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Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

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SITE SERVICING & STORMWATER MANAGEMENT REPORT

1591 & 1611 MICHAEL STREET
OTTAWA, ONTARIO

REPORT NO. 22034

OCTOBER 17, 2023

CONTENTS

LIST OF APPENDICES

1.0 INTRODUCTION

This report has been prepared in support of the Site Plan Control application for the proposed 1-storey light industrial warehouse located at 1591 & 1611 Michael Street in Ottawa, Ontario. The property is currently vacant. Refer to Pre-Application Consultation meeting notes in Appendix A.

This report forms part of the site servicing and stormwater management design for the proposed development. Also refer to drawings C-1 to C-8 prepared by D.B. Gray Engineering Inc.

2.0 WATER SERVICING

2.1 WATER SUPPLY FOR FIREFIGHTING

The proposed building will have a sprinkler system with the fire department connection located south of the Deslaurier Custom Cabinets entrance. The closest existing municipal fire hydrant is located between 1591 Michael Street and 1601 Michael Street. It is 65 m unobstructed distance to the proposed building and ±130 m unobstructed distance to the proposed fire department connection, which is more than the maximum 45 m permitted by the Ontario Building Code; therefore, a private fire hydrant is required. A private fire hydrant is proposed to be located near the SE corner of 1601 Michael Street. It is 40 m unobstructed distance to the proposed fire department connection.

In accordance with City of Ottawa Technical Bulletin ISTB-2021-03, when calculating the required fire flow where pipe sizing is affected, the Fire Underwriters Survey Method is to be used. Using the Fire Underwriters Survey Method the required fire flow was calculated to be 11,000 L/min (183.3 L/s). Refer to calculations in Appendix B.

The boundary conditions in the 300 mm Michael Street municipal watermain provided by the City of Ottawa for the 183.3 L/s fire flow at the subject property indicate a hydraulic grade line (HGL) of 108.6 m. Refer to Appendix B. This HGL calculates to 369 kPa (53 psi). Since the pressure is above the Ontario Building Code's minimum required pressure of 140 kPa (20 psi), there is an adequate water supply for firefighting from the existing municipal water distribution system.

In accordance with City of Ottawa Technical Bulletin ISTB-2018-02, the aggregate flow of all contributing fire hydrants within 150 m of the building shall not be less than the required fire flow. In accordance with City of Ottawa Technical Bulletin ISTB-2018-02 Appendix I, Class AA fire hydrants within 75 m can contribute 5,700 L/min (95 L/s).

The proposed private Class AA fire hydrant serving the fire department connection discussed above can contribute 5,700 L/min (95 L/s). The existing municipal Class AA fire hydrant discussed above can also contribute 5,700 L/min (95 L/s). The aggregate flow of the two contributing fire hydrants is 11,400 L/min (190 L/s), which is greater than the required fire flow of 11,000 L/min (183.3 L/s).

2.2 DOMESTIC WATER SUPPLY

A 150 mm water service connecting to the 300 mm Michael Street municipal watermain is proposed to service the sprinkler system. The same 150 mm water service will provide an adequate domestic water supply.

In accordance with the City of Ottawa Water Design Guidelines for the consumption rate and peaking factors, the average daily demand was calculated to be 0.4 L/s, the maximum daily demand was calculated to be 0.6 L/s and the maximum hourly demand was calculated to be 1.0 L/s. Refer to calculations in Appendix B.

The boundary conditions in the 300 mm Michael Street municipal watermain provided by the City of Ottawa at the subject property indicate a minimum HGL of 110.1 m and a maximum HGL of 118.1 m. Refer to Appendix B. Based on these boundary conditions the pressure at the water meter is calculated to vary between 372 kPa (54 psi) and 451 kPa (65 psi). This is an acceptable range for the proposed development.

3.0 SANITARY SERVICING

In accordance with

i. the City of Ottawa Sewer Design Guidelines for the average daily flow and peaking factor, and
ii. City of Ottawa Technical Bulletin ISTB-2018-01 for the infiltration allowance,

the post-development sanitary flow rate was calculated to be 2.81 L/s. A 150 mm sanitary sewer service at 0.48% slope (10.55 L/s capacity) and 2% slope (21.54 L/s capacity) is proposed to service the development. At the design flow rate the sanitary sewer service will only be at up to 27% of its capacity. The proposed 150 mm sanitary sewer service will connect to the existing 250 mm Michael Street municipal sanitary sewer, which at 2.71% slope has a capacity of 97.90 L/s. Refer to calculations in Appendix C. The proposed development is expected to have an acceptable impact on the 250 mm Michael Street municipal sanitary sewer.

4.0 STORMWATER MANAGEMENT

4.1 QUALITY CONTROL

The Rideau Valley Conservation Authority has stated: *"Based on the information provided, we would require on-site water quality treatment of 'enhanced" (80% TSS Removal)."* Refer to Appendix D. As such, an oil grit separator (OGS) manhole is proposed. Calculations by the manufacturer indicate that the CDS PMSU2015-4 OGS will remove 82.3% of total suspended solids. Refer to calculations in Appendix D. The CDS PMSU2015-4 OGS has an oil capacity of 232 L and a grit capacity of 0.84 cu.m.

An Erosion & Sediment Control Plan has been developed to be implemented during construction. Refer to drawing C-4 and notes 4.1 to 4.9 on drawing C-5.

i. A silt fence barrier is to be installed along the perimeter of the site.
ii. Sediment capture filter sock inserts are to be installed in catch-basins.
iii. Any material deposited on the public road is to be removed.

4.2 QUANTITY CONTROL

The stormwater quantity control criterion is to control the post-development 100-year peak flow rate to the pre-development 100-year peak flow rate and the post-development 5-year peak flow rate to the pre-development 5-year peak flow rate using a calculated pre-development runoff coefficient not more than 0.5 and a calculated pre-development time of concentration not less than 10 minutes. It was

calculated that the pre-development conditions reflect a 5-year runoff coefficient of 0.40. The individual runoff coefficients were each increased by 25% to a maximum of 1.00 to calculate the pre-development conditions during the 100-year event. Using the Bransby Williams Formula the pre-development time of concentration was calculated to be 7 minutes. Using the Rational Method with a time of concentration of 10 minutes, the pre-development flow rates (maximum allowable release rates) were calculated to be 227.78 L/s during the 100-year event and 107.07 L/s during the 5-year event. The Rational and Modified Rational Methods were used to calculate the post-development flow rates and corresponding storage volumes. Refer to calculations in Appendix D.

Drainage Area I (Uncontrolled Flow Off Site)
The grading of the existing asphalt driveway in the SW corner of the property is to remain as is. It will continue to drain uncontrolled off site. The landscaping in the NW corner of the property will also drain uncontrolled off site. The flow rates are calculated at a time of concentration of 10 minutes.

	100-Year Event	5-Year Event
Maximum Flow Rate	27.70 L/s	14.46 L/s

Drainage Area II (Roof)
The 9 roof drains are to be flow control type roof drains which will restrict the flow of stormwater and cause it to pond on the roof. Each roof drain is to be installed with a single-parabolic slotted weir and release 0.01242 L/s/mm (5 USgpm/in). Roof drains are to be Watts with an Accutrol Weir RD-100-A1 or approved equivalent. The opening at the top of the flow control weir is to be a minimum 50 mm in diameter. A minimum of 13 scuppers each a minimum 850 mm wide are to be installed 150 mm above the roof drains. Refer to architectural for exact locations and details. The roof is to be designed to carry the load of water having a 50 mm depth at the scuppers (i.e. 200 mm depth at the roof drains). Refer to structural.

	100-Year Event	5-Year Event
Maximum Release Rate	15.76 L/s	12.16 L/s
Maximum Depth at Roof Drains	141 mm	109 mm
Maximum Volume Stored	154.69 cu.m	71.07 cu.m

Drainage Area III (Excluding 1601 Michael Street)
A private storm sewer system is proposed to drain to a cistern inside the building. A pump will control the flow of stormwater and cause it to fill up the cistern and backup into the upstream infrastructure and pond above CB-1, CB-2, CB/MH-3, CB/MH-4, CB-5, CB-6, CB/MH-7, CB-8, CB-9, CB-10, CB/MH-11, CB/MH-12, CB-13, CB/MH-14 and CB/MH-15. The pump size was selected by the mechanical engineer to be 30.00 L/s. Based on a pump on elevation of 67.54 m the minimum working capacity of the cistern was calculated to be 63.76 cu.m. Refer to mechanical, architectural and structural.

	100-Year Event	5-Year Event
Maximum Pump Release Rate	30.00 L/s	30.00 L/s
Maximum Water Elevation	70.85 m	69.38 m
Pump On Elevation	67.54 m	67.54 m
Maximum Volume Stored	174.79 cu.m	65.89 cu.m

Drainage Area III (Including 1601 Michael Street)
Approximately 2,105 sq.m of 1601 Michael Street currently drains on to 1591 & 1611 Michael Street and will continue to do so. Since the stormwater from 1601 Michael Street is not required to be controlled, some of it will overflow out the driveway to the right-of-way.

	100-Year Event	5-Year Event
Maximum Pump Release Rate	30.00 L/s	30.00 L/s
Maximum Overflow Release Rate	21.76 L/s	0.00 L/s
Total Maximum Release Rate	51.76 L/s	30.00 L/s
Maximum Water Elevation	70.85 m	70.30 m
Pump On Elevation	67.54 m	67.54 m
Maximum Volume Stored	174.79 cu.m	93.74 cu.m

Drainage Area IV
The loading bays will drain to a separate cistern inside the building. A pump will control the flow of stormwater and cause it to fill up the cistern. The pump size was selected by the mechanical engineer to be 20.00 L/s. Based on a pump on elevation of 67.54 m the minimum working capacity of the cistern was calculated to be 9.30 cu.m. Refer to mechanical, architectural and structural.

	100-Year Event	5-Year Event
Maximum Pump Release Rate	20.00 L/s	20.00 L/s
Maximum Water Elevation	69.98 m	67.54 m
Pump On Elevation	67.54 m	67.54 m
Maximum Volume Stored	9.30 cu.m	0.00 cu.m

Summary
The maximum post-development release rate during the 100-year event was calculated to be 59.98 L/s, which is 74% less than the maximum allowable release rate during the 100-year event. To achieve the maximum post-development release rate, a maximum storage volume of 368.35 cu.m is required and provided. The maximum post-development release rate during the 5-year event was calculated to be 45.66 L/s, which is 57% less than the maximum allowable release rate during the 5-year event. The post-development reduction in flow is expected to have a positive impact on the Michael Street municipal roadside ditch.

	100-Year Event	5-Year Event
Pre-Development Flow Rate	227.78 L/s	107.07 L/s
Maximum Allowable Release Rate	227.78 L/s	107.07 L/s
Maximum Release Rate	59.98 L/s	45.66 L/s
Maximum Volume Required	368.35 cu.m	153.64 cu.m
Maximum Volume Stored	368.35 cu.m	153.64 cu.m

4.3 STORM SERVICING

The peak restricted roof flow rate during the 100-year event was calculated to be 15.76 L/s. Refer to calculations in Appendix D. The rainwater leaders are to drain to the cistern.

A forcemain designed by the mechanical engineer is proposed to service the development. The forcemain will connect to MH-21 adjacent to the Michael Street municipal roadside ditch.

5.0 CONCLUSIONS

1. A private fire hydrant is required and provided.
2. There is an adequate water supply for firefighting from the existing municipal water distribution system.
3. There is an acceptable range of water pressures in the existing municipal water distribution system.
4. The post-development sanitary flow rate will be adequately handled by the proposed sanitary sewer service.
5. The proposed development is expected to have an acceptable impact on the existing municipal sanitary sewer.
6. The proposed OGS will achieve the Rideau Valley Conservation Authority's recommended water quality target.
7. An Erosion & Sediment Control Plan has been developed to be implemented during construction.
8. The maximum post-development release rates will be less than the maximum allowable release rates.

