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SITE SERVICING & STORMWATER MANAGEMENT REPORT

475 TERRY FOX DRIVE
OTTAWA, ONTARIO

REPORT NO. 24103

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CONTENTS

1.0 INTRODUCTION

2.0 WATER SERVICING

- 2.1 WATER SUPPLY FOR FIREFIGHTING
- 2.2 DOMESTIC WATER SUPPLY

3.0 SANITARY SERVICING

4.0 STORMWATER MANAGEMENT

- 4.1 QUANTITY CONTROL
- 4.2 QUALITY CONTROL
- 4.3 STORM SERVICING

5.0 CONCLUSIONS

LIST OF APPENDICES

A PRE-APPLICATION CONSULTATION MEETING NOTES

B WATER SERVICING

C SANITARY SERVICING

D STORMWATER MANAGEMENT

1.0 INTRODUCTION

This report has been prepared in support of the Site Plan Control application for proposed 6-storey apartment buildings located at 475 Terry Fox Drive in Ottawa, Ontario. This report describes the servicing of the proposed buildings and stormwater management for the 12,270 m^2 property. 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-22 prepared by D.B. Gray Engineering Inc.

2.0 WATER SERVICING

2.1 WATER SUPPLY FOR FIREFIGHTING

The proposed buildings will have fully supervised sprinkler systems. The fire department connection for Building A and Building B will be located at the north entrance of the east façade of Building A. The fire department connection for Building C will be located at the main entrance. The sprinkler systems are to be designed, installed and maintained in accordance with NFPA standards and the Fire Underwriters Survey. Refer to Appendix B. A private fire hydrant (FH-8) is proposed to be located 25 m unobstructed distance to the proposed fire department connection for Building A and Building B. A private fire hydrant (FH-9) is proposed to be located 40 m unobstructed distance to the proposed fire department connection for Building C.

In accordance with City of Ottawa Technical Bulletin IWSTB-2024-05, when calculating the required fire flow where municipal pipe sizing is affected, the Fire Underwriters Survey method is to be used. Using the Fire Underwriters Survey method, the required fire flow is calculated to be 12,000 L/min (200 L/s) for Building A, and 11,000 L/min (183.3 L/s) for Building B and Building C. Refer to calculations in Appendix B.

There are no existing municipal watermains fronting the property. As such, looping a municipal watermain between the existing municipal watermain crossing Kanata Avenue between 150 Ingersoll Crescent and 152 Ingersoll Crescent (Connection 1), and the existing municipal watermain at the intersection of Terry Fox Drive and Tillsonburg Street (Connection 2) is proposed. The boundary conditions provided by the City of Ottawa for the 200 L/s fire flow indicate a hydraulic grade line (HGL) of 143.7 m at Connection 1 and 132.0 m at Connection 2. Refer to Appendix B.

Using EPANET, four models were created to analyze the hydraulics of the proposed watermains under fire flow conditions. Refer to Appendix B.

Building A
Based on a 50 L/s demand at four fire hydrants (FH-5, FH-7, FH-8 and FH-9, totaling 200 L/s) and 1.3 L/s domestic demand at each building (Buildings A, B and C), and the 143.7 m HGL at Connection 1 and 132.0 m HGL at Connection 2 provided by the City of Ottawa, the pressures at the fire hydrants are determined to be 217 kPa (31 psi) at FH-5, 164 kPa (24 psi) at FH-7, 170 kPa (25 psi) at FH-8, and 166 kPa (24 psi) at FH-9. Since the pressures are above the Ontario Building Code's minimum required pressure of 140 kPa (20 psi), there is an adequate water supply for firefighting at Building A.

Building B
Based on a 61.1 L/s demand at three fire hydrants (FH-7, FH-8 and FH-9, totaling 183.3 L/s) and a 1.3 L/s domestic demand at each building (Buildings A, B and C), and the 143.7 m HGL at Connection 1 and 132.0 m HGL at Connection 2 provided by the City of Ottawa, the pressures at the fire hydrants are determined to be 162 kPa (23 psi) at FH-7, 172 kPa (25 psi) at FH-8, and 165 kPa (24 psi) at FH-9. Since the pressures are above the Ontario Building Code's minimum required pressure of 140 kPa (20 psi), there is an adequate water supply for firefighting at Building B.

Building C
Based on a 61.1 L/s demand at three fire hydrants (FH-7, FH-8 and FH-9, totaling 183.3 L/s) and a 1.3 L/s domestic demand at each building (Buildings A, B and C), and the 143.7 m HGL at Connection 1 and 132.0 m HGL at Connection 2 provided by the City of Ottawa, the pressures at the fire hydrants are determined to be 162 kPa (23 psi) at FH-7, 172 kPa (25 psi) at FH-8, and 165 kPa (24 psi) at FH-9. Since the pressures are above the Ontario Building Code's minimum required pressure of 140 kPa (20 psi), there is an adequate water supply for firefighting at Building B.

Class AA Fire Hydrants
Based on a 95 L/s demand at fire hydrant FH-9 (the most remote fire hydrant) and a 1.3 L/s domestic demand at each building (Buildings A, B and C), and the 143.7 m HGL at Connection 1 and 132.0 m HGL at Connection 2 provided by the City of Ottawa, the pressures at fire hydrant FH-9 is determined to be 263 kPa (38 psi). Since the pressure is above the Ontario Building Code's minimum required pressure of 140 kPa (20 psi) at the most remote fire hydrant, it can be concluded that all proposed fire hydrants (municipal and private) will be Class AA Fire Hydrants.

2.2 DOMESTIC WATER SUPPLY

In accordance with
i. the City of Ottawa Water Design Guidelines for the populations,
ii. City of Ottawa Technical Bulletin ISTB-2021-03 for the consumption rate, and
iii. the Ministry of the Environment Water Design Guidelines for the peaking factors, and

based on the 81 1-bedroom apartment units, 70 2-bedroom apartment units and 31 3-bedroom apartment units, the average daily demand is calculated to be 1.2 L/s, the maximum daily demand is calculated to be 3.9 L/s, and the maximum hourly demand is calculated to be 5.8 L/s. Refer to calculations in Appendix B. Since the average daily demand is more than 50,000 L/day, a redundant water supply separated by an isolation valve is required to avoid the creation of a vulnerable service area.

The boundary conditions provided by the City of Ottawa indicate a minimum HGL of 156.2 m at Connection 1 and Connection 2, and a maximum HGL of 161.3 m at Connection 1 and Connection 2. Refer to Appendix B.

Using EPANET, a model was created to analyze the hydraulics of the proposed watermains. Based on a 5.8 L/s maximum hourly demand, and the 156.2 m HGL at Connection 1 and Connection 2 provided by the City of Ottawa, the minimum pressures at the buildings are determined to be 565 kPa (82 psi) at Building A, 565 kPa (82 psi) at Building B, and 570 kPa (83 psi) at Building C. Based on a 1.2 L/s average daily demand, and the 161.3 m HGL at Connection 1 and Connection 2 provided by the City of Ottawa, the maximum pressures at the buildings are determined to be 615 kPa (89 psi) at Building A, 615 kPa (89 psi) at Building B, and 620 kPa (90 psi) at Building C. Refer to Appendix B. This is an acceptable range for the

proposed development. Since the water pressure is expected to be above 80 psi, pressure reducing valves are to be installed immediately after the water meters.

A looped 200 mm private watermain connecting to the looped 200 mm Kanata Avenue and Terry Fox Drive municipal watermains is proposed to service the development. Three 150 mm water services connecting to the looped 200 mm private watermain are proposed to service the sprinkler systems. The same 150 mm water services will provide adequate domestic water supplies.

3.0 SANITARY SERVICING

In accordance with

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

based on the 81 1-bedroom apartment units, 70 2-bedroom apartment units and 31 3-bedroom apartment units, the post-development sanitary flow rate is calculated to be 4.10 L/s. Refer to calculations in Appendix C.

Two 200 mm sanitary sewer services at 2% slope (46.38 L/s capacity) are proposed to service the buildings. Refer to calculations in Appendix C. The proposed sanitary sewer services will connect to the proposed private sanitary sewer system.

A 200 mm private sanitary sewer at 0.32% slope (18.55 L/s capacity) is proposed to service the development. At the design flow rate, the 200 mm sanitary sewer will only be at 22% capacity. The proposed 200 mm sanitary sewer will connect to the existing 375 mm Terry Fox Drive municipal sanitary sewer, which at 0.15% slope has a capacity of 67.91 L/s. Refer to calculations in Appendix C. The post-development increase in flow is expected to have an acceptable impact on the 375 mm Terry Fox Drive municipal sanitary sewer.

4.0 STORMWATER MANAGEMENT

4.1 QUANTITY CONTROL

The stormwater quantity control criterion is to control the post-development 100-year peak flow rate to the 100-year pre-development peak flow rate, the 50-year post to the 50-year pre, and 2-year post to the 2-year pre, all using a pre-development runoff coefficient of 0.2 and time of concentration of 10 minutes. Using the Rational Method, the pre-development flow rates (maximum allowable release rates) are calculated to be 121.82 L/s during the 100-year event, 110.16 L/s during the 50-year and 52.40 L/s during the 2-year.

The Rational and Modified Rational Methods are used to calculate the post-development flow rates and corresponding storage volumes. The 2-year runoff coefficients are increased by 20% to a maximum of 1.00 to calculate the 50-year runoff coefficients, and 25% to a maximum of 1.00 to calculate the 100-year runoff coefficients. Refer to calculations in Appendix D.

Drainage Area I (Uncontrolled Flow Off Site – 450 m^2)

A few isolated sections of the perimeter of the property will drain uncontrolled off site. The flow rates are calculated at a time of concentration of 10 minutes.

	100-Year Event	50-Year Event	2-Year Event
Maximum Flow Rate	6.52 L/s	5.70 L/s	2.30 L/s

Drainage Area II (6,325 m^2)

An inlet control device (ICD) located in the outlet pipe of MH-7 will restrict the flow of stormwater and cause it to back up into the upstream infrastructure and pond above catch basins CB-1, CB/MH-2, CB/MH-4, CB/MH-5 and CB/MH-6. The ICD will be a plug style with a round orifice located at the bottom of the plug c/w a trash basket manufactured by Pedro Plastics or approved equivalent sized by the manufacturer. It is calculated that an orifice area of 5,675 mm^2 (±85 mm diameter) with a discharge coefficient of 0.61 will restrict the maximum flow rate to 24.53 L/s at 2.56 m. Based on this orifice the maximum flow rate during the 50-year event is calculated to be 20.92 L/s at 1.86 m, and during the 2-year event it is calculated to be 13.40 L/s at 0.76 m. Since some of the restricted stormwater is proposed to be stored using underground infrastructure, a release rate equal to 50% of the maximum release rate is used to calculate the required storage volumes. The underground infrastructure will include 42 – Soleno HydroStor HS180 chambers or approved equivalent surrounded by clear stone wrapped in a waterproof thermoplastic liner.

	100-Year Event	50-Year Event	2-Year Event
Maximum Release Rate	24.53 L/s	20.92 L/s	13.40 L/s
Maximum Water Elevation	98.29 m	97.59 m	96.50 m
Maximum Volume Required	265.92 m^3	243.81 m^3	94.85 m^3
Maximum Volume Available	336.36 m^3	336.36 m^3	336.36 m^3

(There are off-site areas draining onto the subject property, the extra available storage is intended to accommodate this off-site drainage to ensure the ICD is not submerged (refer to culvert section below).)

Drainage Area III (5,495 m^2)

An ICD located in the outlet pipe of CB/MH-14 will restrict the flow of stormwater and cause it to back up into the upstream infrastructure. When the water elevation reaches 95.67 m it will overflow via 450 mm overflow pipe. The ICD will be a plug style with a round orifice located at the bottom of the plug manufactured by Pedro Plastics or approved equivalent sized by the manufacturer. It is calculated that an orifice area of 32,826 sq.mm (±204 mm diameter) with a discharge coefficient of 0.61 will restrict the maximum flow rate to 103.20 L/s at 1.35 m. Based on this orifice the maximum flow rate during the 50-year event is calculated to be 94.04 L/s at 1.12 m, and during the 2-year event it is calculated to be 49.50 L/s at 0.31 m. Since the restricted stormwater is proposed to be stored using underground infrastructure, an average release rate equal to 50% of the maximum release rate is used to calculate the required storage volumes. The underground infrastructure will include 22 – Soleno HydroStor HS180 chambers or approved equivalent surrounded by clear stone wrapped in a waterproof thermoplastic liner.

	100-Year Event	50-Year Event	2-Year Event
Maximum ICD Release Rate	103.20 L/s	94.04 L/s	49.50 L/s
Maximum Overflow Rate	3.82 L/s	0.00 L/s	0.00 L/s
Total Maximum Release Rate	107.02 L/s	94.04 L/s	49.50 L/s
Maximum Water Elevation	95.67 m	95.44 m	94.62 m
Maximum Volume Required	142.58 m^3	128.42 m^3	55.22 m^3
Maximum Volume Available	142.58 m^3	142.58 m^3	142.58 m^3

Summary

	100-Year Event	50-Year Event	2-Year Event
Maximum Allowable Release Rate	122.82 L/s	110.70 L/s	52.40 L/s
Maximum Release Rate	113.53 L/s	99.74 L/s	51.80 L/s
Maximum Volume Required	408.50 m^3	372.22 m^3	150.07 m^3
Maximum Volume Available	478.94 m^3	478.94 m^3	478.94 m^3

The maximum post-development release rate during the 100-year event is calculated to be 113.53 L/s, which is about 7% less than the maximum allowable release rate. To achieve the 100-year maximum allowable release rate, a maximum storage volume of 408.50 m^3 is required; 478.94 m^3 is provided. The maximum post-development release rate during the 50-year event is calculated to be 110.70 L/s, which is about 9% less than the maximum allowable release rate. The maximum post-development release rate during the 2-year event is calculated to be 51.80 L/s, which is about 1% less than the maximum allowable release rate. (There are off-site areas draining onto the subject property, the proposed extra available storage is intended to accommodate this off-site drainage to ensure the ICD is not submerged (refer to culvert section below).)

1200 mm Terry Fox Drive and 600 mm Kanata Avenue Municipal Culverts

The subject and adjacent properties, totaling about 2.0 ha, currently drain to the Carp River via a 600 mm municipal culvert crossing Kanata Avenue and a 1200 mm culvert crossing Tery Fox Drive. Using the Rational Method, the pre-development flow rates are calculated to be 539.86 L/s during the 100-year event, 470.11 L/s during the 50-year and 184.91 L/s during the 2-year. Post development these areas area will continue to drain to the Carp River.

As per the *'Terry Fox Drive Storm Water Facility at Realigned Richardson Side Road'* (a 2002 report prepared by Dillon Consulting Limited and Cummings Cockburn Limited), the 1200 mm culvert crossing Terry Fox Drive at Kanata Avenue (formerly the realigned Richardson Side Road) was originally designed for an 11.0 ha drainage area, with a peak flow rate of 1.39 m^3/s during the 50-year event. The 11.0 ha included 1.4 ha to the northeast of the Terry Fox Drive / Kanata Avenue intersection which includes the subject property (refer to Figure No. 2 in Appendix D). Based on this 2002 Dillon report during the 50-year event the headwater at the 1200 mm culvert is 0.96 m above the inlet invert (refer to Chart D5-1G reproduced in Appendix D); therefore, based on an inlet invert of 92.28, the headwater elevation was 93.24. Using HY-8 Culvert Hydraulic Analysis Program (developed by the U.S. Department of Transportation Federal Highway Administration) the headwater elevation of the 1200 mm culvert is calculated to be

approximately the same at 93.34 m (refer to the HY-8 output in Appendix D). Based on the 2002 Dillon report, it is calculated that the 100-year peak flow rate would have been 1.60 m^3/s; and 100-year peak flow rate in the 600 mm culvert crossing Kanata Avenue would have been 0.20 m^3/s. Refer to Appendix D.

