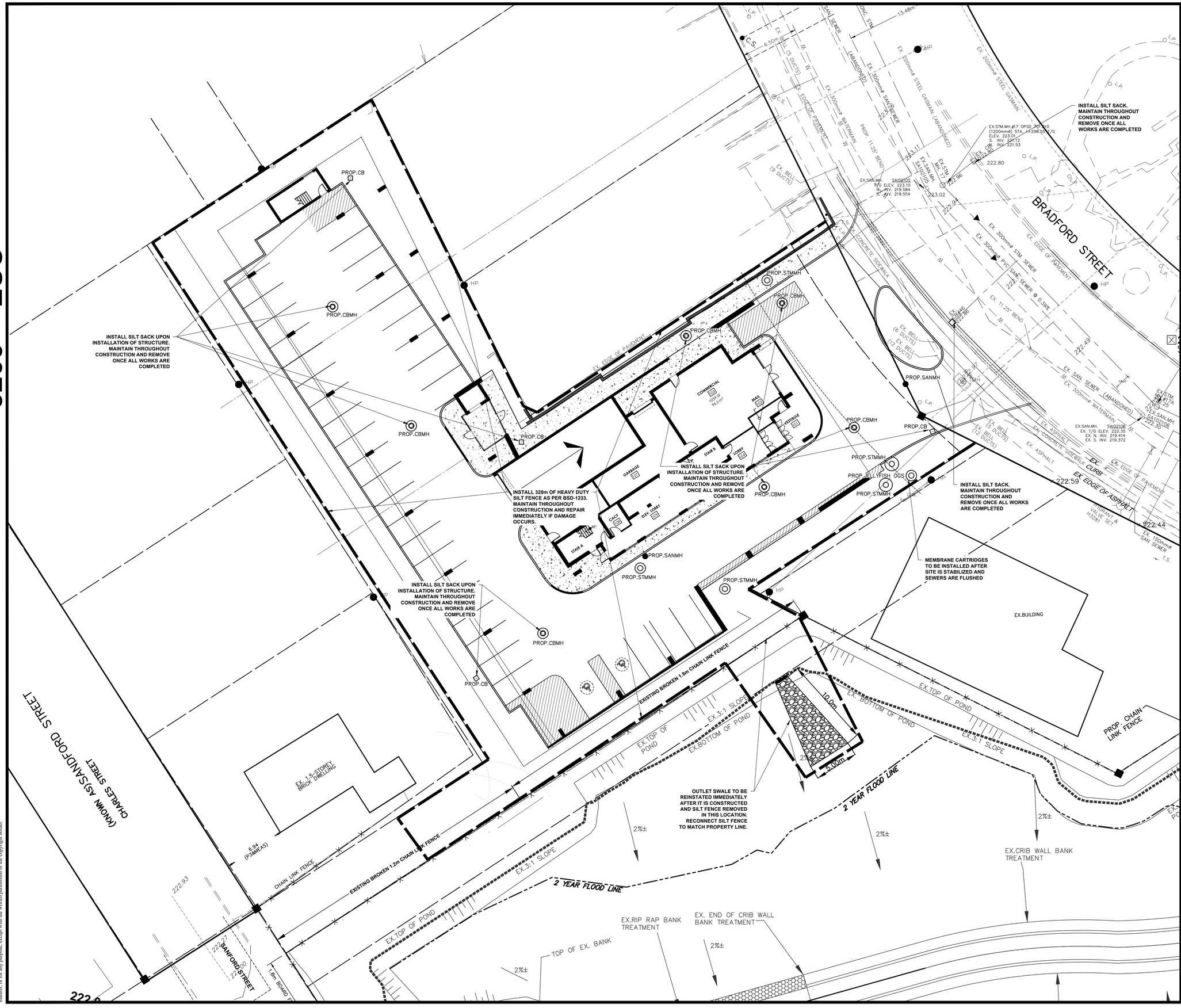
TOLL FREE (877) 726-1141

3266 – ESC



KEY MAP
N.T.S.

LEGEND

- PROPOSED SILTATION FENCE
- PROP. CB — PROPOSED CATCH BASIN
- PROP. STMMH — PROPOSED MAINTENANCE HOLE
- PROP. CBMH — PROPOSED CATCH BASIN MAINTENANCE HOLE
- EXISTING CURB
- EXISTING PAVEMENT
- EXISTING FENCE
- EXISTING LOT
- EXISTING BUILDINGS
- EXISTING SIDEWALK
- EXISTING TREE LINE
- EX.SAN.MH. — EXISTING SANITARY MAINTENANCE HOLE
- EXISTING SANITARY SEWER
- EX.STM. — EXISTING STORM MAINTENANCE HOLE
- EX. CB — EXISTING STORM CATCH BASIN
- EXISTING STORM SEWER
- EXISTING WATER MAIN
- EXISTING WATER SERVICE
- EXISTING UNDERGROUND BELL
- EXISTING UNDERGROUND CCTV
- EXISTING UNDERGROUND GAS
- EXISTING UNDERGROUND HYDRO
- EXISTING UNDERGROUND CONDUIT
- EXISTING ABOVEGROUND BELL
- EXISTING ABOVEGROUND CCTV
- EXISTING ABOVEGROUND HYDRO