9. The post-development reduction in stormwater flow is expected to have a positive impact on the municipal roadside ditch.
10. The unrestricted flow rate during the 2-year event will be adequately handled by the proposed private storm sewer system.
11. The rainwater leaders inside the building are to be constructed to withstand the pressure from a water column the height of the rainwater leader. It is recommended pressure tests be performed on the systems in accordance with the mechanical engineer's instructions.
12. An Environmental Compliance Approval from the Ministry of the Environment, Conservation and Parks will be required.

Prepared by D.B. Gray Engineering Inc.

APPENDIX A

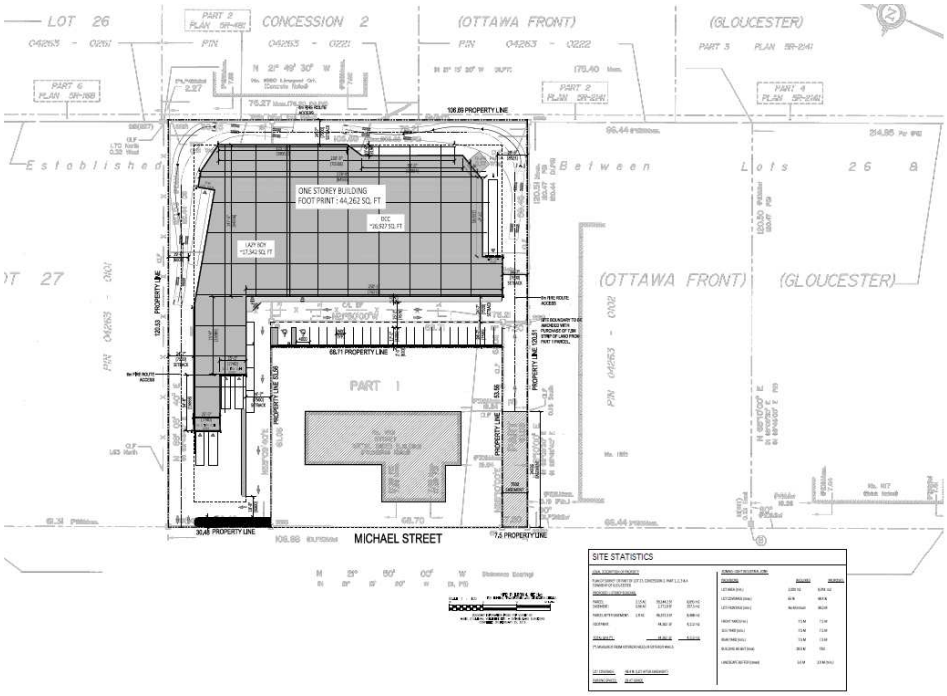
PRE-APPLICATION CONSULTATION MEETING NOTES

1591 & 1611 Michael Street
Meeting Summary Notes
March 9, 2022. Online Teams Meeting

Attendees:
- David Maxwell (La-Z-Boy Home Furnishings)
- Nicolas Caragianis (Nicholas Caragianis Architect Inc.)
- Jessica Penn (Nicholas Caragianis Architect Inc.)
- Lan Wang (Nicholas Caragianis Architect Inc.)
- Roberto
- Katie Morphet (File Lead, Panner, City of Ottawa)
- Eric Harold (Project Manager, City of Ottawa)
- Kelsey Charie (Project Manager, City of Ottawa)
- Patrick McMahon (Transportation Project Manager, City of Ottawa)
- Jeannette Krabicka (Parks, City of Ottawa)

Not in Attendance:
- Matthew Hayley (Environmental Planner, City of Ottawa)
- Mark Richardson (Forestry, City of Ottawa)
- RVCA

Issue of Discussion:
- Site Plan Control for a new 1-storey 44,262 sq.ft
- Development to be located on the existing vacant property.



1. **Official Plan -** designated “Urban Employment Area” in the current OP

   Warehouse and manufacturing is a permitted use

   Designated “Employment and Logistics” with an in the new OP

2. **Zoning Information**

   Zoned IL

   IL Zone permits warehouse and light industrial uses

3. **Infrastructure/Servicing – Eric Harold**

   1. The Servicing Study Guidelines for Development Applications are available at the following address:

      https://ottawa.ca/en/city-hall/planning-and-development/how-develop-property/development-application-review-process-2/guide-preparing-studies-and-plans

   2. Servicing and site works shall be in accordance with the following documents:
      - Ottawa Sewer Design Guidelines, Second Edition, (October 2012), including Technical Bulletins, ISDTB-2014-01, PIEDTB-2016-01, ISTB 2018-01, ISTB-2018-04, and ISTB-2019-02
      - Ottawa Design Guidelines – Water Distribution, First Edition, (July 2010), including Technical Bulletins ISD-2010-2, ISDTB-2014-02, ISTB-2018-02, and ISTB-2021-03
      - Geotechnical Investigation and Reporting Guidelines for Development Applications in the City of Ottawa (Revised 2008)
      - City of Ottawa Slope Stability Guidelines for Development Applications (Revised 2012)
      - City of Ottawa Environmental Noise Control Guidelines (January, 2016)
      - City of Ottawa Hydrogeological and Terrain Analysis Guidelines (March 2021)
      - City of Ottawa Park and Pathway Development Manual (2012)
      - City of Ottawa Accessibility Design Standards (2012)
      - Ottawa Standard Tender Documents (latest version)
      - Ontario Provincial Standards for Roads & Public Works (2013)

3. Record drawings and utility plans are also available for purchase from the City (Contact the City's Information Centre by email at InformationCentre@ottawa.ca or by phone at (613) 580-2424 x 44455
4. The Stormwater Management Criteria for the subject site is to be based on the following:
    - **This site is unique as there aren't any storm sewers fronting the property, and stormwater is managed via roadside ditches.**
    - For stormwater quantity control, the post-development release rate should be controlled to pre-development levels, using the pre-development runoff coefficient or an equivalent coefficient of 0.5, whichever is lesser.
    - The 2-yr storm or 5-yr storm event using the IDF information derived from the Meteorological Services of Canada rainfall data, taken from the MacDonald Cartier Airport, collected 1966 to 1997.
    - A calculated time of concentration (cannot be less than 10 minutes).
    - Please consult with the Rideau Valley Conservation Authority (RVCA) for stormwater quality control requirements for the subject site.

5. Deep Services:

Hydrants

Hydrant Laterals

Water Pipes
Public
Private

Valves
Valve
TVS, A, D

Trunk Sewers
Sanitary Pipe
Combined Pipe
Storm Pipe

Storm Manholes

Storm Inlets

i. *A plan view of the approximate services may be seen above. Services should ideally be grouped in a common trench to minimize the number of road cuts. The sizing of available future services is:*
    a. Connections (Michael Street):
        i. 305 mm dia. Watermain (CI)
        ii. 250 mm dia. SAN (Conc)

ii. *Provide existing servicing information and the recommended location for the proposed connections. Services should ideally be grouped in a common trench to minimize the number of road cuts.*

iii. *Provide information on the monitoring manhole requirements – should be located in an accessible location on private property near the property line (ie. Not in a parking area).*

iv. *Provide information on the type of connection permitted*

Sewer connections to be made above the springline of the sewermain as per:

a. Std Dwg S11.1 for flexible main sewers – *connections made using approved tee or wye fittings.*
b. Std Dwg S11 (For rigid main sewers) – *lateral must be less that 50% the diameter of the sewermain,*
c. Std Dwg S11.2 (for rigid main sewers using bell end insert method) – *for larger diameter laterals where manufactured inserts are not available; lateral must be less than 50% the diameter of the sewermain,*
d. Connections to manholes permitted when the connection is to rigid main sewers where the lateral exceeds 50% the diameter of the sewermain. – Connect obvert to obvert with the outlet pipe unless pipes are a similar size.
e. *No submerged outlet connections.*

v. *Please provide estimated sanitary flows with the first submission, to allow the City to confirm whether there are any downstream capacity constraints.*
vi. ***Please note that there is a fire hydrant, utility pole, and what appears to be a Bell utility manhole along the right of way at the north end of the property. Consideration will need to be given to these elements as well as the roadside ditches when designing the driveway, and an adequate setback must be provided.***

6. Civil consultant must request boundary conditions from the City's assigned Project Manager prior to first submission. Water Boundary condition requests must include the location of the service and the expected loads required by the proposed development. Please provide the following information:
   i. Location of service(s)
   ii. Type of development and the amount of fire flow required (as per FUS, 1999).
   iii. Average daily demand: ___ l/s.
   iv. Maximum daily demand: ___l/s.
   v. Maximum hourly daily demand: ___ l/s.
   vi. Hydrant location and spacing to meet City's Water Design guidelines.
   vii. Water supply redundancy will be required for more than 50 m3/day water demand.

Please note that a boundary condition request should be made to the City as early as possible, in order to identify any water supply constraints (if

any exist). Please also provide the estimated sanitary flows with the design, so the City can confirm that there aren't any capacity constraints downstream.

7. Phase 1 ESAs and Phase 2 ESAs must conform to clause 4.8.4 of the Official Plan that requires that development applications conform to Ontario Regulation 153/04.
8. All development applications should be considered for an Environmental Compliance Approval (ECA) by the Ministry of the Environment, Conservation, and Parks (MECP);
    a. The consultants determine if an approval for sewage works under Section 53 of OWRA is required and determines what type of application. The City's project manager may help confirm and coordinate with the MECP as required.
    b. The project will be either transfer of review (standard), transfer of review (additional), direct submission, or exempt as per O. Reg. 525/98.
    c. Pre-consultation is not required if applying for standard or additional works (Schedule A of the Agreement) under Transfer Review.
    d. Pre-consultation with local District office of MECP is recommended for direct submission.
    e. Consultant completes an MECP request form for a pre-consultation. Send request to moeccottawasewage@ontario.ca
    f. ECA applications are required to be submitted online through the MECP portal. A business account required to submit ECA application. For more information visit https://www.ontario.ca/page/environmental-compliance-approval

    NOTE: Site Plan Approval, or Draft Approval, is required before an application is sent to the MECP.
9. General Engineering Submission requirements:
    a. As per section 53 of the Professional Engineers Act, O. Reg 941/40, R.S.O. 1990, all documents prepared by engineers must be signed and dated on the seal.
    b. All required plans are to be submitted on standard A1 size sheets (594mm x 841mm) sheets, utilizing a reasonable and appropriate metric scale as per City of Ottawa Servicing and Grading Plan Requirements: title blocks are to be placed on the right of the sheets and not along the bottom. Engineering plans may be combined, but the Site Plans must be provided separately. Plans shall include the survey monument used

to confirm datum. Information shall be provided to enable a non-surveyor to locate the survey monument presented by the consultant.

c. All required plans & reports are to be provided in *.pdf format (at application submission and for any, and all, re-submissions)

Should you have any questions or require additional information, please contact me directly at (613) 580-2424, ext. 21447 or by email at eric.harrold@ottawa.ca.

4. Initial Planning Comments – Katie Morphet

- Please updated zoning table on site plan to identify all required zone and applicable general provisions and that they are being met.
- A Survey Plan will be required to clarify property boundaries and lot ownership.
- A Planning brief outlines how the proposed plan meets the current and new Official Plan policies will be required.
- Additional landscaping onsite where possible is recommended. There may be opportunities to add additional landscaping between some of the parking spaces.
- As there is a bus route along Michael Street delineation of a pedestrian pathway to the building is recommended.