As per *'Broughton Lands Subdivision Phases 1 and 2 Stormwater Management Report'* (a 2008 report prepared by Novatech Engineering Consultants Ltd), as result of the *"majority of runoff from the subdivision will be captured by the minor system and conveyed to the RRSR SWM facility"* (the Realigned Richardson Side Road SWM facility), the peak flow in 1200 mm culvert crossing Terry Fox Drive was reduced to 0.740 m^3/s during the 100-year event (refer to page 7 of the report reproduced in Appendix D). Based on this 2008 Novatech report during the 100-year event the headwaters at the 1200 mm culvert is 0.70 m above the inlet invert (0.70 = 0.58 HW/D x 1.2 D, refer to Chart D5-1G reproduced in Appendix D); therefore, based on an inlet invert of 92.28, the headwater elevation is 92.98.

As per *'Heritage Hills Condominium Development 124 Battersea Crescent … Stormwater Management Report'* (a 2016 report prepared by Novatech Engineering Consultants Ltd), the peak flow rate in 1200 mm culvert crossing Terry Fox Drive is 1.065 m^3/s during the 100-year event (refer to page 8 and 9 of the report reproduced in Appendix D). Using the HY-8 program the headwater elevation of the 1200 mm culvert is calculated to be 93.18 m. The 1200 mm culvert crossing Terry Fox Drive and 600 mm culvert crossing Kanata Avenue connect at a common manhole; therefore, the tailwater elevation of the 600 mm culvert is at the same elevation as the headwater of the 1200 mm culvert (i.e. 93.18 m). Using the HY-8 program the headwater elevation of the 600 mm culvert is calculated to be 94.00 m. Refer to the HY-8 output in Appendix D.

The 2002 Dillon report and the 2008 and 2016 Novatech reports indicate that the 1200 mm Terry Fox Drive culvert is under inlet control during the design storm event, which means tailwater level water level does not affect the capacity of the culvert during the 50-year event (as per the Dillon report) or the 100-year event (as per the Novatech reports). It is calculated that based on inlet control that the assumed tailwater elevation in these reports must be 92.50 m or lower, which means that, since the 1200mm culvert outlets directly to the Carp River, authors of these reports assumed that the Carp River was not at the 100-year flood elevation of 93.51 (as provided by the MVCA). Except as indicated below, the calculations and analysis in this report assumes that the tailwater (Carp River) elevation of the 1200 mm culvert is 92.50.

The topographic survey of the subject property and adjacent lands agrees with the 2002 Dillon report in that 1.4 ha (measured to be 14,415 m^2) to the northeast of the Terry Fox Drive / Kanata Avenue intersection drains to the 1200 mm culvert crossing Terry Fox Drive (via the 600 mm culvert crossing Kanata Avenue). This 14,355 m^2 drainage area includes the subject property and the part of the road ROW between the lot line of the subject property and the back of the municipal sidewalks. There are rear yard catch basins located in the Insmill Crescent properties that back onto the subject property that are intended to receive the rear yard drainage; however, based on the topographic survey prepared for the subject development it is calculated that about 5,725 m^2 of the Insmill Crescent rear yards drain onto the subject property. Using the Rational Method, it is calculated that, including these off-site areas (plus 60 m^2 of the road ROW at the Kanata Avenue entrance), the 100-year pre-development flow rate in the 1200 mm culvert is 1.147 m^3/s, and 0.540 m^3/s in the 600 mm culvert. Using the HY-8 program the pre-development headwater elevation of the 1200 mm culvert is calculated to be 93.22 m, and 95.54 m for the 600 mm culvert. Refer to Appendix D.

To ensure the proposed ICDs are free flowing (i.e. not submerged due to the headwater of the 600 mm culvert) extra storage capacity is proposed. To calculate the headwater elevation of the municipal culverts, the Rational and Modified Rational Methods calculations for are repeated with the off-site drainage areas

included. The City also requested that the proposed drainage system during a 5-year storm event under a scenario where the outlet of the 1200 mm culvert is submerged by the 100-year Carp River water level of 93.51.

Drainage Area I (Uncontrolled Flow Off Site – Including Off-site Drainage Areas – 2,535 m^2)
The flow rates are calculated at a time of concentration of 10 minutes.

	100-Year Event	50-Year Event	5-Year Event	2-Year Event
Maximum Flow Rate	32.39 L/s	28.16 L/s	15.19 L/s	11.20 L/s

Drainage Area II (Including Off-site Drainage Areas – 10,656 m^2)

An inlet control device (ICD) located in the outlet pipe of MH-7 will restrict the flow of stormwater and cause it to back up into the upstream infrastructure and pond above catch basins CB-1, CB/MH-2, CB/MH-4, CB/MH-5 and CB/MH-6. When the water elevation reaches 98.37 m it overflows to Drainage Area III; and the overflow rate is added as inflow to Drainage Area III. The ICD will be a plug style with a round orifice located at the bottom of the plug c/w a trash basket manufactured by Pedro Plastics or approved equivalent sized by the manufacturer for a release rate of 24.90 L/s at 2.64 m. It is calculated that an orifice area of 5,675 mm^2 (±85 mm diameter) with a discharge coefficient of 0.61 will restrict the maximum flow rate to 24.90 L/s at 2.64 m. Based on this orifice the maximum flow rate during the 50-year event is also calculated to be 24.90 L/s at 2.64 m, and during the 5-year and 2-year events it is calculated to be 1881 L/s at 1.51 m and 15.36 L/s at 1.00 m, respectively. Since some of the restricted stormwater is proposed to be stored using underground infrastructure, a release rate equal to 50% of the maximum release rate is used to calculate the required storage volumes. The underground infrastructure will include 42 – Soleno HydroStor HS180 chambers, or approved equivalent, surrounded by clear stone wrapped in a thermoplastic liner.

	100-Year Event	50-Year Event	5-Year Event	2-Year Event
Maximum ICD Release Rate	24.90 L/s	24.90 L/s	18.81 L/s	15.36 L/s
Maximum Overflow Rate	28.29 L/s	7.97 L/s	0.00 L/s	0.00 L/s
Total Maximum Release Rate	53.19 L/s	26.66 L/s	18.81 L/s	15.36 L/s
Maximum Water Elevation	98.37 m	98.37 m	97.24 m	96.74 m
Maximum Volume Required	336.36 m^3	336.36 m^3	193.13 m^3	140.45 m^3
Maximum Volume Available	336.36 m^3	336.36 m^3	336.36 m^3	336.36 m^3

Drainage Area III (Including Off-site Drainage Areas – 6,949 m^2)
An ICD located in the outlet pipe of CB/MH-14 will restrict the flow of stormwater and cause it to back up into the upstream infrastructure. When the water elevation reaches 95.67 m it will overflow via 450 mm overflow pipe. The ICD will be a plug style with a round orifice located at the bottom of the plug manufactured by Pedro Plastics or approved equivalent sized by the manufacturer for a release rate of 103.20 L/s at 1.35 m. It is calculated that an orifice area of 32,826 sq.mm (±204 mm diameter) with a discharge coefficient of 0.61 will restrict the maximum flow rate to 103.20 L/s at 1.35 m. Based on this orifice the maximum flow rate during the 50-year event is also calculated to be 103.20 L/s at 1.35 m, and during the 5-year and 2-year event it is calculated to be 74.99 L/s at 0.71 m and 56.17 L/s at 0.40 m, respectively. Since the restricted stormwater is proposed to be stored using underground infrastructure, an average release rate equal to 50% of the maximum release rate is used to calculate the required storage

volumes. The underground infrastructure will include 22 – Soleno HydroStor HS180 chambers or approved equivalent surrounded by clear stone wrapped in a waterproof thermoplastic liner.

	100-Year Event	50-Year Event	5-Year Event	2-Year Event
Maximum ICD Release Rate	103.20 L/s	103.20 L/s	74.99 L/s	56.17 L/s
Maximum Overflow Rate	79.62 L/s	17.25 L/s	0.00 L/s	0.00 L/s
Total Maximum Release Rate	182.82 L/s	120.44 L/s	74.99 L/s	56.17 L/s
Maximum Water Elevation	95.67 m	95.67 m	95.03 m	94.71 m
Maximum Volume Required	142.58 m^3	142.58 m^3	84.93 m^3	65.59 m^3
Maximum Volume Available	142.58 m^3	142.58 m^3	142.58 m^3	142.58 m^3

Summary (Including Off-site Drainage Areas)

	100-Year Event	50-Year Event	5-Year Event	2-Year Event
Pre-development Flow Rate	539.86 L/s	470.11 L/s	250.85 L/s	184.91 L/s
Maximum Post Development Flow Rate	215.21 L/s	148.61 L/s	90.18 L/s	67.37 L/s
Maximum Volume Required	478.94 m^3	478.94 m^3	278.06 m^3	206.04 m^3
Maximum Volume Available	478.94 m^3	478.94 m^3	478.94 m^3	478.94 m^3

As previously mentioned, the 100-year pre-development flow rate in the 1200 mm culvert is 1.147 m^3/s, and 0.540 m^3/s in the 600 mm culvert. Post development, it is calculated to be 1.077 m^3/s in the 1200 mm culvert and 0.215 m^3/s in the 600 mm culvert. Using the HY-8 program the post development headwater elevation of the 1200 mm culvert is calculated to be 93.19 m (slightly lower than pre-development), and 94.00 m for the 600 mm culvert, significantly lower than pre-development, and more importantly lower than the 94.21 m invert elevation of the ICD; therefore, the ICD is not submerged and the downstream pipe is free flowing. Refer to Appendix D.

Also as previously mentioned, the City requested that the proposed drainage system during a 5-year storm event under a scenario where the outlet of the 1200 mm culvert is submerged by the 100-year Carp River water level of 93.51. Using the HY-8 program the post development headwater elevation of the 1200 mm culvert is calculated to be 93.58 m, and 93.79 m for the 600 mm culvert, lower than the 94.21 m invert elevation of the ICD; therefore, the ICD is not submerged and the downstream pipe is free flowing. Refer to Appendix D.

As indicated above, the maximum post-development flow rate during the 100-year event is calculated to be 215.21 L/s, which is about 60% less than the 539.86 L/s pre-development flow rate. To achieve the 100-year maximum allowable release rate, a maximum storage volume of 479.94 m^3 is required and provided. The maximum post-development flow rate during the 50-year event is calculated to be 148.61 L/s, which is about 68% less than the 470.11 L/s pre-development flow rate. The maximum post-development flow rate during the 2-year event is calculated to be 67.37 L/s, which is about 64% less than the 184.91 L/s pre-development flow rate. (Refer to Appendix D.) Therefore, it is expected that there will be no negative impacts on flooding or erosion in the Carp River.

4.2 QUALITY CONTROL

The stormwater quality control recommendation is to provide an enhanced (80% TSS removal) level of protection. An oil grit separator (OGS) manhole is proposed to be located downstream of the inlet control device. Calculations by the manufacturer indicate that the CDS PMSU-2025-5 OGS will remove 83% of total suspended solids. Refer to calculations in Appendix D.

An Erosion & Sediment Control Plan has been developed to be implemented during construction. Refer to drawings C-8 to C-10 and notes on drawing C-11.

i. Sediment capture filter sock inserts are to be installed in all existing and proposed catch-basins and catch-basin/manholes adjacent to and within the site.
ii. A silt fence barrier is to be installed along the perimeter of the site.
iii. A geotextile mud mat is to be installed at the egress from the site.
iv. Straw bale flow check dams are to be installed.
v. Any material deposited on the public road is to be removed.

4.3 STORM SERVICING

The peak flow rate draining into the last sewer segment of the private storm sewer system during the 2-year event is calculated to be 56.16 L/s. A 450 mm storm sewer at 0.195% slope (130.43 L/s capacity) is proposed to connect to the existing 600 mm Terry Fox Drive and Kanata Avenue municipal culvert. At the peak 2-year flow rate the proposed 450 mm storm sewer will only be at 43% capacity. Refer to calculations in Appendix D.

The area, foundation and trench drains will drain to a storm sump and be pumped to an outlet 0.30 m above grade. Refer to mechanical.

5.0 CONCLUSIONS

1. Private fire hydrants are required and provided.

2. There is an adequate water supply for firefighting.

3. There is an acceptable range of water pressures.

4. Since the water pressure is expected to be above 80 psi, pressure reducing valves are to be installed immediately after the water meters.

5. The post-development sanitary flow rates will be adequately handled by the proposed sanitary sewer services and private sanitary sewer system.

6. The post-development increase in sanitary flow is expected to have an acceptable impact on the 375 mm Terry Fox Drive municipal sanitary sewer.

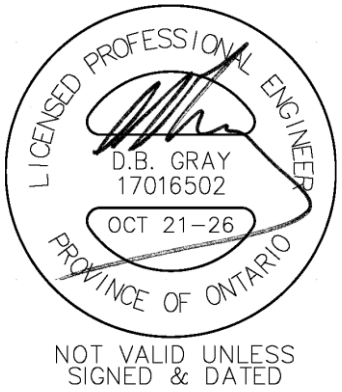
7. The maximum post-development 100-year flow rate is calculated to be 60% less than the pre-development flow rate; 68% and 64% less for the 50-year and 2-year events, respectively. The proposed stormwater management facility is expected to have a positive impact on the 1200 mm Terry Fox Drive municipal culvert, the 600 mm Kanata Avenue municipal culvert, and Carp River. It is expected that there will be no negative impacts on flooding or erosion in the Carp River.

8. The proposed OGS will provide an enhanced (80% TSS removal) level of protection.

9. An Erosion & Sediment Control Plan has been developed to be implemented during construction.

10. The peak flow rates during the 2-year event will be adequately handled by the proposed private storm sewer system.

Prepared by D.B. Gray Engineering Inc.



APPENDIX A

PRE-APPLICATION CONSULTATION MEETING NOTES

File No.: PC2024-0342

September 5, 2024

Santan Singh
Ironclad Development Inc.
Via email: ssingh@icdev.ca

Subject: **Pre-Consultation: Meeting Feedback**
Proposed Zoning By-law Amendment and Site Plan Control Application – 475 Terry Fox Drive

Please find below information regarding next steps as well as consolidated comments from the above-noted pre-consultation meeting held on August 29, 2024.

Pre-Consultation Preliminary Assessment

1 ☐	**2** ☐	**3** ☒	**4** ☐	**5** ☐

One (1) indicates that considerable major revisions are required while five (5) suggests that the proposal appears to meet the City's key land use policies and guidelines. This assessment is purely advisory and does not consider technical aspects of the proposal or in any way guarantee application approval.

Next Steps

1. Please submit any subsequent submissions to planningcirculations@ottawa.ca, copying the file lead (Nishant Dave). Ensure that all comments or issues detailed herein are addressed. A detailed cover letter stating how each issue has been addressed must be included with the submission materials. Please coordinate the numbering of your responses within the cover letter with the comment number(s) herein.

2. Please note, if your development proposal changes significantly in scope, design, or density before the next submission, you may be requested to repeat the pre-consultation process before filing an Official application.

Supporting Information and Material Requirements

1. The attached **Study and Plan Identification List** outlines the information and material that has been identified, during this phase of pre-consultation, as either required (R) or advised (A) as part of a future complete application submission.

    a. The required plans and studies must meet the City's Terms of Reference (ToR) and/or Guidelines, as available on Ottawa.ca. These ToR and Guidelines outline the specific requirements that must be met for each plan or study to be deemed adequate.

Consultation with Technical Agencies

1. You are encouraged to consult with technical agencies early in the development process and throughout the development of your project concept. A list of technical agencies and their contact information is enclosed.

Planning

Policies

The following policies apply to the site:

a. The site is designated Minor Corridor and Neighborhood with portion of the lot within an Evolving Neighbourhood overlay shown on Schedule B3 – Suburban Transect.

b. Per Schedule C16 – Road Classification and Rights-of-Way Protection – Terry Fox has a 44.5 m protected Right-of-Way.

c. Per Schedule C4 – Urban Road Network, Terry Fox Drive is classified as an Arterial – Existing Road. Kanata Avenue is classified as Major Collector Existing Road.

d. There are no applicable area-specific policies or secondary plans associated with the subject property.