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1.	2020 02 07	SITE PLAN APPLICATION	BWB

LICENSED PROFESSIONAL ENGINEER
Feb 7, 2020
B. W. BOLIVAR
100017673
PROVINCE OF ONTARIO

CHAYELL HOSPITALITY GROUP
220 BRADFORD STREET
CITY OF BARRIE

EROSION AND SEDIMENT CONTROL

PROJECT NO.	3266	DRWG NO.	3266-ESC
DATE:	NOV. 2019	SCALE:	1:200
DRAWN:		CHECKED:	APPROVED:

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS
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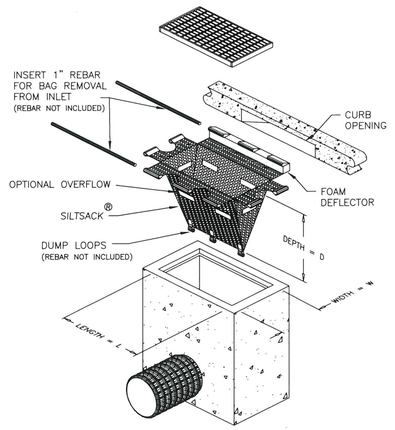
TOLL FREE (877) 726-1141

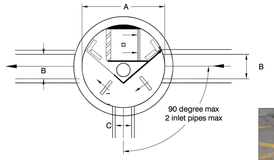
3266 – DET4

Typical Siltsack® Construction - Type A

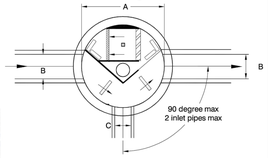


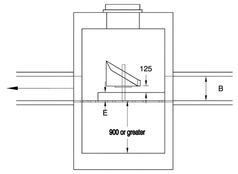
Typical Siltsack® Construction - Type B

Inlets at 180 - 270 degrees from outlet

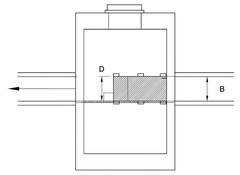


Inlets at 90 - 180 degrees from outlet





Section A-A

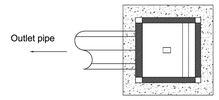


Inlet deflection wall

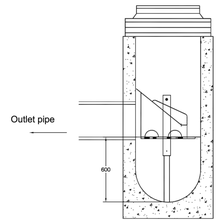
Sizing					
A	B	C	D	E	min depth
1500	450	300	450	150	1.2m
1800	750	450	750	150	1.5m
2400	1200	600	1200	300	2.1m

CBMH Shield-Information Chart

Notes
1. CB Shield can be installed at any time. In a non frozen condition.
2. The **frame and cover MUST BE well aligned** with the catchbasin for proper installation.
3. The catchbasin sump must be clean before installation
4. The grate should be at the same level as the standing water in the sump.