5. Urban Design (Christopher Moise)

- This proposal does not run along or does not meet the threshold in one of the City's Design Priority Areas and need not attend the City's UDRP. Staff will be responsible for evaluating the proposal and providing design direction.
- **Pedestrian safety**: We recommend a safe and clear path of travel be provided from and to the street to accommodate visitors/employees who travel by alternate modes of transportation.
- **Landscaping**: We recommend additional opportunities for landscaping be provided within the visitors/vehicular parking area in front of the entrances to the buildings;
    - We recommend the small area of landscaping provided at the public street include additional plantings of trees/bushes;
- Drawings: We recommend the elevations be provided for review when the application is submitted. No massing or additional drawings are necessary;

- A scoped Design Brief is a required submittal for all Site Plan/Re-zoning applications and can be combined with the Planning Rationale. Please see the Design Brief Terms of Reference provided.
    - ***Note. The Design Brief submittal should have a section which addresses these pre-consultation comments;***

This is an exciting project in an area full of potential. We look forward to helping you achieve its goals with the highest level of design resolution. We are happy to assist and answer any questions regarding the above. Good luck.

6. Parks – Jeanette Krabicka

Please see the attached comments.

7. Trees - Mark Richardson

1) a tree permit is required prior to any tree removal on site
2) they will need to submit a TCR with their application
3) you will send them our TCR requirements and you will also include tree planting specifications for the Landscape Plan

TCR requirements:

1. a Tree Conservation Report (TCR) must be supplied for review along with the suite of other plans/reports required by the City
    a. an approved TCR is a requirement of Site Plan approval.
    b. The TCR may be combined with the LP provided all information is supplied
2. Any removal of privately-owned trees 10cm or larger in diameter, or city-owned trees of any diameter requires a tree permit issued under the Tree Protection Bylaw (Bylaw 2020 – 340); the permit will be based on an approved TCR and made available at or near plan approval.
3. The Planning Forester from Planning and Growth Management as well as foresters from Forestry Services will review the submitted TCR
    a. If tree removal is required, both municipal and privately-owned trees will be addressed in a single permit issued through the Planning Forester
    b. Compensation may be required for city owned trees – if so, it will need to be paid prior to the release of the tree permit
4. the TCR must list all trees on site, as well as off-site trees if the CRZ extends into the developed area, by species, diameter and health condition
5. please identify trees by ownership – private onsite, private on adjoining site, city owned, co-owned (trees on a property line)
6. If trees are to be removed, the TCR must clearly show where they are, and document the reason they cannot be retained

7. All retained trees must be shown, and all retained trees within the area impacted by the development process must be protected as per City guidelines available at Tree Protection Specification or by searching Ottawa.ca
    a. the location of tree protection fencing must be shown on the plan
    b. show the critical root zone of the retained trees
    c. if excavation will occur within the critical root zone, please show the limits of excavation
8. the City encourages the retention of healthy trees; if possible, please seek opportunities for retention of trees that will contribute to the design/function of the site.
9. For more information on the process or help with tree retention options, contact Mark Richardson mark.richardson@ottawa.ca or on City of Ottawa

LP tree planting requirements:

For additional information on the following please contact tracy.smith@Ottawa.ca

Minimum Setbacks

- Maintain 1.5m from sidewalk or MUP/cycle track.
- Maintain 2.5m from curb
- Coniferous species require a minimum 4.5m setback from curb, sidewalk or MUP/cycle track/pathway.
- Maintain 7.5m between large growing trees, and 4m between small growing trees. Park or open space planting should consider 10m spacing, except where otherwise approved in naturalization / afforestation areas. Adhere to Ottawa Hydro's planting guidelines (species and setbacks) when planting around overhead primary conductors.

Tree specifications

- Minimum stock size: 50mm tree caliper for deciduous, 200cm height for coniferous.
- Maximize the use of large deciduous species wherever possible to maximize future canopy coverage
- Tree planting on city property shall be in accordance with the City of Ottawa's Tree Planting Specification; and include watering and warranty as described in the specification (can be provided by Forestry Services).
- Plant native trees whenever possible
- No root barriers, dead-man anchor systems, or planters are permitted.
- No tree stakes unless necessary (and only 1 on the prevailing winds side of the tree)

Hard surface planting

- Curb style planter is highly recommended
- No grates are to be used and if guards are required, City of Ottawa standard (which can be provided) shall be used.
- Trees are to be planted at grade

Soil Volume

- Please ensure adequate soil volumes are met:

Tree Type/Size	Single Tree Soil Volume (m3)	Multiple Tree Soil Volume (m3/tree)
Ornamental	15	9
Columnar	15	9
Small	20	12
Medium	25	15
Large	30	18
Conifer	25	15

Please note that these soil volumes are not applicable in cases with Sensitive Marine Clay.

Sensitive Marine Clay

- Please follow the City's 2017 Tree Planting in Sensitive Marine Clay guidelines

Tree Canopy Cover

- The landscape plan shall show how the proposed tree planting will replace and increase canopy cover on the site over time, to support the City's 40% urban forest canopy cover target.
- At a site level, efforts shall be made to provide as much canopy cover as possible, through tree planting and tree retention, with an aim of 40% canopy cover at 40 years, as appropriate.
- Indicate on the plan the projected future canopy cover at 40 years for the site.

8. Environment – Matthew Hayley

- Please add features that reduce the urban heat island effect (see OP 10.3.3) produced by the parking lot and a building footprint. For example, this impact can be reduced by adding large canopy trees, green roofs or vegetation walls, or constructing the parking lot or building differently (e.g., using lighter coloured materials).

- Please reach out to RVCA directly to ensure their submission requirements if any.

9. Transportation – Patrick McMahon

- Neither a Transportation Impact Assessment nor noise study are required.
- On site plan:

    - Show all details of the roads abutting the site up to and including the opposite curb; include such items as pavement markings, accesses and/or sidewalks.
    - Turning templates will be required for all accesses showing the largest vehicle to access the site; required for internal movements and at all access (entering and exiting and going in both directions).
    - Show lane/aisle widths including the proposed offset to both neighbouring property lines on the east access.
- Consider how pedestrians/transit users will enter the site and provide a connection for those users.
- Michael Street is a local cycling route. Providing sheltered and/or secured bicycle parking spaces to make cycling more attractive to employees is encouraged.

10. General Information

a. Ensure that all plans and studies are prepared as per City guidelines – as available online…
   https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans

APPENDIX B

WATER SERVICING

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle
Ottawa, Ontario K1T 4E9

613-425-8044
d.gray@dbgrayengineering.com

August 24, 2022

1591 & 1611 Michael Street

1-Storey Light Industrial Warehouse

Ottawa, Ontario

FIRE FLOW CALCULATIONS

FUS Method

F = Required fire flow in litres per minutes
= $220CA^{0.5}$

C = Coefficient related to the type of construction
= 0.8 Noncombustible Construction

A = Total floor area in square meters (excluding basements at least 50% below grade)
= 3,893 sq.m

F = 10,981 L/min
= 11,000 L/min (rounded to nearest 1,000 L/min)

15% Charge for Free Burning Occupancy

= 12,650 L/min

30% Credit for sprinkler system designed as per NFPA 13
10% Credit for standard water supply for both sprinkler system and fire department hose lines

= 5,060 L/min

Side	Charge	Separation	Construction	Length	Storeys	Length • Height
North	0%	over 45 m				
East	13%	10.1 to 20 m	Noncombustible	46	1	46
South	8%	20.1 to 30 m	Noncombustible	45	1	45
West	5%	30.1 to 45 m				

	26%	Total Exposure Charge
=	3,289	L/min Exposure Increase
=	10,879	L/min
=	11,000	L/min (rounded to nearest 1,000 L/min)
=	183.3	L/s

183.3 L/s Fire Flow:	108.6	m				
Elevation at Fire Hydrant:	71.0	m				
Static Pressure at Fire Hydrant:	37.6	m	369	kPa	53	psi

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle
Ottawa, Ontario K1T 4E9

613-425-8044
d.gray@dbgrayengineering.com

August 24, 2022

1591 & 1611 Michael Street

1-Storey Light Industrial Warehouse

Ottawa, Ontario

WATER DEMAND CALCULATIONS

Average Daily Demand:	0.9177	ha				
	35,000	L/ha/day				
	32,120	L/day				
	24	hour day				
	22.3	L/min	0.4	L/s	5.9	USgpm
Maximum Daily Demand:	1.5	(Peaking factor as per City of Ottawa Water Design Guidelines)				
	33.5	L/min	0.6	L/s	8.8	USgpm
Maximum Hourly Demand:	1.8	(Peaking factor as per City of Ottawa Water Design Guidelines)				
	60.2	L/min	1.0	L/s	15.9	USgpm

Elevation of Water Meter:	72.15	m				
Finished Floor Elevation:	71.25	m				
Minimum HGL:	110.1	m				
Static Pressure at Water Meter:	38.0	m	372	kPa	54	psi
Maximum HGL:	118.1	m				
Static Pressure at Water Meter:	46.0	m	451	kPa	65	psi

D.B. Gray Engineering Inc.

Ryan Faith <r.faith@dbgrayengineering.com>

RE: Request for Boundary Conditions - 1591 & 1611 Michael Street

1 message

Harrold, Eric <eric.harrold@ottawa.ca> Wed, Aug 24, 2022 at 9:39 AM
To: Ryan Faith <r.faith@dbgrayengineering.com>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>, "Charie, Kelsey" <kelsey.charie@ottawa.ca>

Hi Ryan,

The following are boundary conditions, HGL, for hydraulic analysis at 1591 Michael Street (zone 1E) assumed to be a dual connection to the 305 mm watermain on Michael Street (see attached PDF for location).

Min HGL: 110.1 m

Max HGL: 118.1 m

Max Day + Fire Flow (266.7 L/s): 104.0 m

Max Day + Fire Flow (183.3 L/s): 108.6 m

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

Best,

Eric Harrold, P.Eng

Project Manager, Infrastructure Approvals

Planning, Real Estate and Economic Development Department

City of Ottawa | Ville d'Ottawa

110 Laurier Avenue West, Ottawa, ON

613.580.2424 ext. 21447, eric.harrold@ottawa.ca

*** OUT OF OFFICE NOTICE – Please note that I will be out of office from September 16th through 28th, inclusive ***

From: Ryan Faith <r.faith@dbgrayengineering.com>
Sent: August 10, 2022 12:41 PM
To: Harrold, Eric <eric.harrold@ottawa.ca>; Charie, Kelsey <kelsey.charie@ottawa.ca>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>
Subject: Request for Boundary Conditions - 1591 & 1611 Michael Street

Hi Eric & Kelsey,

Please provide the boundary conditions for the 300 mm Michael Street municipal watermain at 1591 Michael Street. We have calculated the following expected demands:

Average daily demand: 1.1 L/s
Maximum daily demand: 1.7 L/s
Maximum hourly demand: 3.0 L/s
Fire flow demand: 266.7 L/s
Fire flow + maximum daily demand: 268.4 L/s

We are looking at alternative designs so please also provide the boundary conditions for the following expected demands:

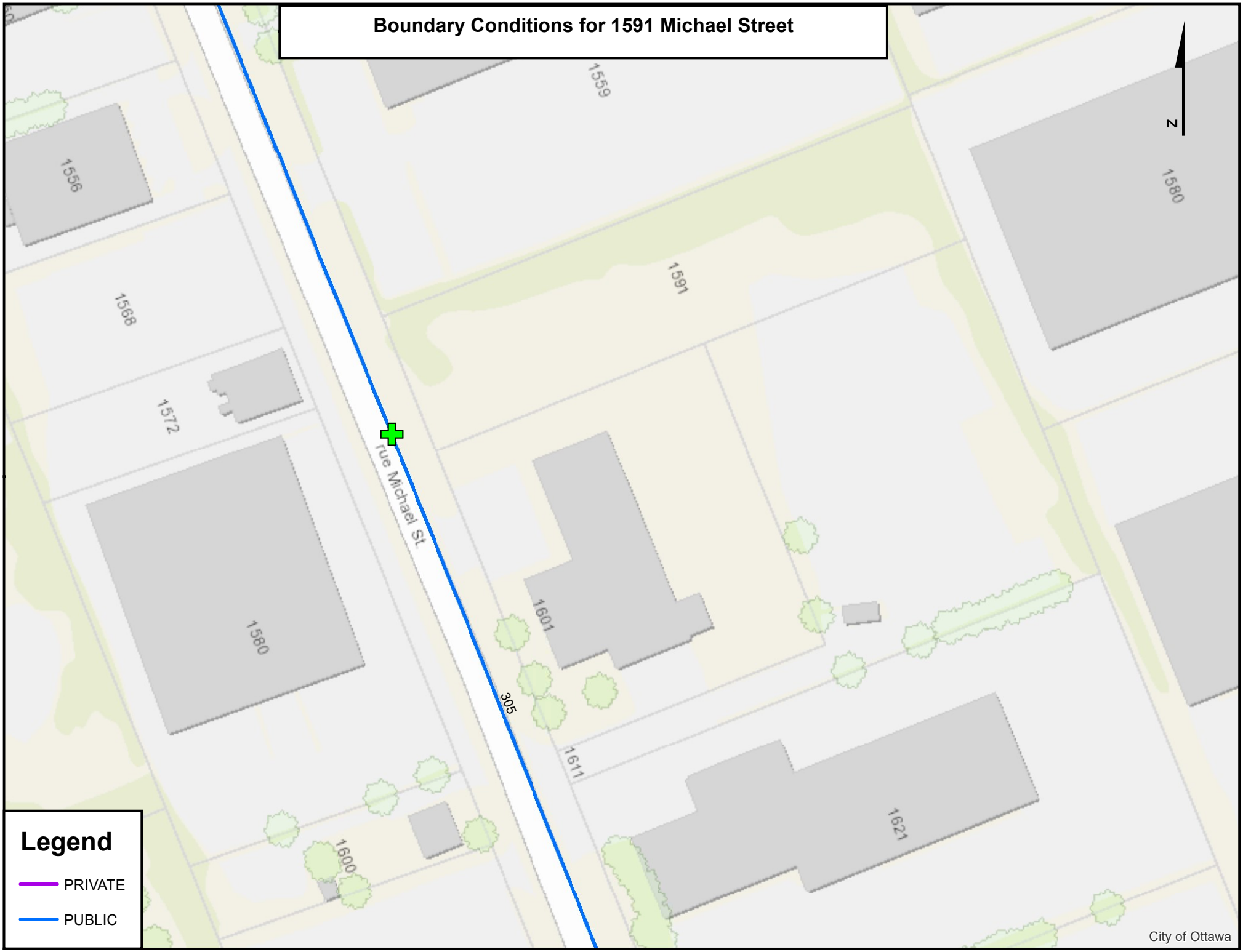
Average daily demand: 1.1 L/s
Maximum daily demand: 1.7 L/s
Maximum hourly demand: 3.0 L/s
Fire flow demand: 183.3 L/s
Fire flow + maximum daily demand: 185.0 L/s

Calculations are attached.

Thanks,

'

1591 Michael Street August 2022.pdf
756K


Boundary Conditions for 1591 Michael Street
N
1559
1556
1580
1568
1591
1572
rue Michael St
1580
1601
305
1611
1621
1600
Legend
PRIVATE
PUBLIC
City of Ottawa

APPENDIX C

SANITARY SERVICING

SANITARY SEWER CALCULATIONS

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle
Ottawa, Ontario K1T 4E9

613-425-8044
d.gray@dbgrayengineering.com

Project: 1591 & 1611 Michael Street
1-Storey Light Industrial Warehouse
Ottawa, Ontario

Date: February 8, 2023

Location		Light Industrial				Infiltration	Q	Sewer Data						
		Individual	Cumulative			Cumulative	Total		Nominal	Actual			Q_{Full}	
From	To	Area (ha)	Area (ha)	Peaking Factor	Flow Rate (L/s)	Flow Rate (L/s)	Flow Rate (L/s)	Length (m)	Diameter (mm)	Diameter (mm)	Slope (%)	Velocity (m/s)	Capacity (L/s)	Q / Q_{Full}
Proposed Building	MH-SA.1	0.9177	0.9177	6.75	2.51	0.30	2.81	2.1	150	150	2	1.22	21.54	13%
MH-SA.1	MH-SA.2		0.9177	6.75	2.51	0.30	2.81	30.3	150	150	2	1.22	21.54	13%
MH-SA.2	MH-SA.3		0.9177	6.75	2.51	0.30	2.81	15.9	150	150	0.48	0.60	10.55	27%
MH-SA.3	SAN MH.A		0.9177	6.75	2.51	0.30	2.81	11.8	150	150	0.48	0.60	10.55	27%
							Existing 250 mm Michael Street Municipal Sanitary Sewer:		250	250	2.71	1.99	97.90	

Commercial Average Daily Flow:	28,000	L/ha/day
Commercial Peaking Factor:	1.5	
Institutional Average Daily Flow:	28,000	L/ha/day
Institutional Peaking Factor:	1.5	
Light Industrial Average Daily Flow:	35,000	L/ha/day
Heavy Industrial Average Daily Flow:	55,000	L/ha/day
Industrial Peaking Factor:	6.75	
Infiltration Allowance:	0.33	L/s/ha
Manning's Roughness Coefficient:	0.013	

APPENDIX D

STORMWATER MANAGEMENT

D.B. Gray Engineering Inc.

Ryan Faith <r.faith@dbgrayengineering.com>

RE: RVCA Stormwater Management Comments - 1591 & 1611 Michael Street

1 message

Jamie Batchelor <jamie.batchelor@rvca.ca> Thu, Sep 22, 2022 at 8:58 AM
To: Ryan Faith <r.faith@dbgrayengineering.com>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>

Good Morning Ryan,

Based on the information provided, we would require on-site water quality treatment of 'enhanced" (80% TSS Removal).

Jamie Batchelor, MCIP, RPP

Planner, ext. 1191

Jamie.batchelor@rvca.ca

Rideau Valley Conservation Authority

3889 Rideau Valley Drive
PO Box 599, Manotick ON K4M 1A5
T 613-692-3571 | 1-800-267-3504 **F** 613-692-0831 | www.rvca.ca

From: Ryan Faith <r.faith@dbgrayengineering.com>
Sent: Thursday, September 22, 2022 8:15 AM
To: Jamie Batchelor <jamie.batchelor@rvca.ca>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>
Subject: Re: RVCA Stormwater Management Comments - 1591 & 1611 Michael Street

Hi Jamie,

Following up on my previous email.

Thanks,

Ryan Faith

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle 613-425-8044
Ottawa, Ontario r.faith@dbgrayengineering.com

On Wed, Aug 24, 2022 at 1:30 PM Ryan Faith <r.faith@dbgrayengineering.com> wrote:

> Hi Jamie,
>
> The property currently sheet drains north to the rear of the property. We intend to drain the majority of the property to the roadside ditch where it appears to drain NW.
>
> Regards,

Ryan Faith

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle 613-425-8044
Ottawa, Ontario r.faith@dbgrayengineering.com

On Wed, Aug 24, 2022 at 9:29 AM Jamie Batchelor <jamie.batchelor@rvca.ca> wrote:

> Good Morning Ryan,
>
> I see that storm sewers are not available fronting Michael Street. Where will the storm water be directed from this site? Where will it end up ultimately?

Jamie Batchelor, MCIP, RPP

Planner, ext. 1191

Jamie.batchelor@rvca.ca

Rideau Valley Conservation Authority

3889 Rideau Valley Drive
PO Box 599, Manotick ON K4M 1A5
T 613-692-3571 | 1-800-267-3504 **F** 613-692-0831 | www.rvca.ca

> **From:** Ryan Faith <r.faith@dbgrayengineering.com>
> **Sent:** Wednesday, August 24, 2022 8:52 AM
> **To:** Jamie Batchelor <jamie.batchelor@rvca.ca>
> **Cc:** Douglas Gray <d.gray@dbgrayengineering.com>
> **Subject:** RVCA Stormwater Management Comments - 1591 & 1611 Michael Street
>
> Hi Jamie,

We are working on a proposed 1 storey light industrial building located at 1591 & 1611 Michael Street in Ottawa.

Please comment on the stormwater management for the site.

I have attached a site plan for your reference.

Thanks,

Ryan Faith

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle 613-425-8044
Ottawa, Ontario r.faith@dbgrayengineering.com

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A FINE PARTICLE SIZE DISTRIBUTION

Project Name:	1591 & 1611 Michael St	**Engineer:**	**D.B. Gray Engineering Inc.**
Location:	Ottawa, ON	**Contact:**	R. Faith
OGS #:	OGS	**Report Date:**	7-Feb-23

Area	0.459	ha	**Rainfall Station #**	215	
Weighted C	0.9		**Particle Size Distribution**	FINE	
CDS Model	2015		**CDS Treatment Capacity**	20	l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	9.2%	9.2%	0.6	0.6	2.9	98.0	9.0
1.0	10.6%	19.8%	1.1	1.1	5.8	97.2	10.3
1.5	9.9%	29.7%	1.7	1.7	8.7	96.4	9.5
2.0	8.4%	38.1%	2.3	2.3	11.6	95.5	8.0
2.5	7.7%	45.8%	2.9	2.9	14.5	94.7	7.3
3.0	5.9%	51.7%	3.4	3.4	17.4	93.9	5.6
3.5	4.4%	56.1%	4.0	4.0	20.3	93.0	4.1
4.0	4.7%	60.7%	4.6	4.6	23.2	92.2	4.3
4.5	3.3%	64.0%	5.2	5.2	26.1	91.4	3.0
5.0	3.0%	67.1%	5.7	5.7	29.0	90.6	2.7
6.0	5.4%	72.4%	6.9	6.9	34.8	88.9	4.8
7.0	4.4%	76.8%	8.0	8.0	40.6	87.2	3.8
8.0	3.5%	80.3%	9.2	9.2	46.3	85.6	3.0
9.0	2.8%	83.2%	10.3	10.3	52.1	83.9	2.4
10.0	2.2%	85.3%	11.5	11.5	57.9	82.3	1.8
15.0	7.0%	92.3%	17.2	17.2	86.9	73.9	5.2
20.0	4.5%	96.9%	23.0	19.8	100.0	60.6	2.8
25.0	1.4%	98.3%	28.7	19.8	100.0	48.5	0.7
30.0	0.7%	99.0%	34.5	19.8	100.0	40.4	0.3
35.0	0.5%	99.5%	40.2	19.8	100.0	34.6	0.2
40.0	0.5%	100.0%	45.9	19.8	100.0	30.3	0.2
45.0	0.0%	100.0%	51.7	19.8	100.0	26.9	0.0
50.0	0.0%	100.0%	57.4	19.8	100.0	24.2	0.0
							88.8

Removal Efficiency Adjustment[2] = 6.5%

Predicted Net Annual Load Removal Efficiency = 82.3%

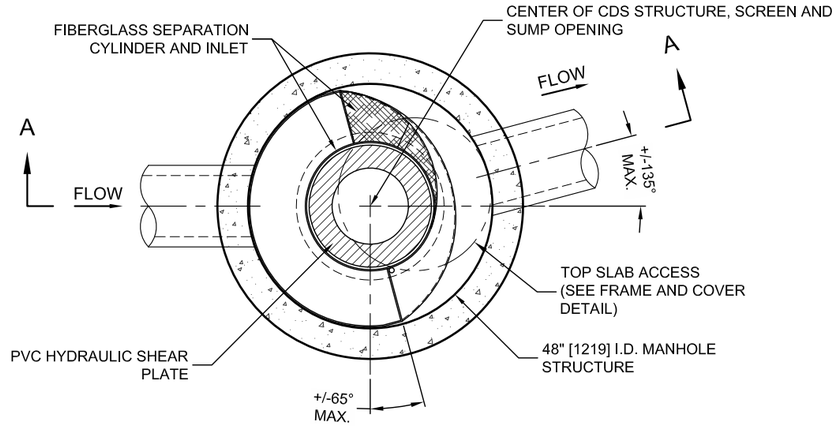
Predicted % Annual Rainfall Treated = 98.1%