Official Plan Policies

1. The subject property is located in the suburban transect, designated Minor Corridor and Neighborhood, with portion of the lot within the Evolving Neighborhood. The overarching vision for this designation is supporting a mix of uses, including residential uses, higher densities along corridors and contributing to the goals of towards 15-minute neighbourhood.

2. Staff note that the proposed development of three, six-storey apartment dwellings on the subject site generally align with the OP policies.

Zoning

3. General Zoning Performance Requirements

    a. A major zoning by-law amendment will be required to add apartment dwelling, mid-rise as a permitted use.

    b. Provide additional dimensions on plans to confirm zoning compliance and/or identify any performance standards requiring relief.

4. Right of Way (ROW)

a. Please indicate the ROW boundaries on your site plan on Terry Fox Drive as part of your next submission.

5. Site Design and Configurations

    a. Staff are appreciative of the desire to redevelop this vacant, underutilized site.

    b. Explore opportunities to include active commercial services on ground floor to support cultural development in order to maintain, extend, or create a continuous stretch of active frontages along a Minor Corridor. Refer to section 6.2.2., subsection 1 of the Official Plan.

    c. Please explore alternative iterations of site configurations and building shape for this site. Consider reducing the number of buildings from three to two buildings.

        i. Consider amalgamating Building A and B into one L – shaped building, providing active frontages to both Terry Fox Drive and Kanata Avenue.

6. Landscaping Requirements

    a. Please note a minimum of 3-meter landscaped buffer is required along the perimeter of the subject property that abuts a public street, per Table 110 of the Zoning By-law. There appears to be deficiencies in the following location:

        i. Along the parking spaces and lot line abutting Kanata Avenue. Shift the parking spaces to accommodate for the 3-meter landscaped buffer.

    b. Consider opportunities for additional landscaping throughout the proposed surface parking lot through landscaped islands, landscaped medians, etc.

    c. Provide natural landscaping along the rear lot line to provide a tree buffer between the proposed development and residential homes to the east.

7. Aisle and Driveway

    a. Please provide rationale for a 7-meter driveway width to the underground parking spaces. Consider reducing the width to provide additional landscaping through landscaped islands, landscaped medians, etc. Refer to Section 107 of the Zoning By-law for additional information.

8. Amenity Area

a. How is the outdoor amenity area by Building C, fronting Terry Fox Drive, intended to function? Are all residents to use that space? Consider providing additional outdoor amenity areas closer to Buildings A and B for easy pedestrian access.

9. Parking Requirements

    a. Please provide parking calculations as part of the next submission.

    b. Please provide parking measurements as part of the next submission.

    c. Refer to Section 101, Table 101 of the Zoning By-law for applicable parking rates.

    d. Please provide rationale for substantial surface parking spaces. Consider reducing or shifting the parking spaces underground to provide additional landscaping throughout the site.

10. Bicycle Parking Requirements

    a. Provide additional information on proposed bicycle parking in the next submission. How many interior bicycle parking spaces are being provided?

        i. Please provide an adequate number of bicycle parking facilities in accordance with Policy 9 of Section 4.1.2:

            1. Long-term bicycle parking facilities shall be secure, sheltered and usable by all types of cyclists. Where located inside buildings, long-term bicycle parking facilities shall provide safe, accessible, direct and convenient access to the exterior; and

            2. Short-term bicycle parking facilities shall be highly visible, well-lit, near building entrances and where appropriate, sheltered.

    b. Provide bicycle parking calculation in the next submission.

    c. Please provide surface bicycle parking on site.

    d. Provide design details of the proposed bicycle parking in the next submission.

11. Waste Management Requirements

a. Refer to Section 110(3) of the Zoning By-law for provisions related to outdoor refuse collection areas located within or accessed via a parking lot.

b. Please note that all outdoor refuse collection and refuse loading areas contained within or accessed via a parking lot must be screened from view by an opaque screen with a minimum height of 2.0 metres, per Section 110(3)(c); however, where an in-ground refuse container is provided, the screening requirement of Section (3)(c) above may be achieved with soft landscaping, as per Section 110(3)(d).

c. Provide design details of the proposed waste enclosures.

d. Provide measurements for the proposed waste enclosure. Please note that the bins must be located at least 9 meters from a lot line abutting a public street, and 3 meters from any other lot line, as per Section 110(3)(a). There appears to be deficiencies in the following location:

    i. The waste enclosure abutting the lot line against Kanata Avenue. Please provide measurements to ensure zoning compliance; if not compliant, please shift the waste enclosure accordingly.

Required Applications

12. The following development applications are required to permit the proposed development. Please note all information including process, timeline and fees can be found here:

    a. Site Plan Control (Complex) – more information on the process can be found here.
    b. Zoning By-law Amendment (Major) – more information on the process can be found here.

Feel free to contact Nishant Dave, Planner I, for follow-up questions.

Urban Design

Comments:

13. Staff require a scoped Urban Design Brief, architectural plans (Site Plan, Building Elevations, etc.), and a Landscape Plan. Please refer to the attached Urban Design Brief Terms of Reference.

14. The development should be oriented towards public roads.

15. Active frontage along Terry Fox Drive and Kanata Avenue desired. Explore the potential for grade-related units and ground floor amenity areas.

16. Street trees required along Terry Fox Drive and Kanata Avenue.

17. Parking should be screened entirely from the public realm. Please endeavor to limit surface parking if possible.

18. Explore the potential to consolidate parking to limit the number of parking garage ramps.

19. Consideration for the corner – opportunity for enhanced architecture and landscaping.

20. Please provide a heavily landscaped buffer between the development and the adjacent low-rise neighbourhood.

21. Please relocate the waste room so that it is internal to the property and not along the public street.

22. Please provide outdoor amenity area details and ensure that there is some level of engagement with the adjacent park.

Feel free to contact Nader Kadri, Planner III, for follow-up questions.

Engineering

Watermain Design

23. Boundary Conditions - civil consultant to request boundary conditions from the City's assigned Project Manager, Development Review. Water boundary conditions request must include the location of the service and the expected loads required by the proposed development. Please provide all the following information:

    a. Location of service (show on a plan or map)

    b. Type of development

    c. Average daily demand: ___ l/s.

    d. Maximum daily demand: ___l/s.

    e. Maximum hourly daily demand: ___ l/s.

    f. Required fire flow.

g. Supporting Calculations for all demands listed above and required fire flow as per Fire Underwriter Surveys.

24. Provide a watermain system analysis demonstrating adequate pressure as per section 4.2.2 of the Water Distribution Guidelines.

25. Demonstrate adequate hydrant coverage for fire protection. Please review Technical Bulletin ISTB-2018-02, Appendix I table 1 – maximum flow to be considered from a given hydrant.

26. There is currently no existing public watermain along the frontage of the site on Terry Fox Drive and Kanata Avenue. Since this development is proposing more than 50 residential units, a looped system is required to service this site.

    Internal discussions with stakeholders are on-going to determine the best alternative for the watermain extension. Although it was shared during the pre-consultation meeting with the applicant that the watermain could likely be extended through the park, it has been determined later on that this will not be accepted by the park's group.

    Additional information on the situation will be provided in a separate email once internal water groups have agreed on a better watermain alternative.

27. Please note that the watermain extension will need to be designed and approved prior to the approval of the site plan application. A design for the watermain will need to be submitted along with securities.

28. Two watermains separated by an isolation valve will be required to avoid the creation of a vulnerable service area for proposed developments with more than 50 residential units.

<u>Stormwater Management</u>

29. The Stormwater Management Criteria, for the subject site, is to be based on the following:

    a. Where no governing reports are present and/or there are no specific quantity control requirements, the following shall apply:

        i. The development should be controlled to ensure that post-development conditions (including flows) are consistent with pre-development conditions for all storm events (2-yr, 5-yr & 100-yr).

            - The applicant must demonstrate that there will be no increase in flooding and/or erosion to/of the Carp River;

        ii. The Carp River PCSWMM model shall be used as the representative pre-development condition for comparison purposes.

b. Base Flow Mitigation - Adhere to the Carp River Watershed Study (CRWSS) and provide a minimum of 10l/s over a 7-day period.

c. A minimum 70% Total Suspended Solids (TSS) removal per the CRWSS. Please consult the MVCA, as they may have additional quality control criteria for this development.

d. Infiltration target for this site is expected to be 73mm/year (low recharge area). Soil Infiltration testing will be required to support any proposed infiltration measure to meet this target.

Sanitary Design

30. A capacity review of the receiving 375mm sanitary pipe is required to demonstrate there is adequate residual capacity to accommodate the proposed development. The assessment shall take into account the approved growth in and around the Kanata Highlands. Please refer to *06 External Sanitary Servicing Plan.pdf*.

31. Please apply the wastewater design flow parameters in Technical Bulletin PIEDTB-2018-01.

Additional Comments

32. 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.

33. Provide information on the monitoring manhole requirements – should be located in an accessible location on private property near the property line (i.e., not in a parking area).

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

    i. Std Dwg S11.1 for flexible main sewers – connections made using approved tee or wye fittings.

    ii. Std Dwg S11 (For rigid main sewers) – lateral must be less that 50% the diameter of the sewermain,

    iii. 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 that 50% the diameter of the sewermain,

    iv. 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.

35. An MECP Environmental Compliance Approval may be required for the proposed development, depending on the details of a complete submission. The applicant is advised to refer to the Ontario Regulation 525/98 Approval Exemptions to confirm if an ECA is required.

36. The developer is notified that a Capital Works Project for resurfacing of Terry Fox is anticipated for 2028.

37. A slope stability report may be required for this site. Please consult the City of Ottawa Slope Stability Guidelines for Development Applications prior to your next submission.

38. A **Hydrogeological and Terrain Analysis Report** is likely required for this site. It is understood that the proposal does not contemplate using groundwater as a water supply or to install private servicing in the form of a septic system on the site. Therefore, the scope of the report would be to report on any impacts to groundwater. The requirements of these reports are outlined in the City's Hydrogeological and Terrain Analysis Guidelines in sections 5.0 for Site Plan Control Applications, 7.0 for Zoning By-law and Official Plan Amendments, and section 10.0 for Stormwater Management.

    a. A report would be required if the proposal involves:

        i. On-site stormwater management or infiltration features (e.g., ponds, LIDs, or underground storage). Infiltration is anticipated based on Carp River Subwatershed Study requirements. The report should provide a thorough understanding of the interaction between surface water and groundwater in order to ensure that the stormwater feature will operate as intended and that surrounding properties are not unduly impacted, and groundwater will not be contaminated, or

        ii. Dewatering operations to complete the works which could impact adjacent structures.

    b. Please contact the hydrogeological reviewer, Travis Smith (travis.smith@ottawa.ca), to submit proposed Terms of Reference for the work prior to any work being undertaken.

Feel free to contact Jean-Miguel Roy, Project Manager, for follow-up questions.

Noise

Comments:

39. Road noise study required at site plan control only.

Feel free to contact Mike Giampa (mike.giampa@ottawa.ca), TPM, for follow-up questions.

Transportation

Comments:

40. Right-of-way protection (Terry Fox and Kanata).

    a. See Schedule C16 of the Official Plan.

    b. Any requests for exceptions to ROW protection requirements must be discussed with Transportation Planning and concurrence provided by Transportation Planning management.

41. A TIA is required. The application will not be deemed complete until the submission of the draft step 2 (Scoping) including the functional draft RMA package (if applicable) and/or monitoring report (if applicable). Although a full review of the TIA Strategy report (step 3) is not required prior to an application, it is strongly recommended. Synchro files are required at Step 3.

42. The new required corner triangle dimensions will be embedded within Schedule C16 of the OP in 2024. For now, here is the requirements at all intersection types:

    a. Arterial/Arterial: overlapping 5m x 15m triangles

    b. Arterial/Collector: overlapping 5m x 15m triangles

    c. Collector/Collector: overlapping 5m x 15m triangles

    d. Arterial/Local: 3m x 9m with the longer dimension along the arterial road

    e. Collector/Local: 3m x 9m with the longer dimension along the collector road

43. No issues with the location of the proposed accesses as shown in the concept plan.

Feel free to contact Mike Giampa (mike.giampa@ottawa.ca), Transportation Project Manager, for follow-up questions.

Environment

Comments:

44. Bird Safe Design (since they are over 4 stories and near the Carp River natural area). Please review and incorporate bird safe design elements. Some of the risk factors include glass and related design traps such as corner glass and fly-

through conditions, ventilation grates and open pipes, landscaping, light pollution. More guidance and solutions are available in the guidelines which can be found here: https://documents.ottawa.ca/sites/documents/files/birdsafedesign_guidelines_en.pdf

45. Urban heat Island effect - 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 with low heat absorbing materials.

Feel free to contact Matthew Hayley (matthew.hayley@ottawa.ca), Environmental Planner, for follow-up questions.

Forestry

Comments:

46. Tree Conservation Report

    a. A Tree Conservation Report is required, in accordance with Schedule E of the Tree Protection By-law. Ownership of all trees on the subject site and with Critical Root Zones extending onto the subject site must be determined, and plans must show how they will be protected from proposed works.

    b. Section 4.8.2 of the New Official Plan provides strong direction to maintain the urban forest canopy and its ecosystem services during intensification noting when considering the impacts on individual trees, planning and development decisions, including Committee of Adjustment decisions, shall give priority to the retention and protection of large, healthy trees over replacement plantings and compensation. Applications must address the cumulative impacts on the urban forest, over time and space, with the goal of 40% urban forest canopy cover in mind. Further, that the City and the Committee of Adjustment may refuse a development application where it deems the loss of a tree(s) avoidable.

    c. The locations of vehicle entrances, curbs, buildings and above and below-ground structures should account for the retention and protection of significant trees on and adjacent to the site, particularly those that provide privacy for neighboring properties.

    d. Ownership of all existing trees must be determined in the TCR. If any shared or adjacent trees are impacted by the proposal, the applicant is responsible for consulting with the owners of the trees and for obtaining signed permission if any trees must be removed. If no permission is

granted, plans must be designed to allow for the full protection of these trees.

i. The trees along the east property line, providing shade and screening for the houses facing Insmill should be prioritized for retention, as well as any trees on City property.

ii. The setbacks for the proposed underground parking must be determined based on the ability to safely retain existing trees and/or to plant new trees with adequate soil volumes.

e. Consider opportunities to reduce surface parking to provide more greenspace on site.

f. A permit is required prior to removal of any protected trees on site. The tree permit will be released upon site plan approval. Please contact the planner associated with the file or the Planning Forester, Nancy Young (Nancy.young@ottawa.ca) for information on obtaining the tree permit.

g. To ensure that no harm is caused to breeding birds, tree removal and vegetation clearing should be avoided during the migratory bird season (April 15 – August 15) as specified by The City of Ottawa's Environmental Impact Study Guidelines.

47. Landscape Plan

a. A Landscape Plan is required with this application and must address all requirements within the Landscape Plan Terms of Reference https://documents.ottawa.ca/sites/documents/files/landscape_tor_en.pdf , including the projection of canopy cover toward the target of 40%, and confirmation of adequate soil volumes to support any proposed trees.

b. The Landscape Plan must show the setback distances between proposed and existing trees to buildings and underground structures to ensure that both the above and below-ground space proposed is sufficient for tree planting in the Right of Way and other landscaped areas.

c. The Official Plan section 4.8.2, sub 3 provides the following direction related to tree planting related to site plans:

i. Preserve and provide space for mature, healthy trees on private and public property, including the provision of adequate volumes of high-quality soil as recommended by a Landscape Architect;

ii. On urban properties subject to site plan control or community planning permits, development shall create tree planting areas within the site and in the adjacent boulevard, as applicable, that meet the soil volume requirements in any applicable City standards

or best management practices or in accordance with the recommendation of a Landscape Architect;

d. It is strongly encouraged to provide an area of green space with trees for shade on this property, both for amenity and to address the urban heat island created by surface parking.

e. Space must be provided on both the Terry Fox and Kanata Ave frontages (preferably within the ROW) to plant street trees to improve the streetscape and canopy cover of the site.

f. It is a Best Management Practice to provide one tree for every 5 surface parking spaces to address the urban heat island effect created by the pavement. Retention of existing trees in proximity to parking would count toward this.