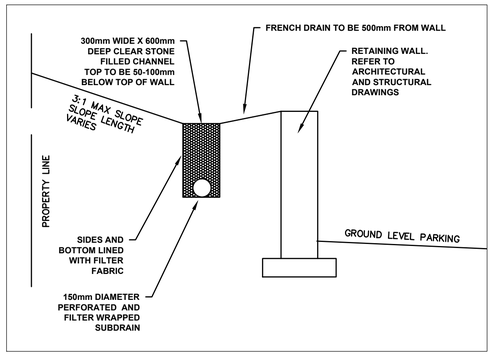


Top view

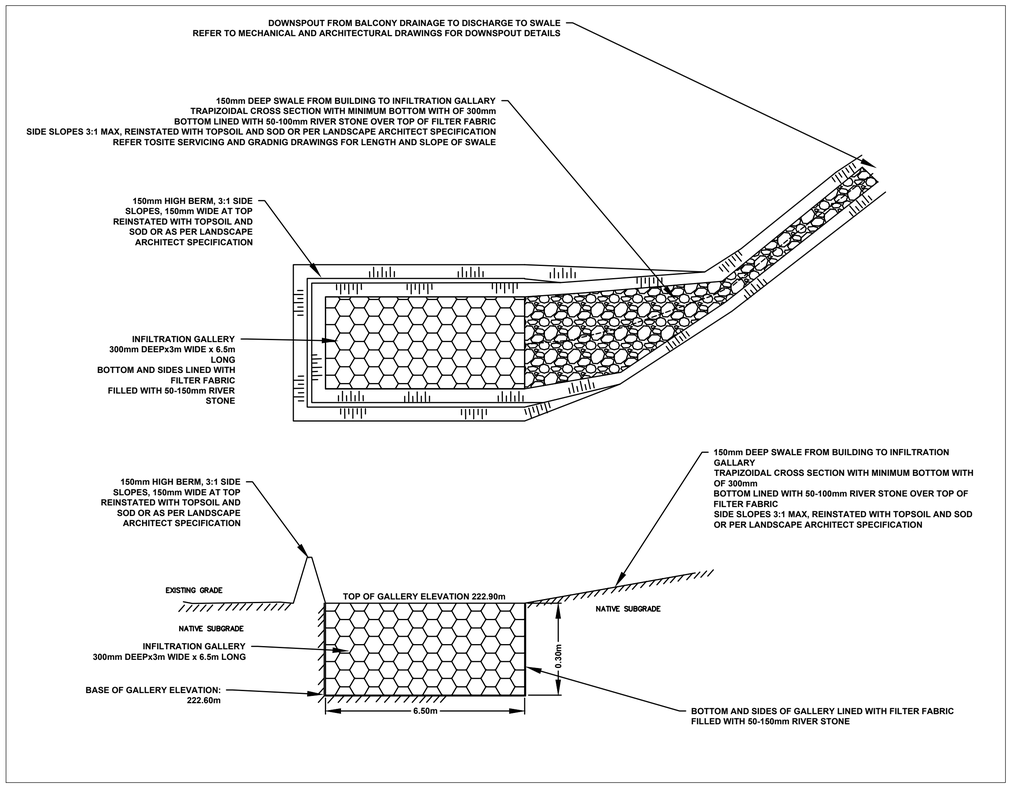


Profile view

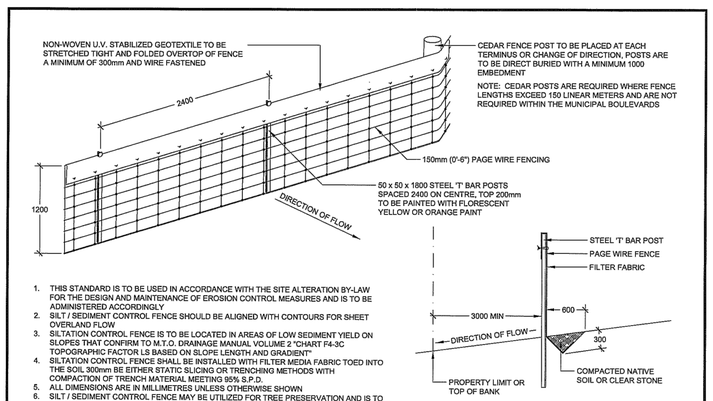
CB Shield (600mm Sump)



FRENCH DRAIN SCHEMATIC DETAIL
SCALE 1:25 HORIZONTAL & VERTICAL



INFILTRATION GALLERY SCHEMATIC DETAIL
SCALE 1:100 HORIZONTAL, 1:10 VERTICAL



1. THIS STANDARD IS TO BE USED IN ACCORDANCE WITH THE SITE ALTERATION BY-LAW FOR THE DESIGN AND MAINTENANCE OF EROSION CONTROL MEASURES AND IS TO BE ADMINISTERED ACCORDINGLY
2. SILT / SEDIMENT CONTROL FENCE SHOULD BE ALIGNED WITH CONTOURS FOR SHEET OVERLAND FLOW
3. SILTATION CONTROL FENCE IS TO BE LOCATED IN AREAS OF LOW SEDIMENT YIELD ON SLOPES THAT CONFIRM TO M.T.O. DRAINAGE MANUAL VOLUME 2 "CHART F4-3C TOPOGRAPHIC FACTOR LS BASED ON SLOPE LENGTH AND GRADIENT"
4. SILTATION CONTROL FENCE SHALL BE INSTALLED WITH FILTER MEDIA FABRIC TOED INTO THE SOIL 300mm BE EITHER STATIC SLICING OR TRENCHING METHODS WITH COMPACTION OF TRENCH MATERIAL MEETING 95% S.P.D.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN
6. SILT / SEDIMENT CONTROL FENCE MAY BE UTILIZED FOR TREE PRESERVATION AND IS TO BE USED IN CONJUNCTION WITH BSD-1231, BSD-1232 AND BSD-1235

Barrie STANDARD DETAIL	SILTATION CONTROL FENCING	REV No. 1 / DATE: OCT 2017 / SCALE: N.T.S.	APPROVED DATE Oct 10/17 DIRECTOR OF ENGINEERING
		BSD-1233 FORMERLY BSD-23A	

KEY MAP
N.T.S.

LEGEND

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1.	2020 02 07	SITE PLAN APPLICATION	BWB

LICENSED PROFESSIONAL ENGINEER
Feb 7, 2020
B. W. BOLIVAR
100017673
PROVINCE OF ONTARIO

CHAYELL HOSPITALITY GROUP
220 BRADFORD STREET
CITY OF BARRIE

DETAILS

PROJECT NO.	3266	DRWG NO.	3266-DET4
DATE:	FEB. 2020	SCALE:	NTS
DRAWN:	NDK/BWB	CHECKED:	APPROVED:

SBA Skelton Brumwell & Associates Inc.
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