1 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa ON

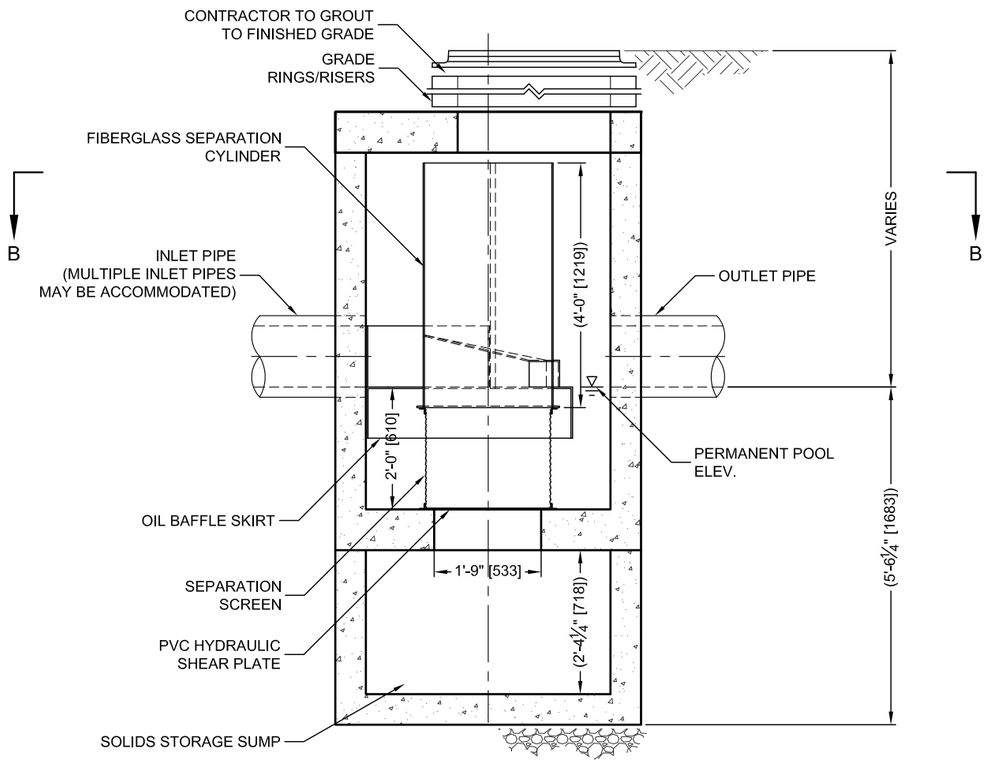
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

3 - CDS Efficiency based on testing conducted at the University of Central Florida

4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications



PLAN VIEW B-B
N.T.S.



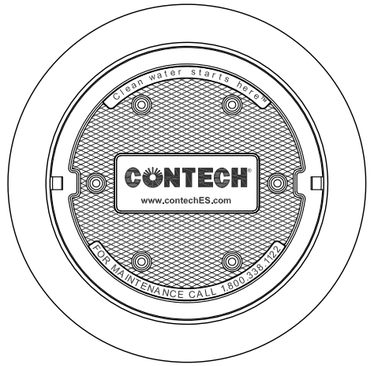
ELEVATION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 8,511,500; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS PMSU2015-4-C DESIGN NOTES

THE STANDARD CDS PMSU2015-4-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
CUSTOMIZABLE SUMP DEPTH AVAILABLE
ANTI-FLOTATION DESIGN AVAILABLE UPON REQUEST



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (CFS OR L/s)	*
PEAK FLOW RATE (CFS OR L/s)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*
SCREEN APERTURE (2400 OR 4700)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

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 CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS PMSU2015-4-C INLINE CDS STANDARD DETAIL

SUMMARY TABLES

100-YEAR EVENT					
Drainage Area	Pre-Development Flow Rate (L/s)	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	-	27.70	-	-
AREA II (Roof)	-	-	15.76	154.69	154.69
AREA III (Excluding 1601 Michael Street)	-	-	30.00	174.79	174.79
AREA IV	-	-	20.00	9.30	9.30
TOTAL (AREA I + AREA III + AREA IV)	227.78	227.78	77.70	338.77	338.77

5-YEAR EVENT					
Drainage Area	Pre-Development Flow Rate (L/s)	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	-	14.46	-	-
AREA II (Roof)	-	-	12.16	71.07	71.07
AREA III (Excluding 1601 Michael Street)	-	-	30.00	65.89	65.89
AREA IV	-	-	20.00	0.00	0.00
TOTAL (AREA I + AREA III + AREA IV)	107.07	107.07	64.46	136.96	136.96

October 17, 2023

1591 & 1611 Michael Street

Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS

Modified Rational Method

100-YEAR EVENT

DRAINAGE AREA A (1591 & 1611 Michael Street)

(100-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Hard Area:	255	sq.m	1.00
Gravel Area:	3,365	sq.m	0.875
Soft Area:	5,557	sq.m	0.25
Total Catchment Area:	9,177	sq.m	0.50

Bransby Williams Formula

$$Tc = \frac{0.057 \bullet L}{Sw^{0.2} \bullet A^{0.1}} min$$

Sheet Flow Distance (L):	125	m
Slope of Land (Sw):	1	%
Area (A):	0.9177	ha
Time of Concentration (Sheet Flow):	7	min
Area (A):	9,177	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
Runoff Coeficient (C):	0.50	
100-Year Pre-Development Flow Rate (2.78AiC):	227.78	L/s

DRAINAGE AREA B (1601 Michael Street)

(100-YEAR EVENT)

			C
Roof Area:	735	sq.m	1.00
Hard Area:	0	sq.m	1.00
Gravel Area:	130	sq.m	0.875
Soft Area:	1,240	sq.m	0.25
Total Catchment Area:	2,105	sq.m	0.55

Area (A):	2,105	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
Runoff Coeficient (C):	0.55	
100-Year Pre-Development Flow Rate (2.78AiC):	57.52	L/s

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(100-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Hard Area:	528	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Soft Area:	120	sq.m	0.25
Total Catchment Area:	648	sq.m	0.86
Area (A):	648	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	179	mm/hr	
Runoff Coeficient (C):	0.86		
Flow Rate (2.78AiC):	27.70	L/s	

DRAINAGE AREA II (Roof)

(100-YEAR EVENT)

			C
Total Catchment Area:	3,779	sq.m	1.00

No. of Roof Drains:	9	
Slots per Wier:	1	0.01242 L/s/mm/slot (5 USgpm/in/slot)
Depth at Roof Drains:	141	mm
Maximum Release Rate:	15.76	L/s

Pond Area:	3,291	sq.m
Maximum Volume Stored:	154.69	cu.m
Maximum Volume Required:	154.69	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	187.59	15.76	171.83	103.10
15	143	150.12	15.76	134.36	120.92
20	120	126.02	15.76	110.25	132.30
25	104	109.10	15.76	93.34	140.00
30	92	96.51	15.76	80.75	145.35
35	83	86.75	15.76	70.99	149.08
40	75	78.94	15.76	63.18	151.64
45	69	72.54	15.76	56.78	153.31
50	64	67.19	15.76	51.43	154.28
55	60	62.64	15.76	46.88	154.69
60	56	58.72	15.76	42.96	154.65
65	53	55.31	15.76	39.55	154.23
70	50	52.31	15.76	36.54	153.49
75	47	49.64	15.76	33.88	152.47
80	45	47.27	15.76	31.50	151.22
85	43	45.13	15.76	29.36	149.75
90	41	43.19	15.76	27.43	148.11
95	39	41.43	15.76	25.67	146.30
100	38	39.82	15.76	24.06	144.34
105	36	38.34	15.76	22.58	142.26
110	35	36.98	15.76	21.22	140.05
115	34	35.72	15.76	19.96	137.74
120	33	34.56	15.76	18.80	135.33
125	32	33.47	15.76	17.71	132.83
130	31	32.46	15.76	16.70	130.25
135	30	31.51	15.76	15.75	127.59
140	29	30.63	15.76	14.86	124.86
145	28	29.79	15.76	14.03	122.06
150	28	29.01	15.76	13.24	119.20
180	24	25.11	15.76	9.35	100.97
210	21	22.21	15.76	6.45	81.29
240	19	19.97	15.76	4.20	60.55
270	17	18.17	15.76	2.41	38.99
300	16	16.69	15.76	0.93	16.79

DRAINAGE AREA III (Excluding 1601 Michael Street)

(100-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Hard Area:	4,035	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Soft Area:	0	sq.m	0.25
Total Catchment Area:	4,035	sq.m	1.00

Water Elevation:	70.85	m
Pump On Elevation:	67.54	m
Maximum Pump Release Rate:	30.00	L/s

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	170	0.15	8.50	cu.m
CB-2	115	0.12	4.60	cu.m
CB/MH-3	231	0.18	13.86	cu.m
CB/MH-4	46	0.08	1.23	cu.m
CB-5	116.5	0.13	5.05	cu.m
CB-6	28	0.07	0.65	cu.m
CB/MH-7	127	0.13	5.50	cu.m
CB-8	38	0.15	1.90	cu.m
CB-9	66	0.15	3.30	cu.m
CB-10	53	0.15	2.65	cu.m
CB/MH-11	46	0.15	2.30	cu.m
CB/MH-12	66	0.15	3.30	cu.m
CB-13	85	0.11	3.12	cu.m
CB/MH-14	113.5	0.09	3.41	cu.m
CB/MH-15	104.5	0.14	4.88	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	68.30	0.61	0.95	cu.m
CB-2	68.17	0.61	1.00	cu.m
CB/MH-3	68.42	1.219	2.84	cu.m
CB/MH-4	68.08	1.219	3.23	cu.m
CB-5	67.91	0.61	1.09	cu.m
CB-6	67.83	0.61	1.12	cu.m
CB/MH-7	67.99	1.219	3.34	cu.m
CB-8	68.40	0.61	0.91	cu.m
CB-9	68.33	0.61	0.94	cu.m
CB-10	68.28	0.61	0.96	cu.m
CB/MH-11	68.38	1.219	2.88	cu.m
CB/MH-12	68.21	1.219	3.08	cu.m
CB-13	67.72	0.61	1.16	cu.m
CB/MH-14	67.74	1.219	3.63	cu.m
CB/MH-15	67.59	1.219	3.80	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB/MH-3	68.42	CB/MH-4	68.08	77	250	3.78	cu.m
CB/MH-4	68.08	CB/MH-7	67.99	19.4	250	0.95	cu.m
CB/MH-7	67.99	CB/MH-15	67.72	61.7	250	3.03	cu.m
CB/MH-11	68.38	CB/MH-12	68.21	48.1	300	3.40	cu.m
CB/MH-12	68.21	CB/MH-14	68.13	22.7	300	1.60	cu.m
CB/MH-14	67.74	CB/MH-15	67.59	43.6	300	3.08	cu.m

Cistern Storage

Inside Length	Inside Width	Depth	Volume	
4.39	4.39	3.31	63.76	cu.m

Maximum Volume Stored:	174.79	cu.m
Maximum Volume Required:	174.79	cu.m

DRAINAGE AREA III (Continued)