48. Tree Conservation Report Requirements

a. a Tree Conservation Report (TCR) must be supplied for review along with the suite of other plans/reports required by the City.

    i. an approved TCR is a requirement of Site Plan approval.

    ii. The TCR may be combined with the LP provided all information is supplied.

b. 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.

c. Compensation may be required for the removal of city owned trees.

d. The TCR must contain 2 separate plans:

    i. Plan/Map 1 - show existing conditions with tree cover information.

    ii. Plan/Map 2 - show proposed development with tree cover information.

    iii. Please ensure retained trees are shown on the landscape plan.

e. 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.

f. please identify trees by ownership – private onsite, private on adjoining site, city owned, co-owned (trees on a property line)

g. If trees are to be removed, the TCR must clearly show where they are, and document the reason they cannot be retained.

h. 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.

    i. the location of tree protection fencing must be shown on the plan.

    ii. show the critical root zone of the retained trees.

i. 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.

49. Landscape Plan tree planting requirements.

a. The City recommends the following Best Management Practices to improve the climate change resiliency of new developments:

    i. For parking lots, provide 1 new tree for every 5 parking spaces to help cool the landscape of the site.

    ii. Confirm sufficient Soil volumes to support canopy cover on site ($30m^3$ for street trees)

    iii. Proposed species must not include invasive species and target a minimum of 50% native species.

b. Minimum Setbacks

    i. Maintain 1.5m from sidewalk or MUP/cycle track or water service laterals.

    ii. Maintain 2.5m from curb.

    iii. Coniferous species require a minimum 4.5m setback from curb, sidewalk or MUP/cycle track/pathway.

    iv. 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.

c. Tree specifications

i. Minimum stock size: 50mm tree caliper for deciduous, 200cm height for coniferous.

ii. Maximize the use of large deciduous species wherever possible to maximize future canopy coverage.

iii. 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).

iv. Plant native trees whenever possible.

v. No root barriers, dead-man anchor systems, or planters are permitted.

vi. No tree stakes unless necessary (and only 1 on the prevailing winds side of the tree)

d. Hard surface planting

i. Curb style planter is highly recommended.

ii. No grates are to be used and if guards are required, City of Ottawa standard (which can be provided) shall be used.

iii. Trees are to be planted at grade.

e. Soil Volume

i. Please document on the LP that adequate soil volumes can be 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

f. Sensitive Marine Clay

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

50. Tree Canopy

    a. 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.

    b. 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.

51. Zoning Comments

    a. Generally speaking, since the majority of the area between buildings is proposed to be paved for parking with little to no opportunity for landscaping, it is preferred to consolidate the underground parking under all 3 buildings to reduce surface parking and provide greater setbacks between above and below-ground parking to the lot lines. This would provide more greenspace and plantable area between the new buildings and existing residences, as well as provide more amenity space.

    b. The following setbacks will be established through the zoning:

        i. The setbacks for all proposed elements along the east property line, adjacent to residential use, both above and below-ground, to allow for the retention and long-term viability of the existing trees, which provide screening and canopy cover for the site.

        ii. The setbacks for proposed elements near the Terry Fox and Kanata frontages which must be sufficient to plant large-growing trees for screening and canopy cover.

Feel free to contact Nancy Young (nancy.young@ottawa.ca), Forester, for follow-up questions.

Parkland

52. Parkland Dedication

    a. The amount of required parkland conveyance is to be calculated as per the City of Ottawa Parkland Dedication By-law No.2022-280 (or as amended):

    b. For cash-in-lieu of conveyance of parkland (residential > 18 units/net ha):

i. one hectare per 1,000 net residential units but shall not exceed a maximum of 10% of the gross land area where less than or equal to five hectares.

53. Form of Parkland Dedication

a. PFP will be requesting **cash-in-lieu of conveyance of parkland** for parkland dedication in accordance with the Parkland Dedication By-law.

b. At the time of site plan application PFP requests the following information to confirm and calculate the parkland conveyance:

i. Gross land area, in square meters
ii. Number of residential units proposed/existing
iii. Gross floor area of proposed residential development
iv. Gross floor area of proposed/existing commercial development
v. The proportion of commercial/residential development proposed on site.

c. Please note, if the proposed unit count, land use changes or gross floor area changes, then the parkland dedication requirement will be re-evaluated accordingly.

d. Cash-in-lieu of conveyance of parkland will be required prior to registration of the Site Plan Agreement. The Owner shall also pay the City's property appraisal fee.

54. Additional Comment for PFP staff:

a. Please note the site is adjacent to an existing park. No construction impacts will be permitted on the park.

b. Constrained park blocks are not accepted, and Parks is not amenable to a waterline being installed in the park. Another solution to service the site will be required.

c. Please note that zoning exceptions to permit reduced setbacks to the park boundary will not be supported by Parks and Facilities planning. Staff recommend a minimum of 3 meter setback of all above and below ground structures to the park boundary.

Feel free to contact Anissa McAlpine (anissa.mcalpine@ottawa,ca), Parks Planner, for follow-up questions.

Other

55. The High Performance Development Standard (HPDS) is a collection of voluntary and required standards that raise the performance of new building projects to achieve sustainable and resilient design. The HPDS was passed by Council on April 13, 2022.

    a. At this time, the HPDS is not in effect and Council has referred the 2023 HPDS Update Report back to staff with direction to bring forward an updated report to Committee with recommendations for revised phasing timelines, resource requirements and associated amendments to the Site Plan Control By-law by no later than Q1 2024.

    b. Please refer to the HPDS information attached and ottawa.ca/HPDS for more information.

Submission Requirements and Fees

1. The attached **Study and Plan Identification List** outlines the information and material that has been identified as either required (R) or advised (A) as part of a future complete application submission.
    a. The required plans and studies must meet the City's Terms of Reference (ToR) and/or Guidelines, as available on Ottawa.ca. These ToR and Guidelines outline the specific requirements that must be met for each plan or study to be deemed adequate.
2. All of the above comments or issues should be addressed to ensure the effectiveness of the application submission review.

Should there be any questions, please do not hesitate to contact myself or the contact identified for the above areas / disciplines.

Yours Truly,
Nishant Dave

c.c. Stream Shen, Planner III (DR West)
Nader Kadri, Senior UD Planner
Sahara Shrestha, UD Planner
Jean-Migel Roy, Infrastructure Project Manager
Ryan Brault, Infrastructure Project Manager
Mike Giampa, Senior Transportation Project Manager
Anissa McAlpine, Parks Planner

Nancy Young, Planning Forester
Matthew Hayley, Environmental Planner

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

October 28, 2025

475 Terry Fox Drive
6-Storey Apartment Building A
Ottawa, Ontario

FIRE FLOW CALCULATIONS
FUS Method

RFF = Required Fire Flow in litres per minute
= $220CA^{0.5}$

C = Construction Coefficient related to the type of construction of the building
= 1.5 Type V Wood Frame Construction

A = Total Effective Floor Area in square meters of the building

6th Floor:	1,295	sq.m
5th Floor:	1,295	sq.m
4th Floor:	1,295	sq.m
3rd Floor:	1,295	sq.m
2nd Floor:	1,295	sq.m
1st Floor:	1,295	sq.m
	7,770	sq.m

RFF = 29,089 L/min
= 29,000 L/min (rounded to nearest 1,000 L/min)

Occupancy and Contents Adjustment Factor
-15% Limited Combustible Contents

= -4,350 L/min Occupancy and Contents Adjustment Factor

RFF = 24,650 L/min

Automatic Sprinkler Protection Credit

30%	Sprinkler system designed, installed and maintained in accordance with NFPA standards
10%	Standard water supply for both the sprinkler system and fire department hose lines
10%	Fully supervised sprinkler system

= 12,325 L/min Automatic Sprinkler Protection Credit

Exposure Adjustment Charge

Side	Charge	Distance	Construction	Length	Storeys	Factor
North	0%	over 30 m				
East	0%	over 30 m				
South	0%	Automatic Sprinkler Protection in both Subject and Exposed Buildings				
West	0%	over 30 m				

0% Exposure Adjustment Charge

= 0 L/min Exposure Adjustment Charge

RFF = 12,325 L/min

= 12,000 L/min (rounded to nearest 1,000 L/min)

= 200 L/s

D.B. Gray Engineering Inc.

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

700 Long Point Circle
Ottawa, Ontario K1T 4E9

613-425-8044
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October 28, 2025

475 Terry Fox Drive
6-Storey Apartment Building B
Ottawa, Ontario

FIRE FLOW CALCULATIONS
FUS Method

RFF = Required Fire Flow in litres per minute
= $220CA^{0.5}$

C = Construction Coefficient related to the type of construction of the building
= 1.5 Type V Wood Frame Construction

A = Total Effective Floor Area in square meters of the building

6th Floor:	1,025	sq.m
5th Floor:	1,025	sq.m
4th Floor:	1,025	sq.m
3rd Floor:	1,025	sq.m
2nd Floor:	1,025	sq.m
1st Floor:	1,025	sq.m
	6,150	sq.m

RFF = 25,879 L/min
= 26,000 L/min (rounded to nearest 1,000 L/min)

Occupancy and Contents Adjustment Factor
-15% Limited Combustible Contents

= -3,900 L/min Occupancy and Contents Adjustment Factor

RFF = 22,100 L/min

Automatic Sprinkler Protection Credit

30%	Sprinkler system designed, installed and maintained in accordance with NFPA standards
10%	Standard water supply for both the sprinkler system and fire department hose lines
10%	Fully supervised sprinkler system

= 11,050 L/min Automatic Sprinkler Protection Credit

Exposure Adjustment Charge

Side	Charge	Distance	Construction	Length	Storeys	Factor
North	0%	Automatic Sprinkler Protection in both Subject and Exposed Buildings				
East	0%	Automatic Sprinkler Protection in both Subject and Exposed Buildings				
South	0%	over 30 m				
West	0%	over 30 m				

0% Exposure Adjustment Charge

= 0 L/min Exposure Adjustment Charge

RFF = 11,050 L/min

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

= 183.3 L/s

D.B. Gray Engineering Inc.

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

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October 28, 2025

475 Terry Fox Drive
6-Storey Apartment Building C
Ottawa, Ontario

FIRE FLOW CALCULATIONS
FUS Method

RFF = Required Fire Flow in litres per minute
= $220CA^{0.5}$

C = Construction Coefficient related to the type of construction of the building
= 1.5 Type V Wood Frame Construction

A = Total Effective Floor Area in square meters of the building

6th Floor:	1,075	sq.m
5th Floor:	1,075	sq.m
4th Floor:	1,075	sq.m
3rd Floor:	1,075	sq.m
2nd Floor:	1,075	sq.m
1st Floor:	1,075	sq.m
	6,450	sq.m

RFF = 26,503 L/min
= 27,000 L/min (rounded to nearest 1,000 L/min)

Occupancy and Contents Adjustment Factor
-15% Limited Combustible Contents

= -4,050 L/min Occupancy and Contents Adjustment Factor

RFF = 22,950 L/min

Automatic Sprinkler Protection Credit

30%	Sprinkler system designed, installed and maintained in accordance with NFPA standards
10%	Standard water supply for both the sprinkler system and fire department hose lines
10%	Fully supervised sprinkler system

= 11,475 L/min Automatic Sprinkler Protection Credit

Exposure Adjustment Charge

Side	Charge	Distance	Construction	Length	Storeys	Factor
North	0%	over 30 m				
East	0%	over 30 m				
South	0%	over 30 m				
West	0%	Automatic Sprinkler Protection in both Subject and Exposed Buildings				

0% Exposure Adjustment Charge

= 0 L/min Exposure Adjustment Charge

RFF = 11,475 L/min

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

= 183.3 L/s

Boundary Conditions
475 Terry Fox

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	72	1.20
Maximum Daily Demand	234	3.90
Peak Hour	354	5.90
Fire Flow Demand #1	12,000	200.00

Location



Results

Connection 1 – Kanata Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	161.3	75.4
Peak Hour	156.2	68.2
Max Day plus Fire Flow #1	143.7	50.5

[1] Ground Elevation = 108.2 m

Connection 2 – Terry Fox Drive

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	161.3	92.9
Peak Hour	156.2	85.7
Max Day plus Fire Flow #1	132.0	51.3

[1] Ground Elevation = 95.9 m

Notes

1. *As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:*
    - *If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.*
    - *Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.*

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. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

June 23, 2026

Building A Fire Flows, 475 Terry Fox Drive

Ottawa, Ontario

EPANET RESULTS

Fire Flow Demand: 200 L/s

Maximum Daily Demand: 3.9 L/s

Fire Flow + Maximum Daily Demand: 203.9 L/s

Node ID	Demand (L/s)	HGL (m)	Elevation (m)	Pressure (m)	Pressure (kPa)	Pressure (psi)
1 - Tillsonburg Street Reservoir	-61.9	132.0	96.00	36.0	353	51
2 - FH-1	0.0	130.3	95.95	34.4	337	49
3 - FH-2	0.0	128.5	96.00	32.5	319	46
4 - FH-3	0.0	126.2	96.05	30.2	296	43
5 - FH-4	0.0	122.6	96.45	26.2	256	37
6 - FH-5	50.0	120.8	98.65	22.2	217	31
7 - Kanata Avenue Reservoir	-142.0	143.7	104.90	38.8	380	55
8 - FH-6	0.0	130.5	101.85	28.7	281	41
9 - E+000.0	0.0	120.9	99.25	21.7	212	31
10 - A+000.0	0.0	120.7	99.25	21.5	210	31
11 - B+000.0	0.0	116.5	98.20	18.3	179	26
12 - C+000.0	0.0	116.4	98.30	18.1	177	26
13 - D+000.0	0.0	116.4	98.35	18.1	177	26
14 - F+000.0	0.0	117.4	98.80	18.6	182	26
15 - A+164.0, E+138.2	0.0	116.5	98.15	18.4	180	26
16 - G+000.0	0.0	116.3	98.15	18.2	178	26
17 - FH-7	50.0	115.2	98.50	16.7	164	24
18 - Building A	1.3	116.4	98.55	17.9	175	25
19 - Building B	1.3	116.4	98.55	17.9	175	25
20 - FH-8	50.0	116.3	98.95	17.4	170	25
21 - FH-9	50.0	115.3	98.40	16.9	166	24
22 - H+000.0	0.0	116.5	98.15	18.4	180	26
23 - Building C	1.3	116.5	98.10	18.4	180	26

Link ID	Length (m)	Diameter (mm)	Roughness Coefficient	Minor Loss Coefficient	Flow (L/s)	Velocity (m/s)
1 - Node 1 to Node 2	50.6	200	110	2.20	61.9	2.0
2 - Node 2 to Node 3	63.6	200	110	0.60	61.9	2.0
3 - Node 3 to Node 4	84.6	200	110	0.60	61.9	2.0
4 - Node 4 to Node 5	104.9	200	110	4.30	61.9	2.0
5 - Node 5 to Node 6	65.5	200	110	0.60	61.9	2.0
6 - Node 6 to Node 10	15.1	200	110	0.60	11.9	0.4
7 - Node 7 to Node 8	90.8	200	110	2.20	142.0	4.5
8 - Node 8 to Node 9	71.2	200	110	0.90	142.0	4.5
9 - Node 9 to Node 10	2	200	110	0.80	56.9	1.8
10 - Node 10 to Node 11	106.4	200	110	3.70	68.9	2.2
11 - Node 11 to Node 12	6.8	200	110	0.60	18.9	0.6
12 - Node 12 to Node 13	2	200	110	0.80	17.6	0.6
13 - Node 13 to Node 16	42.9	200	110	1.25	16.3	0.5
14 - Node 9 to Node 14	52.6	200	110	2.95	85.0	2.7
15 - Node 14 to Node 15	85.6	200	110	1.85	35.0	1.1
16 - Node 15 to Node 16	5.9	200	110	1.80	33.7	1.1
17 - Node 11 to Node 17	5.5	150	100	2.00	50.0	2.8
18 - Node 12 to Node 18	10.6	150	100	2.25	1.3	0.1
19 - Node 13 to Node 19	10.7	150	100	2.25	1.3	0.1
20 - Node 14 to Node 20	3.1	150	100	2.00	50.0	2.8
21 - Node 16 to Node 21	2	150	100	2.00	50.0	2.8
22 - Node 15 to Node 22	4	200	110	0.80	1.3	0.0
23 - Node 22 to Node 23	33.6	150	100	1.30	1.3	0.1