(100-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Roof Inflow (L/s)	Total Inflow (L/s)	Pump Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	200.30	15.76	216.06	30.00	186.06	111.63
15	143	160.29	15.76	176.05	30.00	146.05	131.45
20	120	134.55	15.76	150.31	30.00	120.31	144.38
25	104	116.49	15.76	132.25	30.00	102.25	153.38
30	92	103.05	15.76	118.81	30.00	88.81	159.86
35	83	92.63	15.76	108.39	30.00	78.39	164.63
40	75	84.29	15.76	100.05	30.00	70.05	168.13
45	69	77.46	15.76	93.22	30.00	63.22	170.69
50	64	71.74	15.76	87.50	30.00	57.50	172.50
55	60	66.88	15.76	82.64	30.00	52.64	173.72
60	56	62.70	15.76	78.46	30.00	48.46	174.46
65	53	59.06	15.76	74.82	30.00	44.82	174.79
70	50	55.85	15.76	71.61	30.00	41.61	174.77
75	47	53.01	15.76	68.77	30.00	38.77	174.47
80	45	50.47	15.76	66.23	30.00	36.23	173.90
85	43	48.18	15.76	63.94	30.00	33.94	173.12
90	41	46.12	15.76	61.88	30.00	31.88	172.14
95	39	44.24	15.76	60.00	30.00	30.00	170.98
100	38	42.52	15.76	58.28	30.00	28.28	169.67
105	36	40.94	15.76	56.70	30.00	26.70	168.22
110	35	39.49	15.76	55.25	30.00	25.25	166.65
115	34	38.14	15.76	53.91	30.00	23.91	164.96
120	33	36.90	15.76	52.66	30.00	22.66	163.16
125	32	35.74	15.76	51.50	30.00	21.50	161.27
130	31	34.66	15.76	50.42	30.00	20.42	159.29
135	30	33.65	15.76	49.41	30.00	19.41	157.23
140	29	32.70	15.76	48.46	30.00	18.46	155.09
145	28	31.81	15.76	47.57	30.00	17.57	152.88
150	28	30.97	15.76	46.73	30.00	16.73	150.60
180	24	26.81	15.76	42.57	30.00	12.57	135.80
210	21	23.72	15.76	39.48	30.00	9.48	119.45
240	19	21.32	15.76	37.08	30.00	7.08	101.97
270	17	19.40	15.76	35.16	30.00	5.16	83.62
300	16	17.83	15.76	33.59	30.00	3.59	64.58

DRAINAGE AREA III (Including 1601 Michael Street)

(100-YEAR EVENT)

			C
Roof Area:	735	sq.m	1.00
Hard Area:	4,035	sq.m	1.00
Gravel Area:	130	sq.m	0.875
Soft Area:	1,240	sq.m	0.25
Total Catchment Area:	6,140	sq.m	0.85

Water Elevation:	70.85	m
Pump On Elevation:	67.54	m
Maximum Pump Release Rate:	30.00	L/s
Maximum Overflow Release Rate:	21.76	L/s
Total Maximum Release Rate:	51.76	

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	170	0.15	8.50	cu.m
CB-2	115	0.12	4.60	cu.m
CB/MH-3	231	0.18	13.86	cu.m
CB/MH-4	46	0.08	1.23	cu.m
CB-5	116.5	0.13	5.05	cu.m
CB-6	28	0.07	0.65	cu.m
CB/MH-7	127	0.13	5.50	cu.m
CB-8	38	0.15	1.90	cu.m
CB-9	66	0.15	3.30	cu.m
CB-10	53	0.15	2.65	cu.m
CB/MH-11	46	0.15	2.30	cu.m
CB/MH-12	66	0.15	3.30	cu.m
CB-13	85	0.11	3.12	cu.m
CB/MH-14	113.5	0.09	3.41	cu.m
CB/MH-15	104.5	0.14	4.88	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	68.30	0.61	0.95	cu.m
CB-2	68.17	0.61	1.00	cu.m
CB/MH-3	68.42	1.219	2.84	cu.m
CB/MH-4	68.08	1.219	3.23	cu.m
CB-5	67.91	0.61	1.09	cu.m
CB-6	67.83	0.61	1.12	cu.m
CB/MH-7	67.99	1.219	3.34	cu.m
CB-8	68.40	0.61	0.91	cu.m
CB-9	68.33	0.61	0.94	cu.m
CB-10	68.28	0.61	0.96	cu.m
CB/MH-11	68.38	1.219	2.88	cu.m
CB/MH-12	68.21	1.219	3.08	cu.m
CB-13	67.72	0.61	1.16	cu.m
CB/MH-14	67.74	1.219	3.63	cu.m
CB/MH-15	67.59	1.219	3.80	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB/MH-3	68.42	CB/MH-4	68.08	77	250	3.78	cu.m
CB/MH-4	68.08	CB/MH-7	67.99	19.4	250	0.95	cu.m
CB/MH-7	67.99	CB/MH-15	67.72	61.7	250	3.03	cu.m
CB/MH-11	68.38	CB/MH-12	68.21	48.1	300	3.40	cu.m
CB/MH-12	68.21	CB/MH-14	68.13	22.7	300	1.60	cu.m
CB/MH-14	67.74	CB/MH-15	67.59	43.6	300	3.08	cu.m

Cistern Storage

Inside Length	Inside Width	Depth	Volume	
4.39	4.39	3.31	63.76	cu.m

Maximum Volume Stored:	174.79	cu.m
Maximum Volume Required:	174.79	cu.m

DRAINAGE AREA III (Continued)

(100-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Roof Inflow (L/s)	Total Inflow (L/s)	Pump Release Rate (L/s)	Overflow Release Rate (L/s)	Total Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	257.81	15.76	273.58	30.00	0.00	30.00	243.58	146.15
15	143	206.32	15.76	222.08	30.00	0.00	30.00	192.08	172.87
20	120	173.19	15.76	188.95	30.00	13.30	43.30	145.66	174.79
25	104	149.94	15.76	165.70	30.00	19.18	49.18	116.52	174.79
30	92	132.65	15.76	148.41	30.00	21.30	51.30	97.10	174.79
35	83	119.23	15.76	134.99	30.00	21.76	51.76	83.23	174.79
40	75	108.50	15.76	124.26	30.00	21.43	51.43	72.83	174.79
45	69	99.70	15.76	115.46	30.00	20.73	50.73	64.74	174.79
50	64	92.34	15.76	108.10	30.00	19.84	49.84	58.26	174.79
55	60	86.09	15.76	101.85	30.00	18.88	48.88	52.97	174.79
60	56	80.70	15.76	96.47	30.00	17.91	47.91	48.55	174.79
65	53	76.01	15.76	91.78	30.00	16.96	46.96	44.82	174.79
70	50	71.89	15.76	87.65	30.00	16.04	46.04	41.62	174.79
75	47	68.23	15.76	83.99	30.00	15.15	45.15	38.84	174.79
80	45	64.96	15.76	80.72	30.00	14.31	44.31	36.41	174.79
85	43	62.02	15.76	77.78	30.00	13.51	43.51	34.27	174.79
90	41	59.36	15.76	75.12	30.00	12.75	42.75	32.37	174.79
95	39	56.94	15.76	72.70	30.00	12.04	42.04	30.66	174.79
100	38	54.73	15.76	70.49	30.00	11.36	41.36	29.13	174.79
105	36	52.70	15.76	68.46	30.00	10.72	40.72	27.74	174.79
110	35	50.83	15.76	66.59	30.00	10.11	40.11	26.48	174.79
115	34	49.10	15.76	64.86	30.00	9.53	39.53	25.33	174.79
120	33	47.50	15.76	63.26	30.00	8.98	38.98	24.28	174.79
125	32	46.00	15.76	61.77	30.00	8.46	38.46	23.30	174.79
130	31	44.61	15.76	60.37	30.00	7.97	37.97	22.41	174.79
135	30	43.31	15.76	59.07	30.00	7.49	37.49	21.58	174.79
140	29	42.09	15.76	57.85	30.00	7.05	37.05	20.81	174.79
145	28	40.95	15.76	56.71	30.00	6.62	36.62	20.09	174.79
150	28	39.87	15.76	55.63	30.00	6.21	36.21	19.42	174.79
180	24	34.51	15.76	50.27	30.00	4.09	34.09	16.18	174.79
210	21	30.53	15.76	46.29	30.00	2.42	32.42	13.87	174.79
240	19	27.44	15.76	43.20	30.00	1.07	31.07	12.14	174.79
270	17	24.97	15.76	40.73	30.00	0.00	30.00	10.73	173.87
300	16	22.95	15.76	38.71	30.00	0.00	30.00	8.71	156.73

DRAINAGE AREA IV

(100-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Hard Area:	715	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Soft Area:	0	sq.m	0.25
Total Catchment Area:	715	sq.m	1.00

Water Elevation: 69.98 m

Pump On Elevation: 67.54 m

Maximum Pump Release Rate: 20.00 L/s

Cistern Storage

Inside Length	Inside Width	Depth	Volume	
1.95	1.95	2.44	9.30	cu.m

Maximum Volume Stored: 9.30 cu.m

Maximum Volume Required: 9.30 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Pump Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	35.49	20.00	15.49	9.30
15	143	28.40	20.00	8.40	7.56
20	120	23.84	20.00	3.84	4.61
25	104	20.64	20.00	0.64	0.96

STRESS TEST EVENT

DRAINAGE AREA II (Roof)

(STRESS TEST EVENT)

			C
Total Catchment Area:	3,779	sq.m	1.00

No. of Roof Drains:	9	
Slots per Wier:	1	0.01242 L/s/mm/slot (5 USgpm/in/slot)
Depth at Roof Drains:	150	mm
Maximum Roof Drains Release Rate:	16.77	L/s
Maximum Overflow Release Rate:	1.97	L/s
Total Maximum Release Rate:	18.74	L/s

Pond Area:	3,724	sq.m
Maximum Volume Stored:	186.20	cu.m
Maximum Volume Required:	186.20	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Roof Drains Release Rate (L/s)	Overflow Release Rate (L/s)	Total Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	214	225.10	16.77	0.00	16.77	208.34	125.00
15	171	180.14	16.77	0.00	16.77	163.38	147.04
20	144	151.22	16.77	0.00	16.77	134.45	161.34
25	125	130.92	16.77	0.00	16.77	114.15	171.23
30	110	115.82	16.77	0.00	16.77	99.05	178.29
35	99	104.10	16.77	0.00	16.77	87.34	183.41
40	90	94.73	16.77	0.38	17.15	77.58	186.20
45	83	87.05	16.77	1.32	18.09	68.96	186.20
50	77	80.63	16.77	1.79	18.56	62.07	186.20
55	72	75.17	16.77	1.97	18.74	56.43	186.20
60	67	70.46	16.77	1.97	18.74	51.72	186.20
65	63	66.37	16.77	1.86	18.63	47.74	186.20
70	60	62.77	16.77	1.67	18.43	44.33	186.20
75	57	59.57	16.77	1.43	18.20	41.38	186.20
80	54	56.72	16.77	1.16	17.93	38.79	186.20
85	52	54.15	16.77	0.87	17.64	36.51	186.20
90	49	51.83	16.77	0.58	17.35	34.48	186.20
95	47	49.71	16.77	0.28	17.05	32.67	186.20
100	45	47.78	16.77	0.00	16.77	31.02	186.10
105	44	46.01	16.77	0.00	16.77	29.24	184.24
110	42	44.38	16.77	0.00	16.77	27.61	182.24
115	41	42.87	16.77	0.00	16.77	26.10	180.11
120	39	41.47	16.77	0.00	16.77	24.70	177.86
125	38	40.17	16.77	0.00	16.77	23.40	175.50
130	37	38.95	16.77	0.00	16.77	22.19	173.05
135	36	37.82	16.77	0.00	16.77	21.05	170.50
140	35	36.75	16.77	0.00	16.77	19.98	167.87
145	34	35.75	16.77	0.00	16.77	18.98	165.16
150	33	34.81	16.77	0.00	16.77	18.04	162.37
180	29	30.13	16.77	0.00	16.77	13.37	144.36
210	25	26.66	16.77	0.00	16.77	9.89	124.60
240	23	23.96	16.77	0.00	16.77	7.19	103.58
270	21	21.80	16.77	0.00	16.77	5.04	81.58
300	19	20.03	16.77	0.00	16.77	3.27	58.81