June 23, 2026

Building B Fire Flows, 475 Terry Fox Drive

Ottawa, Ontario

EPANET RESULTS

Fire Flow Demand: 183.3 L/s

Maximum Daily Demand: 3.9 L/s

Fire Flow + Maximum Daily Demand: 187.2 L/s

Node ID	Demand (L/s)	HGL (m)	Elevation (m)	Pressure (m)	Pressure (kPa)	Pressure (psi)
1 - Tillsonburg Street Reservoir	-53.2	132.0	96.00	36.0	353	51
2 - FH-1	0.0	130.7	95.95	34.8	341	49
3 - FH-2	0.0	129.4	96.00	33.4	327	47
4 - FH-3	0.0	127.6	96.05	31.6	309	45
5 - FH-4	0.0	124.9	96.45	28.5	279	40
6 - FH-5	0.0	123.6	98.65	25.0	245	35
7 - Kanata Avenue Reservoir	-134.1	143.7	104.90	38.8	380	55
8 - FH-6	0.0	131.8	101.85	30.0	294	43
9 - E+000.0	0.0	123.2	99.25	24.0	235	34
10 - A+000.0	0.0	123.2	99.25	24.0	235	34
11 - B+000.0	0.0	116.9	98.20	18.7	183	27
12 - C+000.0	0.0	116.9	98.30	18.6	182	26
13 - D+000.0	0.0	116.9	98.35	18.6	182	26
14 - F+000.0	0.0	118.1	98.80	19.3	189	27
15 - A+164.0, E+138.2	0.0	116.9	98.15	18.8	184	27
16 - G+000.0	0.0	116.7	98.15	18.6	182	26
17 - FH-7	61.1	115.0	98.50	16.5	162	23
18 - Building A	1.3	116.9	98.55	18.4	180	26
19 - Building B	1.3	116.8	98.55	18.3	179	26
20 - FH-8	61.1	116.5	98.95	17.6	172	25
21 - FH-9	61.1	115.2	98.40	16.8	165	24
22 - H+000.0	0.0	116.9	98.15	18.8	184	27
23 - Building C	1.3	116.9	98.10	18.8	184	27

Link ID	Length (m)	Diameter (mm)	Roughness Coefficient	Minor Loss Coefficient	Flow (L/s)	Velocity (m/s)
1 - Node 1 to Node 2	50.6	200	110	2.20	53.2	1.7
2 - Node 2 to Node 3	63.6	200	110	0.60	53.2	1.7
3 - Node 3 to Node 4	84.6	200	110	0.60	53.2	1.7
4 - Node 4 to Node 5	104.9	200	110	4.30	53.2	1.7
5 - Node 5 to Node 6	65.5	200	110	0.60	53.2	1.7
6 - Node 6 to Node 10	15.1	200	110	0.60	53.2	1.7
7 - Node 7 to Node 8	90.8	200	110	2.20	134.1	4.3
8 - Node 8 to Node 9	71.2	200	110	0.90	134.1	4.3
9 - Node 9 to Node 10	2	200	110	0.80	31.2	1.0
10 - Node 10 to Node 11	106.4	200	110	3.70	84.4	2.7
11 - Node 11 to Node 12	6.8	200	110	0.60	23.3	0.7
12 - Node 12 to Node 13	2	200	110	0.80	22.0	0.7
13 - Node 13 to Node 16	42.9	200	110	1.25	20.7	0.7
14 - Node 9 to Node 14	52.6	200	110	2.95	102.8	3.3
15 - Node 14 to Node 15	85.6	200	110	1.85	41.7	1.3
16 - Node 15 to Node 16	5.9	200	110	1.80	40.4	1.3
17 - Node 11 to Node 17	5.5	150	100	2.00	61.1	3.5
18 - Node 12 to Node 18	10.6	150	100	2.25	1.3	0.1
19 - Node 13 to Node 19	10.7	150	100	2.25	1.3	0.1
20 - Node 14 to Node 20	3.1	150	100	2.00	61.1	3.5
21 - Node 16 to Node 21	2	150	100	2.00	61.1	3.5
22 - Node 15 to Node 22	4	200	110	0.80	1.3	0.0
23 - Node 22 to Node 23	33.6	150	100	1.30	1.3	0.1

June 23, 2026

Building C Fire Flows, 475 Terry Fox Drive

Ottawa, Ontario

EPANET RESULTS

Fire Flow Demand: 183.3 L/s

Maximum Daily Demand: 3.9 L/s

Fire Flow + Maximum Daily Demand: 187.2 L/s

Node ID	Demand (L/s)	HGL (m)	Elevation (m)	Pressure (m)	Pressure (kPa)	Pressure (psi)
1 - Tillsonburg Street Reservoir	-53.2	132.0	96.00	36.0	353	51
2 - FH-1	0.0	130.7	95.95	34.8	341	49
3 - FH-2	0.0	129.4	96.00	33.4	327	47
4 - FH-3	0.0	127.6	96.05	31.6	309	45
5 - FH-4	0.0	124.9	96.45	28.5	279	40
6 - FH-5	0.0	123.6	98.65	25.0	245	35
7 - Kanata Avenue Reservoir	-134.1	143.7	104.90	38.8	380	55
8 - FH-6	0.0	131.8	101.85	30.0	294	43
9 - E+000.0	0.0	123.2	99.25	24.0	235	34
10 - A+000.0	0.0	123.2	99.25	24.0	235	34
11 - B+000.0	0.0	116.9	98.20	18.7	183	27
12 - C+000.0	0.0	116.9	98.30	18.6	182	26
13 - D+000.0	0.0	116.9	98.35	18.6	182	26
14 - F+000.0	0.0	118.1	98.80	19.3	189	27
15 - A+164.0, E+138.2	0.0	116.9	98.15	18.8	184	27
16 - G+000.0	0.0	116.7	98.15	18.6	182	26
17 - FH-7	61.1	115.0	98.50	16.5	162	23
18 - Building A	1.3	116.9	98.55	18.4	180	26
19 - Building B	1.3	116.8	98.55	18.3	179	26
20 - FH-8	61.1	116.5	98.95	17.6	172	25
21 - FH-9	61.1	115.2	98.40	16.8	165	24
22 - H+000.0	0.0	116.9	98.15	18.8	184	27
23 - Building C	1.3	116.9	98.10	18.8	184	27

Link ID	Length (m)	Diameter (mm)	Roughness Coefficient	Minor Loss Coefficient	Flow (L/s)	Velocity (m/s)
1 - Node 1 to Node 2	50.6	200	110	2.20	53.2	1.7
2 - Node 2 to Node 3	63.6	200	110	0.60	53.2	1.7
3 - Node 3 to Node 4	84.6	200	110	0.60	53.2	1.7
4 - Node 4 to Node 5	104.9	200	110	4.30	53.2	1.7
5 - Node 5 to Node 6	65.5	200	110	0.60	53.2	1.7
6 - Node 6 to Node 10	15.1	200	110	0.60	53.2	1.7
7 - Node 7 to Node 8	90.8	200	110	2.20	134.1	4.3
8 - Node 8 to Node 9	71.2	200	110	0.90	134.1	4.3
9 - Node 9 to Node 10	2	200	110	0.80	31.2	1.0
10 - Node 10 to Node 11	106.4	200	110	3.70	84.4	2.7
11 - Node 11 to Node 12	6.8	200	110	0.60	23.3	0.7
12 - Node 12 to Node 13	2	200	110	0.80	22.0	0.7
13 - Node 13 to Node 16	42.9	200	110	1.25	20.7	0.7
14 - Node 9 to Node 14	52.6	200	110	2.95	102.8	3.3
15 - Node 14 to Node 15	85.6	200	110	1.85	41.7	1.3
16 - Node 15 to Node 16	5.9	200	110	1.80	40.4	1.3
17 - Node 11 to Node 17	5.5	150	100	2.00	61.1	3.5
18 - Node 12 to Node 18	10.6	150	100	2.25	1.3	0.1
19 - Node 13 to Node 19	10.7	150	100	2.25	1.3	0.1
20 - Node 14 to Node 20	3.1	150	100	2.00	61.1	3.5
21 - Node 16 to Node 21	2	150	100	2.00	61.1	3.5
22 - Node 15 to Node 22	4	200	110	0.80	1.3	0.0
23 - Node 22 to Node 23	33.6	150	100	1.30	1.3	0.1

June 23, 2026

FH-9, 475 Terry Fox Drive

Ottawa, Ontario

EPANET RESULTS

Fire Flow Demand: 95 L/s

Maximum Daily Demand: 3.9 L/s

Fire Flow + Maximum Daily Demand: 98.9 L/s

Node ID	Demand (L/s)	HGL (m)	Elevation (m)	Pressure (m)	(kPa)	(psi)
1 - Tillsonburg Street Reservoir	-0.1	132.0	96.00	36.0	353	51
2 - FH-1	0.0	132.0	95.95	36.1	353	51
3 - FH-2	0.0	132.0	96.00	36.0	353	51
4 - FH-3	0.0	132.0	96.05	36.0	352	51
5 - FH-4	0.0	132.0	96.45	35.6	349	51
6 - FH-5	0.0	132.0	98.65	33.4	327	47
7 - Kanata Avenue Reservoir	-98.9	143.7	104.90	38.8	380	55
8 - FH-6	0.0	137.0	101.85	35.2	345	50
9 - E+000.0	0.0	132.1	99.25	32.9	322	47
10 - A+000.0	0.0	132.0	99.25	32.8	321	47
11 - B+000.0	0.0	129.8	98.20	31.6	310	45
12 - C+000.0	0.0	129.6	98.30	31.3	307	45
13 - D+000.0	0.0	129.5	98.35	31.2	305	44
14 - F+000.0	0.0	130.8	98.80	32.0	314	46
15 - A+164.0, E+138.2	0.0	129.0	98.15	30.9	302	44
16 - G+000.0	0.0	128.7	98.15	30.6	300	43
17 - FH-7	0.0	129.8	98.50	31.3	307	45
18 - Building A	1.3	129.6	98.55	31.1	304	44
19 - Building B	1.3	129.5	98.55	31.0	303	44
20 - FH-8	0.0	130.8	98.95	31.9	312	45
21 - FH-9	95.0	125.2	98.40	26.8	263	38
22 - H+000.0	0.0	129.0	98.15	30.9	302	44
23 - Building C	1.3	129.0	98.10	30.9	303	44

Link ID	Length (m)	Diameter (mm)	Roughness Coefficient	Minor Loss Coefficient	Flow (L/s)	Velocity (m/s)
1 - Node 1 to Node 2	50.6	200	110	2.20	0.1	0.0
2 - Node 2 to Node 3	63.6	200	110	0.60	0.1	0.0
3 - Node 3 to Node 4	84.6	200	110	0.60	0.1	0.0
4 - Node 4 to Node 5	104.9	200	110	4.30	0.1	0.0
5 - Node 5 to Node 6	65.5	200	110	0.60	0.1	0.0
6 - Node 6 to Node 10	15.1	200	110	0.60	0.1	0.0
7 - Node 7 to Node 8	90.8	200	110	2.20	98.9	3.2
8 - Node 8 to Node 9	71.2	200	110	0.90	98.9	3.2
9 - Node 9 to Node 10	2	200	110	0.80	48.4	1.5
10 - Node 10 to Node 11	106.4	200	110	3.70	48.4	1.5
11 - Node 11 to Node 12	6.8	200	110	0.60	48.4	1.5
12 - Node 12 to Node 13	2	200	110	0.80	47.1	1.5
13 - Node 13 to Node 16	42.9	200	110	1.25	45.8	1.5
14 - Node 9 to Node 14	52.6	200	110	2.95	50.5	1.6
15 - Node 14 to Node 15	85.6	200	110	1.85	50.5	1.6
16 - Node 15 to Node 16	5.9	200	110	1.80	49.2	1.6
17 - Node 11 to Node 17	5.5	150	100	2.00	0.0	0.0
18 - Node 12 to Node 18	10.6	150	100	2.25	1.3	0.1
19 - Node 13 to Node 19	10.7	150	100	2.25	1.3	0.1
20 - Node 14 to Node 20	3.1	150	100	2.00	0.0	0.0
21 - Node 16 to Node 21	2	150	100	2.00	95.0	5.4
22 - Node 15 to Node 22	4	200	110	0.80	1.3	0.0
23 - Node 22 to Node 23	33.6	150	100	1.30	1.3	0.1

D.B. Gray Engineering Inc.

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

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May 30, 2025

475 Terry Fox Drive

6-Storey Apartment Buildings

Ottawa, Ontario

WATER DEMAND CALCULATIONS

	Number of Units	Persons per Unit	Population
1 Bedroom:	81	1.4	113.4
2 Bedroom:	70	2.1	147
3 Bedroom:	31	3.1	96.1
Average:	0	1.8	0
Total:	182		356.5

Average Daily Demand: 280 L/capita/day

69.3 L/min | 1.2 L/s | 18.3 USgpm

Maximum Daily Demand: 3.4 (Peaking factor for a population of 356.5 interpolated from MOE Design Guidelines for Drinking Water Systems Table 3-3)

233.9 L/min | 3.9 L/s | 61.8 USgpm

Maximum Hourly Demand: 5.1 (Peaking factor for a population of 356.5 interpolated from MOE Design Guidelines for Drinking Water Systems Table 3-3)

350.8 L/min | 5.8 L/s | 92.7 USgpm

January 26, 2026

475 Terry Fox Drive

Ottawa, Ontario

EPANET RESULTS

Fire Flow Demand: 0 L/s
Maximum Hourly Demand: 5.8 L/s

Fire Flow + Maximum Hourly Demand: 5.8 L/s

Node ID	Demand (L/s)	HGL (m)	Elevation (m)	Pressure (m)	Pressure (kPa)	Pressure (psi)
1 - Tillsonburg Street Reservoir	-2.2	156.2	96.00	60.2	590	86
2 - FH-1	0.0	156.2	95.95	60.3	591	86
3 - FH-2	0.0	156.2	96.00	60.2	590	86
4 - FH-3	0.0	156.2	96.05	60.2	590	86
5 - FH-4	0.0	156.2	96.45	59.8	586	85
6 - FH-5	0.0	156.2	98.65	57.6	564	82
7 - Kanata Avenue Reservoir	-3.5	156.2	104.90	51.3	503	73
8 - FH-6	0.0	156.2	101.85	54.4	533	77
9 - E+000.0	0.0	156.2	99.25	57.0	558	81
10 - A+000.0	0.0	156.2	99.25	57.0	558	81
11 - B+000.0	0.0	156.2	98.20	58.0	569	82
12 - C+000.0	0.0	156.2	98.30	57.9	568	82
13 - D+000.0	0.0	156.2	98.35	57.9	567	82
14 - F+000.0	0.0	156.2	98.80	57.4	563	82
15 - A+164.0, E+138.2	0.0	156.2	98.15	58.1	569	83
16 - G+000.0	0.0	156.2	98.15	58.1	569	83
17 - FH-7	0.0	156.2	98.50	57.7	566	82
18 - Building A	1.9	156.2	98.55	57.7	565	82
19 - Building B	1.9	156.2	98.55	57.7	565	82
20 - FH-8	0.0	156.2	98.95	57.3	561	81
21 - FH-9	0.0	156.2	98.40	57.8	567	82
22 - H+000.0	0.0	156.2	98.15	58.1	569	83
23 - Building C	1.9	156.2	98.10	58.1	570	83