DRAINAGE AREA III (Including 1601 Michael Street)

(STRESS TEST EVENT)

			C
Roof Area:	735	sq.m	1.00
Hard Area:	4,035	sq.m	1.00
Gravel Area:	130	sq.m	0.875
Soft Area:	1,240	sq.m	0.25
Total Catchment Area:	6,140	sq.m	0.85

Water Elevation:	70.85	m
Pump On Elevation:	67.54	m
Maximum Pump Release Rate:	30.00	L/s
Maximum Overflow Release Rate:	50.17	L/s
Total Maximum Release Rate:	80.17	

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	170	0.15	8.50	cu.m
CB-2	115	0.12	4.60	cu.m
CB/MH-3	231	0.18	13.86	cu.m
CB/MH-4	46	0.08	1.23	cu.m
CB-5	116.5	0.13	5.05	cu.m
CB-6	28	0.07	0.65	cu.m
CB/MH-7	127	0.13	5.50	cu.m
CB-8	38	0.15	1.90	cu.m
CB-9	66	0.15	3.30	cu.m
CB-10	53	0.15	2.65	cu.m
CB/MH-11	46	0.15	2.30	cu.m
CB/MH-12	66	0.15	3.30	cu.m
CB-13	85	0.11	3.12	cu.m
CB/MH-14	113.5	0.09	3.41	cu.m
CB/MH-15	104.5	0.14	4.88	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	68.30	0.61	0.95	cu.m
CB-2	68.17	0.61	1.00	cu.m
CB/MH-3	68.42	1.219	2.84	cu.m
CB/MH-4	68.08	1.219	3.23	cu.m
CB-5	67.91	0.61	1.09	cu.m
CB-6	67.83	0.61	1.12	cu.m
CB/MH-7	67.99	1.219	3.34	cu.m
CB-8	68.40	0.61	0.91	cu.m
CB-9	68.33	0.61	0.94	cu.m
CB-10	68.28	0.61	0.96	cu.m
CB/MH-11	68.38	1.219	2.88	cu.m
CB/MH-12	68.21	1.219	3.08	cu.m
CB-13	67.72	0.61	1.16	cu.m
CB/MH-14	67.74	1.219	3.63	cu.m
CB/MH-15	67.59	1.219	3.80	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB/MH-3	68.42	CB/MH-4	68.08	77	250	3.78	cu.m
CB/MH-4	68.08	CB/MH-7	67.99	19.4	250	0.95	cu.m
CB/MH-7	67.99	CB/MH-15	67.72	61.7	250	3.03	cu.m
CB/MH-11	68.38	CB/MH-12	68.21	48.1	300	3.40	cu.m
CB/MH-12	68.21	CB/MH-14	68.13	22.7	300	1.60	cu.m
CB/MH-14	67.74	CB/MH-15	67.59	43.6	300	3.08	cu.m

Cistern Storage

Inside Length	Inside Width	Depth	Volume	
4.39	4.39	3.31	63.76	cu.m

Maximum Volume Stored:	174.79	cu.m
Maximum Volume Required:	174.79	cu.m

DRAINAGE AREA III (Continued)

(STRESS TEST EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Roof Inflow (L/s)	Total Inflow (L/s)	Pump Release Rate (L/s)	Overflow Release Rate (L/s)	Total Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	214	309.38	16.77	326.14	30.00	4.83	34.83	291.31	174.79
15	171	247.58	16.77	264.35	30.00	40.14	70.14	194.21	174.79
20	144	207.83	16.77	224.60	30.00	48.94	78.94	145.66	174.79
25	125	179.93	16.77	196.70	30.00	50.17	80.17	116.52	174.79
30	110	159.17	16.77	175.94	30.00	48.84	78.84	97.10	174.79
35	99	143.08	16.77	159.85	30.00	46.61	76.61	83.23	174.79
40	90	130.20	17.15	147.35	30.00	44.52	74.52	72.83	174.79
45	83	119.64	18.09	137.72	30.00	42.99	72.99	64.74	174.79
50	77	110.81	18.56	129.37	30.00	41.10	71.10	58.26	174.79
55	72	103.31	18.74	122.05	30.00	39.08	69.08	52.97	174.79
60	67	96.84	18.74	115.59	30.00	37.03	67.03	48.55	174.79
65	63	91.22	18.63	109.84	30.00	35.03	65.03	44.82	174.79
70	60	86.27	18.43	104.70	30.00	33.09	63.09	41.62	174.79
75	57	81.88	18.20	100.07	30.00	31.23	61.23	38.84	174.79
80	54	77.95	17.93	95.88	30.00	29.47	59.47	36.41	174.79
85	52	74.42	17.64	92.06	30.00	27.79	57.79	34.27	174.79
90	49	71.23	17.35	88.58	30.00	26.21	56.21	32.37	174.79
95	47	68.33	17.05	85.37	30.00	24.71	54.71	30.66	174.79
100	45	65.67	16.77	82.44	30.00	23.31	53.31	29.13	174.79
105	44	63.24	16.77	80.00	30.00	22.26	52.26	27.74	174.79
110	42	60.99	16.77	77.76	30.00	21.28	51.28	26.48	174.79
115	41	58.92	16.77	75.69	30.00	20.35	50.35	25.33	174.79
120	39	56.99	16.77	73.76	30.00	19.49	49.49	24.28	174.79
125	38	55.20	16.77	71.97	30.00	18.67	48.67	23.30	174.79
130	37	53.54	16.77	70.30	30.00	17.89	47.89	22.41	174.79
135	36	51.97	16.77	68.74	30.00	17.16	47.16	21.58	174.79
140	35	50.51	16.77	67.28	30.00	16.47	46.47	20.81	174.79
145	34	49.13	16.77	65.90	30.00	15.81	45.81	20.09	174.79
150	33	47.84	16.77	64.61	30.00	15.19	45.19	19.42	174.79
180	29	41.41	16.77	58.18	30.00	12.00	42.00	16.18	174.79
210	25	36.64	16.77	53.40	30.00	9.53	39.53	13.87	174.79
240	23	32.93	16.77	49.70	30.00	7.56	37.56	12.14	174.79
270	21	29.97	16.77	46.73	30.00	5.94	35.94	10.79	174.79
300	19	27.53	16.77	44.30	30.00	4.59	34.59	9.71	174.79

5-YEAR EVENT

DRAINAGE AREA A (1591 & 1611 Michael Street)

(5-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Hard Area:	255	sq.m	0.90
Gravel Area:	3,365	sq.m	0.70
Soft Area:	5,557	sq.m	0.20
Total Catchment Area:	9,177	sq.m	0.40
Area (A):	9,177	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
Runoff Coeficient (C):	0.40		
5-Year Pre-Development Flow Rate (2.78AiC):	107.07	L/s	

DRAINAGE AREA B (1601 Michael Street)

(5-YEAR EVENT)

			C
Roof Area:	735	sq.m	0.90
Hard Area:	0	sq.m	0.90
Gravel Area:	130	sq.m	0.70
Soft Area:	1,240	sq.m	0.20
Total Catchment Area:	2,105	sq.m	0.48
Area (A):	2,105	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
Runoff Coeficient (C):	0.48		
5-Year Pre-Development Flow Rate (2.78AiC):	28.98	L/s	

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(5-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Hard Area:	528	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	120	sq.m	0.20
Total Catchment Area:	648	sq.m	0.77
Area (A):	648	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
Runoff Coeficient (C):	0.77		
Flow Rate (2.78AiC):	14.46	L/s	

DRAINAGE AREA II (Roof)

(5-YEAR EVENT)

			C
Total Catchment Area:	3,779	sq.m	0.90

No. of Roof Drains: 9

Slots per Wier: 1 0.01242 L/s/mm/slot (5 USgpm/in/slot)

Depth at Roof Drains: 109 mm

Maximum Release Rate: 12.16 L/s

Pond Area: 1,960 sq.m

Maximum Volume Stored: 71.07 cu.m

Maximum Volume Required: 71.07 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	104	98.52	12.16	86.35	51.81
15	84	79.00	12.16	66.84	60.16
20	70	66.42	12.16	54.26	65.11
25	61	57.58	12.16	45.41	68.12
30	54	50.99	12.16	38.83	69.89
35	49	45.87	12.16	33.71	70.79
40	44	41.78	12.16	29.61	71.07
45	41	38.41	12.16	26.25	70.88
50	38	35.60	12.16	23.44	70.32
55	35	33.21	12.16	21.05	69.45
60	33	31.15	12.16	18.99	68.35
65	31	29.35	12.16	17.19	67.04
70	29	27.77	12.16	15.61	65.56
75	28	26.37	12.16	14.21	63.93
80	27	25.11	12.16	12.95	62.17
85	25	23.99	12.16	11.82	60.30
90	24	22.96	12.16	10.80	58.33
95	23	22.04	12.16	9.87	56.28
100	22	21.19	12.16	9.02	54.14
105	22	20.41	12.16	8.24	51.93
110	21	19.69	12.16	7.53	49.67
115	20	19.02	12.16	6.86	47.34
120	19	18.41	12.16	6.24	44.96
125	19	17.83	12.16	5.67	42.53
130	18	17.30	12.16	5.13	40.05
135	18	16.80	12.16	4.63	37.54

DRAINAGE AREA III (Excluding 1601 Michael Street)

(5-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Hard Area:	4,035	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	0	sq.m	0.20
Total Catchment Area:	4,035	sq.m	0.90

Water Elevation:	69.38	m
Pump On Elevation:	67.54	m
Maximum Pump Release Rate:	30.00	L/s

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	0	-1.32	0.00	cu.m
CB-2	0	-1.35	0.00	cu.m
CB/MH-3	0	-1.29	0.00	cu.m
CB/MH-4	0	-1.39	0.00	cu.m
CB-5	0	-1.34	0.00	cu.m
CB-6	0	-1.40	0.00	cu.m
CB/MH-7	0	-1.34	0.00	cu.m
CB-8	0	-1.32	0.00	cu.m
CB-9	0	-1.32	0.00	cu.m
CB-10	0	-1.32	0.00	cu.m
CB/MH-11	0	-1.32	0.00	cu.m
CB/MH-12	0	-1.32	0.00	cu.m
CB-13	0	-1.36	0.00	cu.m
CB/MH-14	0	-1.38	0.00	cu.m
CB/MH-15	0	-1.33	0.00	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	68.30	0.61	0.40	cu.m
CB-2	68.17	0.61	0.45	cu.m
CB/MH-3	68.42	1.219	1.12	cu.m
CB/MH-4	68.08	1.219	1.52	cu.m
CB-5	67.91	0.61	0.55	cu.m
CB-6	67.83	0.61	0.58	cu.m
CB/MH-7	67.99	1.219	1.62	cu.m
CB-8	68.40	0.61	0.37	cu.m
CB-9	68.33	0.61	0.39	cu.m
CB-10	68.28	0.61	0.41	cu.m
CB/MH-11	68.38	1.219	1.17	cu.m
CB/MH-12	68.21	1.219	1.37	cu.m
CB-13	67.72	0.61	0.62	cu.m
CB/MH-14	67.74	1.219	1.92	cu.m
CB/MH-15	67.59	1.219	2.09	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB/MH-3	68.42	CB/MH-4	68.08	77	250	3.78	cu.m
CB/MH-4	68.08	CB/MH-7	67.99	19.4	250	0.95	cu.m
CB/MH-7	67.99	CB/MH-15	67.72	61.7	250	3.03	cu.m
CB/MH-11	68.38	CB/MH-12	68.21	48.1	300	3.40	cu.m
CB/MH-12	68.21	CB/MH-14	68.13	22.7	300	1.60	cu.m
CB/MH-14	67.74	CB/MH-15	67.59	43.6	300	3.08	cu.m