Link ID	Length (m)	Diameter (mm)	Roughness Coefficient	Minor Loss Coefficient	Flow (L/s)	Velocity (m/s)
1 - Node 1 to Node 2	50.6	200	110	2.20	2.2	0.07
2 - Node 2 to Node 3	63.6	200	110	0.60	2.2	0.07
3 - Node 3 to Node 4	84.6	200	110	0.60	2.2	0.07
4 - Node 4 to Node 5	104.9	200	110	4.30	2.2	0.07
5 - Node 5 to Node 6	65.5	200	110	0.60	2.2	0.07
6 - Node 6 to Node 10	15.1	200	110	0.60	2.2	0.07
7 - Node 7 to Node 8	90.8	200	110	2.20	3.5	0.11
8 - Node 8 to Node 9	71.2	200	110	0.90	3.5	0.11
9 - Node 9 to Node 10	2	200	110	0.80	0.8	0.03
10 - Node 10 to Node 11	106.4	200	110	3.70	3.0	0.10
11 - Node 11 to Node 12	6.8	200	110	0.60	3.0	0.10
12 - Node 12 to Node 13	2	200	110	0.80	1.1	0.04
13 - Node 16 to Node 13	42.9	200	110	1.25	0.8	0.03
14 - Node 9 to Node 14	52.6	200	110	2.95	2.7	0.09
15 - Node 14 to Node 15	85.6	200	110	1.85	2.7	0.09
16 - Node 15 to Node 16	5.9	200	110	1.80	0.8	0.03
17 - Node 11 to Node 17	5.5	150	100	2.00	0.0	0.00
18 - Node 12 to Node 18	10.6	150	100	2.25	1.9	0.11
19 - Node 13 to Node 19	10.7	150	100	2.25	1.9	0.11
20 - Node 14 to Node 20	3.1	150	100	2.00	0.0	0.00
21 - Node 16 to Node 21	2	150	100	2.00	0.0	0.00
22 - Node 15 to Node 22	4	200	110	0.80	1.9	0.06
23 - Node 22 to Node 23	33.6	150	100	1.30	1.9	0.11

January 26, 2026

475 Terry Fox Drive

Ottawa, Ontario

EPANET RESULTS

Fire Flow Demand: 0 L/s
Average Daily Demand: 1.2 L/s

Fire Flow + Average Daily Demand: 1.2 L/s

Node ID	Demand (L/s)	HGL (m)	Elevation (m)	Pressure (m)	Pressure (kPa)	Pressure (psi)
1 - Tillsonburg Street Reservoir	-0.5	161.3	96.00	65.3	640	93
2 - FH-1	0.0	161.3	95.95	65.4	641	93
3 - FH-2	0.0	161.3	96.00	65.3	640	93
4 - FH-3	0.0	161.3	96.05	65.3	640	93
5 - FH-4	0.0	161.3	96.45	64.9	636	92
6 - FH-5	0.0	161.3	98.65	62.7	614	89
7 - Kanata Avenue Reservoir	-0.7	161.3	104.90	56.4	553	80
8 - FH-6	0.0	161.3	101.85	59.5	583	85
9 - E+000.0	0.0	161.3	99.25	62.1	608	88
10 - A+000.0	0.0	161.3	99.25	62.1	608	88
11 - B+000.0	0.0	161.3	98.20	63.1	619	90
12 - C+000.0	0.0	161.3	98.30	63.0	618	90
13 - D+000.0	0.0	161.3	98.35	63.0	617	90
14 - F+000.0	0.0	161.3	98.80	62.5	613	89
15 - A+164.0, E+138.2	0.0	161.3	98.15	63.2	619	90
16 - G+000.0	0.0	161.3	98.15	63.2	619	90
17 - FH-7	0.0	161.3	98.50	62.8	616	89
18 - Building A	0.4	161.3	98.55	62.8	615	89
19 - Building B	0.4	161.3	98.55	62.8	615	89
20 - FH-8	0.0	161.3	98.95	62.4	611	89
21 - FH-9	0.0	161.3	98.40	62.9	617	89
22 - H+000.0	0.0	161.3	98.15	63.2	619	90
23 - Building C	0.4	161.3	98.10	63.2	620	90

Link ID	Length (m)	Diameter (mm)	Roughness Coefficient	Minor Loss Coefficient	Flow (L/s)	Velocity (m/s)
1 - Node 1 to Node 2	50.6	200	110	2.20	0.5	0.01
2 - Node 2 to Node 3	63.6	200	110	0.60	0.5	0.01
3 - Node 3 to Node 4	84.6	200	110	0.60	0.5	0.01
4 - Node 4 to Node 5	104.9	200	110	4.30	0.5	0.01
5 - Node 5 to Node 6	65.5	200	110	0.60	0.5	0.01
6 - Node 6 to Node 10	15.1	200	110	0.60	0.5	0.01
7 - Node 7 to Node 8	90.8	200	110	2.20	0.7	0.02
8 - Node 8 to Node 9	71.2	200	110	0.90	0.7	0.02
9 - Node 9 to Node 10	2	200	110	0.80	0.2	0.01
10 - Node 10 to Node 11	106.4	200	110	3.70	0.6	0.02
11 - Node 11 to Node 12	6.8	200	110	0.60	0.6	0.02
12 - Node 12 to Node 13	2	200	110	0.80	0.2	0.01
13 - Node 16 to Node 13	42.9	200	110	1.25	0.2	0.01
14 - Node 9 to Node 14	52.6	200	110	2.95	0.6	0.02
15 - Node 14 to Node 15	85.6	200	110	1.85	0.6	0.02
16 - Node 15 to Node 16	5.9	200	110	1.80	0.2	0.01
17 - Node 11 to Node 17	5.5	150	100	2.00	0.0	0.00
18 - Node 12 to Node 18	10.6	150	100	2.25	0.4	0.02
19 - Node 13 to Node 19	10.7	150	100	2.25	0.4	0.02
20 - Node 14 to Node 20	3.1	150	100	2.00	0.0	0.00
21 - Node 16 to Node 21	2	150	100	2.00	0.0	0.00
22 - Node 15 to Node 22	4	200	110	0.80	0.4	0.01
23 - Node 22 to Node 23	33.6	150	100	1.30	0.4	0.02

APPENDIX C

SANITARY 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

SANITARY SEWER CALCULATIONS

Project: 475 Terry Fox Drive
6-Storey Apartment Buildings
Ottawa, Ontario

Date: June 30, 2026

Residential Average Daily Flow:	280	L/capita/day	Residential Peaking Factor:	Harmon Formula
Commercial Average Daily Flow:	28,000	L/ha/day	Harmon Formula Correction Factor:	0.8
Institutional Average Daily Flow:	28,000	L/ha/day	Commercial Peaking Factor:	1.5
Light Industrial Average Daily Flow:	35,000	L/ha/day	Institutional Peaking Factor:	1.5
Heavy Industrial Average Daily Flow:	55,000	L/ha/day	Industrial Peaking Factor:	Ministry of the Environment
Infiltration Allowance:	0.33	L/s/ha	Manning's Roughness Coefficient:	0.013

		Residential													Commercial				Infiltration			Q	Sewer Data						
		Individual									Cumulative				Individual	Cumulative			Individual	Cumulative		Total							
Location		Single	Semi	Duplex	Apartment	Apartment	Apartment	Apartment	Area	Population	Area	Population	Peaking	Flow Rate	Area	Area	Peaking	Flow Rate	Area	Area	Flow Rate	Flow Rate	Length	Nominal Diameter	Actual Diameter	Slope	Velocity	Q_{Full} Capacity	
From	To	Family	Detached		(1 Bed)	(2 Bed)	(3 Bed)	(Average)	(ha)		(ha)		Factor	(L/s)	(ha)	(ha)	Factor	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(m)	(mm)	(mm)	(%)	(m/s)	(L/s)	Q / Q_{Full}
		ppu = 3.4	ppu = 2.7	ppu = 2.3	ppu = 1.4	ppu = 2.1	ppu = 3.1	ppu = 1.8																					
Building B	MH-SA.1				65	43	20		0.8180	243.3	0.8180	243.3	3.2	2.52					0.8180	0.8180	0.27	2.79	3.9	200	200	2.0	1.48	46.38	6%
MH-SA.1	MH-SA.2								0.0000	0.0	0.8180	243.3	3.2	2.52					0.0000	0.8180	0.27	2.79	48.8	200	200	0.32	0.59	18.55	15%
Building C	MH-SA.2				16	27	11		0.4090	113.2	0.4090	113.2	3.2	1.17					0.4090	0.4090	0.13	1.31	9.5	200	200	2	1.48	46.38	3%
MH-SA.2	MH-SA.3								0.0000	0.0	1.2270	356.5	3.2	3.70					0.0000	1.2270	0.40	4.10	28.3	200	200	0.32	0.59	18.55	22%
MH-SA.3	375 SAN								0.0000	0.0	1.2270	356.5	3.2	3.70					0.0000	1.2270	0.40	4.10	50.1	200	200	0.32	0.59	18.55	22%
																							Existing 375 mm Terry Fox Drive Municipal Sanitary Sewer:		375	375	0.15	0.61	67.91	

APPENDIX D

STORMWATER MANAGEMENT

SUMMARY TABLES

100-YEAR EVENT

Drainage Area	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)	-	6.52	-	-
AREA II	-	24.53	265.92	265.92
AREA III	-	107.02	142.58	142.58
TOTAL (AREA I + AREA III)	121.82	113.53	408.50	408.50

50-YEAR EVENT

Drainage Area	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)	-	5.70	-	-
AREA II	-	20.92	243.81	243.81
AREA III	-	94.04	128.42	128.42
TOTAL (AREA I + AREA III)	110.16	99.74	372.22	372.22

SUMMARY TABLES

(continued)

2-YEAR EVENT				
Drainage Area	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)	-	2.30	-	-
AREA II	-	13.40	94.85	94.85
AREA III	-	49.50	55.22	55.22
TOTAL (AREA I + AREA III)	52.40	51.80	150.07	150.07

October 16, 2026

475 Terry Fox Drive

Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS

Modified Rational Method

100-YEAR EVENT

MAXIMUM ALLOWABLE RELEASE RATE

Area (A):	12,270	sq.m.
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
Runoff Coeficient (C):	0.20	
Maximum Allowable Release Rate (2.78AiC):	121.82	L/s

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(100-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Hard Area:	25	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Soft Area:	425	sq.m	0.25
Total Catchment Area:	450	sq.m	0.29
Area (A):	450	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	179	mm/hr	
Runoff Coeficient (C):	0.29		
Flow Rate (2.78AiC):	6.52	L/s	

DRAINAGE AREA II

(100-YEAR EVENT)

			C
Roof Area:	1,325	sq.m	1.00
Hard Area:	3,725	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Soft Area:	1,275	sq.m	0.25
Total Catchment Area:	6,325	sq.m	0.85

Water Elevation:	98.29	m
Head:	2.56	m
Centroid of ICD Orifice:	95.73	m
Invert of Outlet Pipe of MH-7:	95.69	m
Orifice Diameter:	85	mm
Orifice Area:	5,675	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	24.53	L/s

DRAINAGE AREA II (Continued)

(100-YEAR EVENT)

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	4	0.02	0.03	cu.m
CB/MH-2	95	0.12	3.85	cu.m
CB/MH-4	150	0.12	6.07	cu.m
CB/MH-5	65	0.07	1.55	cu.m
CB/MH-6	136	0.12	5.48	cu.m

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
42	3.22	2	4	0.43	136.96	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
47.429	5.152	1.46	218.82	87.53	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	96.02	0.61	0.85	cu.m
CB/MH-2	95.92	1.219	2.77	cu.m
MH-3	95.77	1.219	2.94	cu.m
CB/MH-4	95.72	1.219	3.00	cu.m
CB/MH-5	95.92	1.219	2.77	cu.m
CB/MH-6	95.84	1.219	2.86	cu.m
MH-7	95.69	1.219	3.04	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB-1	96.02	CB/MH-2	95.84	6.9	250	0.34	cu.m
CB/MH-2	95.92	MH-3	95.77	33.2	250	1.63	cu.m
MH-3	95.77	CB/MH-4	95.72	9.6	250	0.47	cu.m
CB/MH-4	95.72	MH-7	95.69	8.5	300	0.60	cu.m
CB/MH-5	95.92	CB/MH-6	95.84	22.2	300	1.57	cu.m
CB/MH-6	95.84	MH-7	95.76	23.1	300	1.63	cu.m

Maximum Volume Stored: 265.92 cu.m

Maximum Volume Required: 265.92 cu.m

DRAINAGE AREA II (Continued)

(100-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	266.50	12.26	254.24	152.54
15	143	213.27	12.26	201.01	180.91
20	120	179.03	12.26	166.76	200.12
25	104	154.99	12.26	142.73	214.10
30	92	137.11	12.26	124.85	224.73
35	83	123.25	12.26	110.99	233.07
40	75	112.16	12.26	99.89	239.74
45	69	103.06	12.26	90.80	245.15
50	64	95.45	12.26	83.19	249.57
55	60	88.99	12.26	76.73	253.20
60	56	83.42	12.26	71.16	256.18
65	53	78.58	12.26	66.31	258.62
70	50	74.31	12.26	62.05	260.61
75	47	70.53	12.26	58.27	262.20
80	45	67.15	12.26	54.89	263.46
85	43	64.11	12.26	51.85	264.42
90	41	61.36	12.26	49.10	265.12
95	39	58.86	12.26	46.59	265.59
100	38	56.57	12.26	44.31	265.85
105	36	54.47	12.26	42.21	265.92
110	35	52.54	12.26	40.28	265.83
115	34	50.75	12.26	38.49	265.59
120	33	49.10	12.26	36.83	265.20
125	32	47.55	12.26	35.29	264.69
130	31	46.12	12.26	33.85	264.06
135	30	44.77	12.26	32.51	263.32
140	29	43.51	12.26	31.25	262.48
145	28	42.32	12.26	30.06	261.54
150	28	41.21	12.26	28.95	260.52
180	24	35.67	12.26	23.41	252.85
210	21	31.56	12.26	19.30	243.13
240	19	28.37	12.26	16.10	231.89
270	17	25.81	12.26	13.55	219.51
300	16	23.72	12.26	11.46	206.20
330	15	21.97	12.26	9.70	192.15
360	14	20.48	12.26	8.22	177.49
390	13	19.20	12.26	6.94	162.30
420	12	18.08	12.26	5.82	146.67
450	11	17.10	12.26	4.84	130.64
480	11	16.23	12.26	3.97	114.28
510	10	15.45	12.26	3.19	97.62
540	10	14.75	12.26	2.49	80.69

DRAINAGE AREA III

(100-YEAR EVENT)

			C
Roof Area:	2,070	sq.m	1.00
Hard Area:	1,725	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Soft Area:	1,700	sq.m	0.25
Total Catchment Area:	5,495	sq.m	0.77

Water Elevation:	95.67	m
Head:	1.35	m
Centroid of ICD Orifice:	94.31	m
Invert of Outlet Pipe of CB/MH-14:	94.21	m
Orifice Diameter:	204	mm
Orifice Area:	32,826	sq.mm
Discharge Coefficient:	0.61	
Maximum ICD Release Rate:	103.20	L/s
Maximum Overflow Rate:	3.82	L/s
Total Maximum Release Rate:	107.02	L/s

DRAINAGE AREA III (Continued)

(100-YEAR EVENT)

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
22	3.22	1	2	0.43	71.70	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
49.596	2.776	1.46	128.76	51.50	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-8	94.71	0.61	0.36	cu.m
CB/MH-9	94.63	1.219	1.21	cu.m
CB-10	94.52	0.61	0.43	cu.m
CB/MH-11	94.49	1.219	1.37	cu.m
MH-12	94.33	1.219	1.56	cu.m
CB/MH-13	94.21	1.219	1.70	cu.m
CB/MH-14	93.78	1.219	2.20	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
MH-7	95.69	MH-12	95.61	21	300	0.00	cu.m
CB-8	94.71	CB/MH-9	94.63	17.8	250	0.87	cu.m
CB/MH-9	94.63	MH-12	94.33	69.6	250	3.42	cu.m
CB-10	94.52	CB/MH-11	94.49	6.1	250	0.30	cu.m
CB/MH-11	94.49	MH-12	94.30	15.2	250	0.75	cu.m
MH-12	94.33	CB/MH-13	94.21	47.2	375	5.21	cu.m

Maximum Volume Stored: 142.58 cu.m

Maximum Volume Required: 142.58 cu.m

DRAINAGE AREA III (Continued)

(100-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Inflow from Area II (L/s)	50% ICD Release Rate (L/s)	50% Overflow Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	209.48	24.53	51.60	0.00	182.40	109.44
15	143	167.64	24.53	51.60	0.00	140.56	126.51
20	120	140.72	24.53	51.60	0.00	113.65	136.38
25	104	121.83	24.53	51.60	0.00	94.75	142.13
30	92	107.78	24.53	51.60	1.49	79.21	142.58
35	83	96.88	24.53	51.60	1.91	67.89	142.58
40	75	88.16	24.53	51.60	1.68	59.41	142.58
45	69	81.01	24.53	51.60	1.13	52.81	142.58
50	64	75.03	24.53	51.60	0.43	47.53	142.58
55	60	69.95	24.53	51.60	0.00	42.87	141.48
60	56	65.57	24.53	51.60	0.00	38.50	138.60
65	53	61.76	24.53	51.60	0.00	34.69	135.28
70	50	58.41	24.53	51.60	0.00	31.34	131.61
75	47	55.44	24.53	51.60	0.00	28.36	127.64
80	45	52.78	24.53	51.60	0.00	25.71	123.39
85	43	50.39	24.53	51.60	0.00	23.32	118.92
90	41	48.23	24.53	51.60	0.00	21.16	114.24
95	39	46.26	24.53	51.60	0.00	19.19	109.38
100	38	44.47	24.53	51.60	0.00	17.39	104.35
105	36	42.82	24.53	51.60	0.00	15.74	99.18
110	35	41.30	24.53	51.60	0.00	14.22	93.88
115	34	39.89	24.53	51.60	0.00	12.82	88.45
120	33	38.59	24.53	51.60	0.00	11.52	82.92
125	32	37.38	24.53	51.60	0.00	10.30	77.29
130	31	36.25	24.53	51.60	0.00	9.17	71.56
135	30	35.19	24.53	51.60	0.00	8.12	65.75
140	29	34.20	24.53	51.60	0.00	7.13	59.85
145	28	33.27	24.53	51.60	0.00	6.19	53.89
150	28	32.39	24.53	51.60	0.00	5.32	47.86
180	24	28.04	24.53	51.60	0.00	0.97	10.45
210	21	24.81	24.53	49.33	0.00	0.00	0.00
240	19	22.30	24.53	46.82	0.00	0.00	0.00
270	17	20.29	24.53	44.81	0.00	0.00	0.00
300	16	18.64	24.53	43.17	0.00	0.00	0.00
330	15	17.27	24.53	41.79	0.00	0.00	0.00
360	14	16.10	24.53	40.62	0.00	0.00	0.00
390	13	15.09	24.53	39.62	0.00	0.00	0.00
420	12	14.21	24.53	38.74	0.00	0.00	0.00
450	11	13.44	24.53	37.97	0.00	0.00	0.00
480	11	12.76	24.53	37.28	0.00	0.00	0.00
510	10	12.15	24.53	36.67	0.00	0.00	0.00
540	10	11.60	24.53	36.12	0.00	0.00	0.00

50-YEAR EVENT

MAXIMUM ALLOWABLE RELEASE RATE

Area (A):	12,270	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	161	mm/hr
Runoff Coeficient (C):	0.20	
Maximum Allowable Release Rate (2.78AiC):	110.16	L/s

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(50-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Hard Area:	25	sq.m	1.00
Gravel Area:	0	sq.m	0.84
Soft Area:	425	sq.m	0.24
Total Catchment Area:	450	sq.m	0.28
Area (A):	450	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	161	mm/hr	
Runoff Coeficient (C):	0.28		
Flow Rate (2.78AiC):	5.70	L/s	

DRAINAGE AREA II

(50-YEAR EVENT)

			C
Roof Area:	1,325	sq.m	1.00
Hard Area:	3,725	sq.m	1.00
Gravel Area:	0	sq.m	0.84
Soft Area:	1,275	sq.m	0.24
Total Catchment Area:	6,325	sq.m	0.85

Water Elevation:	97.59	m
Head:	1.86	m
Centroid of ICD Orifice:	95.73	m
Invert of Outlet Pipe of MH-7:	95.69	m
Orifice Diameter:	85	mm
Orifice Area:	5,675	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	20.92	L/s

DRAINAGE AREA II (Continued)

(50-YEAR EVENT)

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	0	0.00	0.00	cu.m
CB/MH-2	0	0.00	0.00	cu.m
CB/MH-4	0	0.00	0.00	cu.m
CB/MH-5	0	0.00	0.00	cu.m
CB/MH-6	0	0.00	0.00	cu.m

Chamber Storage

No. of Chambers	Stage Volume	No. of Rows	No. of End Caps	Stage Volume	Volume	
42	3.22	2	4	0.43	136.96	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
47.429	5.152	1.46	218.82	87.53	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	96.02	0.61	0.59	cu.m
CB/MH-2	95.92	1.219	1.95	cu.m
MH-3	95.77	1.219	2.13	cu.m
CB/MH-4	95.72	1.219	2.19	cu.m
CB/MH-5	95.92	1.219	1.95	cu.m
CB/MH-6	95.84	1.219	2.05	cu.m
MH-7	95.69	1.219	2.22	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB-1	96.02	CB/MH-2	95.84	6.9	250	0.34	cu.m
CB/MH-2	95.92	MH-3	95.77	33.2	250	1.63	cu.m
MH-3	95.77	CB/MH-4	95.72	9.6	250	0.47	cu.m
CB/MH-4	95.72	MH-7	95.69	8.5	300	0.60	cu.m
CB/MH-5	95.92	CB/MH-6	95.84	22.2	300	1.57	cu.m
CB/MH-6	95.84	MH-7	95.76	23.1	300	1.63	cu.m

Maximum Volume Stored: 243.81 cu.m

Maximum Volume Required: 243.81 cu.m

DRAINAGE AREA II (Continued)

(50-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	161	240.42	10.46	229.97	137.98
15	129	192.40	10.46	181.94	163.75
20	108	161.51	10.46	151.05	181.26
25	94	139.83	10.46	129.37	194.05
30	83	123.70	10.46	113.24	203.83
35	75	111.19	10.46	100.73	211.53
40	68	101.18	10.46	90.72	217.73
45	62	92.97	10.46	82.52	222.79
50	58	86.11	10.46	75.65	226.96
55	54	80.28	10.46	69.82	230.42
60	51	75.26	10.46	64.80	233.29
65	48	70.89	10.46	60.43	235.67
70	45	67.04	10.46	56.58	237.64
75	43	63.63	10.46	53.17	239.26
80	41	60.58	10.46	50.12	240.58
85	39	57.84	10.46	47.38	241.63
90	37	55.35	10.46	44.90	242.44
95	36	53.10	10.46	42.64	243.04
100	34	51.04	10.46	40.58	243.46
105	33	49.14	10.46	38.68	243.71
110	32	47.40	10.46	36.94	243.81
115	31	45.79	10.46	35.33	243.77
120	30	44.29	10.46	33.83	243.60
125	29	42.90	10.46	32.44	243.32
130	28	41.60	10.46	31.14	242.93
135	27	40.39	10.46	29.93	242.44
140	26	39.25	10.46	28.79	241.87
145	26	38.18	10.46	27.72	241.20
150	25	37.18	10.46	26.72	240.46
180	22	32.18	10.46	21.73	234.63
210	19	28.47	10.46	18.01	226.95
240	17	25.59	10.46	15.13	217.90
270	16	23.29	10.46	12.83	207.81
300	14	21.40	10.46	10.94	196.90
330	13	19.82	10.46	9.36	185.31
360	12	18.48	10.46	8.02	173.17
390	12	17.32	10.46	6.86	160.55
420	11	16.31	10.46	5.85	147.53

DRAINAGE AREA III

(50-YEAR EVENT)

			C
Roof Area:	2,070	sq.m	1.00
Hard Area:	1,725	sq.m	1.00
Gravel Area:	0	sq.m	0.84
Soft Area:	1,700	sq.m	0.24
Total Catchment Area:	5,495	sq.m	0.76

Water Elevation:	95.44	m
Head:	1.12	m
Centroid of ICD Orifice:	94.31	m
Invert of Outlet Pipe of CB/MH-14:	94.21	m
Orifice Diameter:	204	mm
Orifice Area:	32,826	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	94.04	L/s

DRAINAGE AREA III (Continued)

(50-YEAR EVENT)

Chamber Storage

No. of Chambers	Stage Volume	No. of Rows	No. of End Caps	Stage Volume	Volume	
22	3.22	1	2	0.430	71.70	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
49.596	2.776	1.23	97.14	38.86	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-8	94.71	0.61	0.27	cu.m
CB/MH-9	94.63	1.219	0.94	cu.m
CB-10	94.52	0.61	0.34	cu.m
CB/MH-11	94.49	1.219	1.10	cu.m
MH-12	94.33	1.219	1.29	cu.m
CB/MH-13	94.21	1.219	1.43	cu.m
CB/MH-14	93.78	1.219	1.93	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
MH-7	95.69	MH-12	95.61	21	300	0.00	cu.m
CB-8	94.71	CB/MH-9	94.63	17.8	250	0.87	cu.m
CB/MH-9	94.63	MH-12	94.33	69.6	250	3.42	cu.m
CB-10	94.52	CB/MH-11	94.49	6.1	250	0.30	cu.m
CB/MH-11	94.49	MH-12	94.30	15.2	250	0.75	cu.m
MH-12	94.33	CB/MH-13	94.21	47.2	375	5.21	cu.m

Maximum Volume Stored: 128.42 cu.m

Maximum Volume Required: 128.42 cu.m

DRAINAGE AREA III (Continued)

(50-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Inflow from Area II (L/s)	50% Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	161	188.67	20.92	47.02	162.57	97.54
15	129	150.98	20.92	47.02	124.88	112.39
20	108	126.74	20.92	47.02	100.64	120.77
25	94	109.73	20.92	47.02	83.62	125.44
30	83	97.07	20.92	47.02	70.97	127.74
35	75	87.25	20.92	47.02	61.15	128.42
40	68	79.40	20.92	47.02	53.30	127.91
45	62	72.96	20.92	47.02	46.86	126.51
50	58	67.57	20.92	47.02	41.47	124.42
55	54	63.00	20.92	47.02	36.90	121.76
60	51	59.06	20.92	47.02	32.96	118.64
65	48	55.63	20.92	47.02	29.52	115.15
70	45	52.61	20.92	47.02	26.51	111.33
75	43	49.93	20.92	47.02	23.83	107.23
80	41	47.54	20.92	47.02	21.44	102.89
85	39	45.39	20.92	47.02	19.28	98.35
90	37	43.44	20.92	47.02	17.34	93.62
95	36	41.67	20.92	47.02	15.57	88.72
100	34	40.05	20.92	47.02	13.95	83.68
105	33	38.56	20.92	47.02	12.46	78.51
110	32	37.20	20.92	47.02	11.09	73.22
115	31	35.93	20.92	47.02	9.83	67.81
120	30	34.76	20.92	47.02	8.65	62.32
125	29	33.67	20.92	47.02	7.56	56.73
130	28	32.65	20.92	47.02	6.55	51.05
135	27	31.70	20.92	47.02	5.59	45.30
140	26	30.80	20.92	47.02	4.70	39.48
145	26	29.96	20.92	47.02	3.86	33.59
150	25	29.17	20.92	47.02	3.07	27.64
180	22	25.26	20.92	46.17	0.00	0.00
210	19	22.34	20.92	43.26	0.00	0.00
240	17	20.08	20.92	41.00	0.00	0.00
270	16	18.27	20.92	39.19	0.00	0.00
300	14	16.79	20.92	37.71	0.00	0.00
330	13	15.55	20.92	36.47	0.00	0.00
360	12	14.50	20.92	35.42	0.00	0.00
390	12	13.59	20.92	34.51	0.00	0.00
420	11	12.80	20.92	33.72	0.00	0.00

2-YEAR EVENT

MAXIMUM ALLOWABLE RELEASE RATE

Area (A):	12,270	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	77	mm/hr
Runoff Coeficient (C):	0.20	
Maximum Allowable Release Rate (2.78AiC):	52.40	L/s

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(2-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Hard Area:	25	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	425	sq.m	0.20
Total Catchment Area:	450	sq.m	0.24
Area (A):	450	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	77	mm/hr	
Runoff Coeficient (C):	0.24		
Flow Rate (2.78AiC):	2.30	L/s	

DRAINAGE AREA II

(2-YEAR EVENT)

			C
Roof Area:	1,325	sq.m	0.90
Hard Area:	3,725	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	1,275	sq.m	0.20
Total Catchment Area:	6,325	sq.m	0.76

Water Elevation:	96.50	m
Head:	0.76	m
Centroid of ICD Orifice:	95.73	m
Invert of Outlet Pipe of MH-7:	95.69	m
Orifice Diameter:	85	mm
Orifice Area:	5,675	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	13.40	L/s

DRAINAGE AREA II (Continued)

(2-YEAR EVENT)

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	0	0.00	0.00	cu.m
CB/MH-2	0	0.00	0.00	cu.m
CB/MH-4	0	0.00	0.00	cu.m
CB/MH-5	0	0.00	0.00	cu.m
CB/MH-6	0	0.00	0.00	cu.m

Chamber Storage

No. of Chambers	Stage Volume	No. of Rows	No. of End Caps	Stage Volume	Volume	
42	1.60	2	4	0.26	68.24	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
47.429	5.152	0.44	38.45	15.38	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	96.02	0.61	0.18	cu.m
CB/MH-2	95.92	1.22	0.67	cu.m
MH-3	95.77	1.22	0.85	cu.m
CB/MH-4	95.72	1.22	0.91	cu.m
CB/MH-5	95.92	1.22	0.67	cu.m
CB/MH-6	95.84	1.22	0.77	cu.m
MH-7	95.69	1.22	0.94	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB-1	96.02	CB/MH-2	95.84	6.9	250	0.34	cu.m
CB/MH-2	95.92	MH-3	95.77	33.2	250	1.63	cu.m
MH-3	95.77	CB/MH-4	95.72	9.6	250	0.47	cu.m
CB/MH-4	95.72	MH-7	95.69	8.5	300	0.60	cu.m
CB/MH-5	95.92	CB/MH-6	95.84	22.2	300	1.57	cu.m
CB/MH-6	95.84	MH-7	95.76	23.1	300	1.63	cu.m

Maximum Volume Stored: 94.85 cu.m

Maximum Volume Required: 94.85 cu.m

DRAINAGE AREA II (Continued)