Cistern Storage

Inside Length	Inside Width	Depth	Volume	
4.39	4.39	1.84	35.47	cu.m

Maximum Volume Stored:	65.89	cu.m
Maximum Volume Required:	65.89	cu.m

DRAINAGE AREA III (Continued)

(5-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Roof Inflow (L/s)	Total Inflow (L/s)	Pump Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	104	105.19	12.16	117.35	30.00	87.35	52.41
15	84	84.36	12.16	96.52	30.00	66.52	59.87
20	70	70.92	12.16	83.09	30.00	53.09	63.70
25	61	61.48	12.16	73.64	30.00	43.64	65.46
30	54	54.44	12.16	66.61	30.00	36.61	65.89
35	49	48.98	12.16	61.14	30.00	31.14	65.40
40	44	44.61	12.16	56.77	30.00	26.77	64.25
45	41	41.02	12.16	53.18	30.00	23.18	62.58
50	38	38.01	12.16	50.18	30.00	20.18	60.53
55	35	35.46	12.16	47.62	30.00	17.62	58.15
60	33	33.26	12.16	45.42	30.00	15.42	55.52
65	31	31.34	12.16	43.50	30.00	13.50	52.66
70	29	29.65	12.16	41.82	30.00	11.82	49.62
75	28	28.15	12.16	40.32	30.00	10.32	46.43
80	27	26.82	12.16	38.98	30.00	8.98	43.10
85	25	25.61	12.16	37.77	30.00	7.77	39.65
90	24	24.52	12.16	36.68	30.00	6.68	36.09
95	23	23.53	12.16	35.69	30.00	5.69	32.44
100	22	22.62	12.16	34.78	30.00	4.78	28.70
105	22	21.79	12.16	33.95	30.00	3.95	24.89
110	21	21.02	12.16	33.18	30.00	3.18	21.01
115	20	20.31	12.16	32.47	30.00	2.47	17.07
120	19	19.65	12.16	31.82	30.00	1.82	13.08
125	19	19.04	12.16	31.20	30.00	1.20	9.03
130	18	18.47	12.16	30.63	30.00	0.63	4.93
135	18	17.93	12.16	30.10	30.00	0.10	0.79

DRAINAGE AREA III (Including 1601 Michael Street)

(5-YEAR EVENT)

			C
Roof Area:	735	sq.m	0.90
Hard Area:	4,035	sq.m	0.90
Gravel Area:	130	sq.m	0.70
Soft Area:	1,240	sq.m	0.20
Total Catchment Area:	6,140	sq.m	0.75

Water Elevation: 70.30 m

Pump On Elevation: 67.54 m

Maximum Pump Release Rate: 30.00 L/s

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	0	-0.40	0.00	cu.m
CB-2	0	-0.43	0.00	cu.m
CB/MH-3	0	-0.37	0.00	cu.m
CB/MH-4	0	-0.47	0.00	cu.m
CB-5	0	-0.42	0.00	cu.m
CB-6	0	-0.48	0.00	cu.m
CB/MH-7	0	-0.42	0.00	cu.m
CB-8	0	-0.40	0.00	cu.m
CB-9	0	-0.40	0.00	cu.m
CB-10	0	-0.40	0.00	cu.m
CB/MH-11	0	-0.40	0.00	cu.m
CB/MH-12	0	-0.40	0.00	cu.m
CB-13	0	-0.44	0.00	cu.m
CB/MH-14	0	-0.46	0.00	cu.m
CB/MH-15	0	-0.41	0.00	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	68.30	0.61	0.74	cu.m
CB-2	68.17	0.61	0.79	cu.m
CB/MH-3	68.42	1.219	2.19	cu.m
CB/MH-4	68.08	1.219	2.59	cu.m
CB-5	67.91	0.61	0.89	cu.m
CB-6	67.83	0.61	0.92	cu.m
CB/MH-7	67.99	1.219	2.69	cu.m
CB-8	68.40	0.61	0.71	cu.m
CB-9	68.33	0.61	0.73	cu.m
CB-10	68.28	0.61	0.75	cu.m
CB/MH-11	68.38	1.219	2.24	cu.m
CB/MH-12	68.21	1.219	2.44	cu.m
CB-13	67.72	0.61	0.96	cu.m
CB/MH-14	67.74	1.219	2.98	cu.m
CB/MH-15	67.59	1.219	3.16	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB/MH-3	68.42	CB/MH-4	68.08	77	250	3.78	cu.m
CB/MH-4	68.08	CB/MH-7	67.99	19.4	250	0.95	cu.m
CB/MH-7	67.99	CB/MH-15	67.72	61.7	250	3.03	cu.m
CB/MH-11	68.38	CB/MH-12	68.21	48.1	300	3.40	cu.m
CB/MH-12	68.21	CB/MH-14	68.13	22.7	300	1.60	cu.m
CB/MH-14	67.74	CB/MH-15	67.59	43.6	300	3.08	cu.m

Cistern Storage

Inside Length	Inside Width	Depth	Volume	
4.39	4.39	2.76	53.12	cu.m

Maximum Volume Stored: 93.74 cu.m

Maximum Volume Required: 93.74 cu.m

DRAINAGE AREA III (Continued)

(5-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Roof Inflow (L/s)	Total Inflow (L/s)	Pump Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	104	134.17	12.16	146.33	30.00	116.33	69.80
15	84	107.60	12.16	119.76	30.00	89.76	80.78
20	70	90.46	12.16	102.62	30.00	72.62	87.15
25	61	78.42	12.16	90.58	30.00	60.58	90.87
30	54	69.44	12.16	81.61	30.00	51.61	92.89
35	49	62.48	12.16	74.64	30.00	44.64	93.74
40	44	56.90	12.16	69.06	30.00	39.06	93.74
45	41	52.32	12.16	64.48	30.00	34.48	93.10
50	38	48.49	12.16	60.65	30.00	30.65	91.95
55	35	45.23	12.16	57.39	30.00	27.39	90.39
60	33	42.42	12.16	54.58	30.00	24.58	88.50
65	31	39.97	12.16	52.14	30.00	22.14	86.34
70	29	37.82	12.16	49.98	30.00	19.98	83.94
75	28	35.91	12.16	48.07	30.00	18.07	81.33
80	27	34.20	12.16	46.37	30.00	16.37	78.56
85	25	32.67	12.16	44.83	30.00	14.83	75.63
90	24	31.28	12.16	43.44	30.00	13.44	72.57
95	23	30.01	12.16	42.17	30.00	12.17	69.39
100	22	28.85	12.16	41.02	30.00	11.02	66.10
105	22	27.79	12.16	39.95	30.00	9.95	62.71
110	21	26.81	12.16	38.98	30.00	8.98	59.24
115	20	25.91	12.16	38.07	30.00	8.07	55.69
120	19	25.07	12.16	37.23	30.00	7.23	52.06
125	19	24.29	12.16	36.45	30.00	6.45	48.37
130	18	23.56	12.16	35.72	30.00	5.72	44.62
135	18	22.88	12.16	35.04	30.00	5.04	40.81

DRAINAGE AREA IV

(5-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Hard Area:	715	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	0	sq.m	0.20
Total Catchment Area:	715	sq.m	0.90

Water Elevation: 67.54 m

Pump On Elevation: 67.54 m

Maximum Pump Release Rate: 20.00 L/s

Cistern Storage

Inside Length	Inside Width	Depth	Volume	
1.95	1.95	0.00	0.00	cu.m

Maximum Volume Stored: 0.00 cu.m

Maximum Volume Required: 0.00 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Pump Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	104	18.64	20.00	-1.36	-0.82

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

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STORM SEWER CALCULATIONS

Rational Method

2-YEAR EVENT

Project: 1591 & 1611 Michael Street
1-Storey Light Industrial Warehouse
Ottawa, Ontario

Date: October 17, 2023

Manning's Roughness Coefficient: 0.013

Location		Individual					Cumulative				Sewer Data							
From	To	Roof C = 0.90 (ha)	Hard C = 0.90 (ha)	Gravel C = 0.70 (ha)	Soft C = 0.20 (ha)	2.78AC	2.78AC	Time (min)	Rainfall Intensity (mm/hr)	Q Flow Rate (L/s)	Length (m)	Nominal Diameter (mm)	Actual Diameter (mm)	Slope (%)	Velocity (m/s)	Q_{Full} Capacity (L/s)	Time (min)	Q / Q_{Full}
Roof Drains	Cistern	0.3779				0.9455	0.9455	10.00	77	72.62								
							Flow through flow control roof drains:			12.16								
CB-1	CB/MH-3		0.0285			0.0713	0.0713	10.00	77	5.48	1.7	250	250	1	1.21	59.47	0.02	9%
CB-2	CB/MH-3		0.0170			0.0425	0.0425	10.00	77	3.27	0.9	250	250	1	1.21	59.47	0.01	5%
CB/MH-3	CB/MH-4		0.0810			0.2027	0.3165	10.02	77	24.28	77	250	250	0.432	0.80	39.09	1.61	62%
CB/MH-4	CB/MH-7		0.0115			0.0288	0.3453	11.64	71	24.53	19.4	250	250	0.432	0.80	39.09	0.41	63%
CB-5	CB/MH-7		0.0200			0.0500	0.0500	10.00	77	3.84	0.9	250	250	1	1.21	59.47	0.01	6%
CB-6	CB/MH-7		0.0120			0.0300	0.0300	10.00	77	2.31	1.5	250	250	1	1.21	59.47	0.02	4%
CB/MH-7	CB/MH-15		0.0200			0.0500	0.4754	12.04	70	33.17	61.7	250	250	0.432	0.80	39.09	1.29	85%
CB-8	CB/MH-11	0.0735	0.1010	0.0130	0.1240	0.5308	0.5308	10.00	77	40.77	2.8	300	300	1	1.37	96.70	0.03	42%
CB-9	CB/MH-11		0.0120			0.0300	0.0300	10.00	77	2.31	1.1	300	300	1	1.37	96.70	0.01	2%
CB-10	CB/MH-11		0.0120			0.0300	0.0300	10.00	77	2.31	1.1	300	300	1	1.37	96.70	0.01	2%
CB/MH-11	CB/MH-12		0.0170			0.0425	0.6334	10.03	77	48.57	48.1	300	300	0.34	0.80	56.39	1.00	86%
CB/MH-12	CB/MH-14		0.0150			0.0375	0.6710	11.04	73	49.00	22.7	300	300	0.34	0.80	56.39	0.47	87%
CB-13	CB/MH-14		0.0165			0.0413	0.0413	10.00	77	3.17	1.7	250	250	1	1.21	59.47	0.02	5%
CB/MH-14	CB/MH-15		0.0190			0.0475	0.7598	11.51	71	54.28	43.6	300	300	0.34	0.80	56.39	0.91	96%
CB/MH-15	Cistern		0.0210			0.0525	1.2877	13.33	66	84.99	4.8	300	300	1	1.37	96.70	0.06	88%
CB-16	Cistern		0.0105			0.0263	0.0263	10.00	77	2.02	2	250	250	1	1.21	59.47	0.03	3%
CB-17	Cistern		0.0095			0.0238	0.0238	10.00	77	1.83	2	250	250	1	1.21	59.47	0.03	3%
CB-18	Cistern		0.0120			0.0300	0.0300	10.00	77	2.31	2	250	250	1	1.21	59.47	0.03	4%
CB-19	Cistern		0.0175			0.0438	0.0438	10.00	77	3.36	2	250	250	1	1.21	59.47	0.03	6%
CB-20	Cistern		0.0220			0.0550	0.0550	10.00	77	4.23	3.5	250	250	1	1.21	59.47	0.05	7%
MH-21	MH-22					Flow through stormwater management pump:				50.00	2.2	300	300	0.34	0.80	56.39	0.05	89%
MH-22	525 Culvert					Flow through stormwater management pump:				50.00	3.2	300	300	0.34	0.80	56.39	0.07	89%