(2-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	77	102.49	6.70	95.79	57.47
15	62	82.42	6.70	75.72	68.15
20	52	69.43	6.70	62.73	75.28
25	45	60.27	6.70	53.57	80.35
30	40	53.43	6.70	46.73	84.12
35	36	48.12	6.70	41.42	86.97
40	33	43.85	6.70	37.15	89.17
45	30	40.35	6.70	33.65	90.86
50	28	37.42	6.70	30.72	92.15
55	26	34.92	6.70	28.22	93.13
60	25	32.77	6.70	26.07	93.85
65	23	30.89	6.70	24.19	94.35
70	22	29.24	6.70	22.54	94.66
75	21	27.77	6.70	21.07	94.82
80	20	26.46	6.70	19.76	94.85
85	19	25.28	6.70	18.58	94.75
90	18	24.21	6.70	17.51	94.55
95	17	23.24	6.70	16.54	94.25
100	17	22.35	6.70	15.64	93.87
105	16	21.53	6.70	14.83	93.41
110	16	20.78	6.70	14.07	92.89
115	15	20.08	6.70	13.38	92.30
120	15	19.43	6.70	12.73	91.66
125	14	18.83	6.70	12.13	90.96
130	14	18.27	6.70	11.57	90.22
135	13	17.74	6.70	11.04	89.43
140	13	17.25	6.70	10.55	88.60
145	13	16.79	6.70	10.08	87.73
150	12	16.35	6.70	9.65	86.83
180	11	14.18	6.70	7.48	80.77
210	9	12.56	6.70	5.86	73.87
240	8	11.31	6.70	4.61	66.35
270	8	10.30	6.70	3.60	58.35
300	7	9.48	6.70	2.78	49.98
330	7	8.79	6.70	2.09	41.29
360	6	8.20	6.70	1.50	32.35
390	6	7.69	6.70	0.99	23.19
420	5	7.25	6.70	0.55	13.85

DRAINAGE AREA III

(2-YEAR EVENT)

			C
Roof Area:	2,070	sq.m	0.90
Hard Area:	1,725	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	1,700	sq.m	0.20
Total Catchment Area:	5,495	sq.m	0.68

Water Elevation:	94.62	m
Head:	0.31	m
Centroid of ICD Orifice:	94.31	m
Invert of Outlet Pipe of CB/MH-14:	94.21	m
Orifice Diameter:	204	mm
Orifice Area:	32,826	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	49.50	L/s

DRAINAGE AREA III (Continued)

(2-YEAR EVENT)

Chamber Storage

No. of Chambers	Stage Volume	No. of Rows	No. of End Caps	Stage Volume	Volume	
22	1.55	1	2	0.25	34.60	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
49.596	2.776	0.41	22.36	8.94	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-8	94.71	0.61	0.00	cu.m
CB/MH-9	94.63	1.22	0.00	cu.m
CB-10	94.52	0.61	0.04	cu.m
CB/MH-11	94.49	1.22	0.16	cu.m
MH-12	94.33	1.22	0.34	cu.m
CB/MH-13	94.21	1.22	0.48	cu.m
CB/MH-14	93.78	1.22	0.98	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
MH-7	95.69	MH-12	95.61	21	300	0.00	cu.m
CB-8	94.71	CB/MH-9	94.63	18	250	0.00	cu.m
CB/MH-9	94.63	MH-12	94.33	70	250	3.42	cu.m
CB-10	94.52	CB/MH-11	94.49	6	250	0.30	cu.m
CB/MH-11	94.49	MH-12	94.30	15	250	0.75	cu.m
MH-12	94.33	CB/MH-13	94.21	47	375	5.21	cu.m

Maximum Volume Stored: 55.22 cu.m

Maximum Volume Required: 55.22 cu.m

DRAINAGE AREA III (Continued)

(2-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Inflow from Area II (L/s)	50% Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	77	80.19	13.40	24.75	68.84	41.30
15	62	64.49	13.40	24.75	53.14	47.82
20	52	54.32	13.40	24.75	42.97	51.57
25	45	47.16	13.40	24.75	35.81	53.71
30	40	41.81	13.40	24.75	30.46	54.82
35	36	37.65	13.40	24.75	26.30	55.22
40	33	34.31	13.40	24.75	22.96	55.11
45	30	31.57	13.40	24.75	20.22	54.60
50	28	29.28	13.40	24.75	17.93	53.78
55	26	27.32	13.40	24.75	15.97	52.71
60	25	25.64	13.40	24.75	14.29	51.44
65	23	24.17	13.40	24.75	12.82	50.00
70	22	22.88	13.40	24.75	11.53	48.42
75	21	21.73	13.40	24.75	10.38	46.71
80	20	20.70	13.40	24.75	9.35	44.90
85	19	19.78	13.40	24.75	8.43	42.99
90	18	18.94	13.40	24.75	7.59	41.00
95	17	18.18	13.40	24.75	6.83	38.93
100	17	17.48	13.40	24.75	6.13	36.81
105	16	16.84	13.40	24.75	5.49	34.62
110	16	16.25	13.40	24.75	4.91	32.37
115	15	15.71	13.40	24.75	4.36	30.08
120	15	15.20	13.40	24.75	3.85	27.75
125	14	14.73	13.40	24.75	3.38	25.37
130	14	14.29	13.40	24.75	2.94	22.96
135	13	13.88	13.40	24.75	2.53	20.51
140	13	13.50	13.40	24.75	2.15	18.03
145	13	13.13	13.40	24.75	1.78	15.51
150	12	12.79	13.40	24.75	1.44	12.98
180	11	11.09	13.40	24.50	0.00	0.00
210	9	9.83	13.40	23.23	0.00	0.00
240	8	8.85	13.40	22.25	0.00	0.00
270	8	8.06	13.40	21.46	0.00	0.00
300	7	7.42	13.40	20.82	0.00	0.00
330	7	6.87	13.40	20.28	0.00	0.00
360	6	6.41	13.40	19.82	0.00	0.00
390	6	6.02	13.40	19.42	0.00	0.00
420	5	5.67	13.40	19.08	0.00	0.00

SUMMARY TABLES

100-YEAR EVENT
(INCLUDING OFF-SITE AREAS)

Drainage Area	Pre-Development Maximum Flow Rate (L/s)	Post Development Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I + OFF-SITE AREAS (Uncontrolled Flow Off Site)		32.39	-	-
AREA II + OFF-SITE AREAS		53.19	336.36	336.36
AREA III + OFF-SITE AREAS		182.82	142.58	142.58
TOTAL (AREA I + AREA III + OFF-SITE AREAS)	539.86	215.21	478.94	478.94

50-YEAR EVENT
(INCLUDING OFF-SITE AREAS)

Drainage Area	Pre-Development Maximum Flow Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I + OFF-SITE AREAS (Uncontrolled Flow Off Site)		28.16	-	-
AREA II + OFF-SITE AREAS		32.87	336.36	336.36
AREA III + OFF-SITE AREAS		120.44	142.58	142.58
TOTAL (AREA I + AREA III + OFF-SITE AREAS)	470.11	148.61	478.94	478.94

SUMMARY TABLES

(continued)

2-YEAR EVENT
(INCLUDING OFF-SITE AREAS)

Drainage Area	Pre-Development Maximum Flow Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I + OFF-SITE AREAS (Uncontrolled Flow Off Site)		11.20	-	-
AREA II + OFF-SITE AREAS		15.36	140.45	140.45
AREA III + OFF-SITE AREAS		56.17	65.59	65.59
TOTAL (AREA I + AREA III + OFF-SITE AREAS)	184.91	67.37	206.04	206.04

5-YEAR EVENT
(INCLUDING OFF-SITE AREAS
CARP RIVER AT 100-YEAR ELEV.: 93.51)

Drainage Area	Pre-Development Maximum Flow Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I + OFF-SITE AREAS (Uncontrolled Flow Off Site)		15.19	-	-
AREA II + OFF-SITE AREAS		18.81	193.13	193.13
AREA III + OFF-SITE AREAS		74.99	84.93	84.93
TOTAL (AREA I + AREA III + OFF-SITE AREAS)	250.85	90.18	278.06	278.06

100-YEAR EVENT (INCLUDING OFF-SITE AREAS)

PRE-DEVELOPMENT CONDITIONS

				C
NW Off-site Drainage	(Insmill Cr rear yards)	5,725	sq.m	0.54
1.4 ha	SW Off-site Drainage	2,145	sq.m	0.54
	475 Terry Fox Dr	12,270	sq.m	0.54
	Total Catchment Area:	20,140	sq.m	0.54

Time of Concentration (Tc)

Bransby Williams Formula (Used when C > 0.40)

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

Sheet Flow Distance (L):	200	m
Slope of Land (Sw):	4	%
Area (A):	2.01	ha
Time of Concentration (Sheet Flow):	8	min
Minimum Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr (100-year event)
100-Year Pre-Development Flow Rate (2.78AiC):	539.86	L/s

POST-DEVELOPMENT CONDITIONS

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(100-YEAR EVENT - INCLUDING OFF-SITE AREAS)

			C
Off-site Areas:	2,085	sq.m	0.25
Roof Area:	0	sq.m	1.00
Hard Area:	25	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Soft Area:	425	sq.m	0.25
Total Catchment Area:	2,535	sq.m	0.26
Area (A):	2,535	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	179	mm/hr	
Runoff Coeficient (C):	0.26		
Flow Rate (2.78AiC):	32.39	L/s	

DRAINAGE AREA II

(100-YEAR EVENT - INCLUDING OFF-SITE AREAS)

			C
Off-site Areas:	4,331	sq.m	0.54
Roof Area:	1,325	sq.m	1.00
Hard Area:	3,725	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Soft Area:	1,275	sq.m	0.25
Total Catchment Area:	10,656	sq.m	0.72

Water Elevation:	98.37	m
Head:	2.64	m
Centroid of ICD Orifice:	95.73	m
Invert of Outlet Pipe of MH-7:	95.69	m
Orifice Diameter:	85	mm
Orifice Area:	5,675	sq.mm
Discharge Coefficient:	0.61	
Maximum ICD Release Rate:	24.90	L/s
Maximum Overflow Rate:	28.29	L/s
Total Maximum Release Rate:	53.19	L/s

DRAINAGE AREA II (Continued)

(100-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	90	0.10	3.00	cu.m
CB/MH-2	260	0.20	17.33	cu.m
CB/MH-4	410	0.20	27.33	cu.m
CB/MH-5	290	0.15	14.50	cu.m
CB/MH-6	370	0.20	24.67	cu.m

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
42	3.22	2	4	0.43	136.96	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
47.429	5.152	1.46	218.82	87.53	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	96.02	0.61	0.87	cu.m
CB/MH-2	95.92	1.219	2.86	cu.m
MH-3	95.77	1.219	3.03	cu.m
CB/MH-4	95.72	1.219	3.09	cu.m
CB/MH-5	95.92	1.219	2.86	cu.m
CB/MH-6	95.84	1.219	2.95	cu.m
MH-7	95.69	1.219	3.13	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB-1	96.02	CB/MH-2	95.84	6.9	250	0.34	cu.m
CB/MH-2	95.92	MH-3	95.77	33.2	250	1.63	cu.m
MH-3	95.77	CB/MH-4	95.72	9.6	250	0.47	cu.m
CB/MH-4	95.72	MH-7	95.69	8.5	300	0.60	cu.m
CB/MH-5	95.92	CB/MH-6	95.84	22.2	300	1.57	cu.m
CB/MH-6	95.84	MH-7	95.76	23.1	300	1.63	cu.m

Maximum Volume Stored: 336.36 cu.m

Maximum Volume Required: 336.36 cu.m

DRAINAGE AREA II (Continued)

(100-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% ICD Release Rate (L/s)	50% Overflow Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	382.60	12.45	0.00	370.15	222.09
15	143	306.18	12.45	0.00	293.73	264.35
20	120	257.02	12.45	0.00	244.57	293.48
25	104	222.51	12.45	0.00	210.06	315.09
30	92	196.84	12.45	0.00	184.39	331.91
35	83	176.94	12.45	4.32	160.17	336.36
40	75	161.01	12.45	8.41	140.15	336.36
45	69	147.95	12.45	10.92	124.58	336.36
50	64	137.03	12.45	12.46	112.12	336.36
55	60	127.75	12.45	13.38	101.93	336.36
60	56	119.76	12.45	13.88	93.43	336.36
65	53	112.80	12.45	14.11	86.25	336.36
70	50	106.68	12.45	14.15	80.09	336.36
75	47	101.25	12.45	14.06	74.75	336.36
80	45	96.40	12.45	13.88	70.08	336.36
85	43	92.04	12.45	13.63	65.95	336.36
90	41	88.09	12.45	13.35	62.29	336.36
95	39	84.50	12.45	13.03	59.01	336.36
100	38	81.21	12.45	12.70	56.06	336.36
105	36	78.20	12.45	12.36	53.39	336.36
110	35	75.43	12.45	12.01	50.96	336.36
115	34	72.86	12.45	11.66	48.75	336.36
120	33	70.48	12.45	11.32	46.72	336.36
125	32	68.27	12.45	10.97	44.85	336.36
130	31	66.21	12.45	10.63	43.12	336.36
135	30	64.27	12.45	10.30	41.53	336.36
140	29	62.46	12.45	9.97	40.04	336.36
145	28	60.76	12.45	9.65	38.66	336.36
150	28	59.16	12.45	9.34	37.37	336.36
180	24	51.22	12.45	7.62	31.14	336.36
210	21	45.31	12.45	6.16	26.70	336.36
240	19	40.72	12.45	4.91	23.36	336.36
270	17	37.06	12.45	3.84	20.76	336.36
300	16	34.05	12.45	2.91	18.69	336.36
330	15	31.54	12.45	2.10	16.99	336.36
360	14	29.40	12.45	1.38	15.57	336.36
390	13	27.56	12.45	0.74	14.37	336.36
420	12	25.96	12.45	0.16	13.35	336.36
450	11	24.55	12.45	0.00	12.10	326.72
480	11	23.30	12.45	0.00	10.85	312.51
510	10	22.18	12.45	0.00	9.73	297.87
540	10	21.18	12.45	0.00	8.73	282.84

DRAINAGE AREA III

(100-YEAR EVENT - INCLUDING OFF-SITE AREAS)

			C
Off-site Areas:	1,454	sq.m	0.54
Roof Area:	2,070	sq.m	1.00
Hard Area:	1,725	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Soft Area:	1,700	sq.m	0.25
Total Catchment Area:	6,949	sq.m	0.72

Water Elevation:	95.67	m
Head:	1.35	m
Centroid of ICD Orifice:	94.31	m
Invert of Outlet Pipe of CB/MH-14:	94.21	m
Orifice Diameter:	204	mm
Orifice Area:	32,826	sq.mm
Discharge Coefficient:	0.61	
Maximum ICD Release Rate:	103.20	L/s
Maximum Overflow Rate:	79.62	L/s
Total Maximum Release Rate:	182.82	L/s

DRAINAGE AREA III (Continued)

(100-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
22	3.22	1	2	0.43	71.70	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
49.596	2.776	1.46	128.76	51.50	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-8	94.71	0.61	0.36	cu.m
CB/MH-9	94.63	1.219	1.21	cu.m
CB-10	94.52	0.61	0.43	cu.m
CB/MH-11	94.49	1.219	1.37	cu.m
MH-12	94.33	1.219	1.56	cu.m
CB/MH-13	94.21	1.219	1.70	cu.m
CB/MH-14	93.78	1.219	2.20	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
MH-7	95.69	MH-12	95.61	21	300	0.00	cu.m
CB-8	94.71	CB/MH-9	94.63	17.8	250	0.87	cu.m
CB/MH-9	94.63	MH-12	94.33	69.6	250	3.42	cu.m
CB-10	94.52	CB/MH-11	94.49	6.1	250	0.30	cu.m
CB/MH-11	94.49	MH-12	94.30	15.2	250	0.75	cu.m
MH-12	94.33	CB/MH-13	94.21	47.2	375	5.21	cu.m

Maximum Volume Stored: 142.58 cu.m

Maximum Volume Required: 142.58 cu.m

DRAINAGE AREA III (Continued)

(100-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Inflow from Area II (L/s)	50% ICD Release Rate (L/s)	50% Overflow Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	248.45	24.90	51.60	0.00	221.75	133.05
15	143	198.83	24.90	51.60	13.71	158.42	142.58
20	120	166.90	24.90	51.60	21.39	118.81	142.58
25	104	144.50	24.90	51.60	22.75	95.05	142.58
30	92	127.83	24.90	51.60	21.92	79.21	142.58
35	83	114.90	33.53	51.60	28.94	67.89	142.58
40	75	104.56	41.72	51.60	35.27	59.41	142.58
45	69	96.08	46.75	51.60	38.42	52.81	142.58
50	64	88.99	49.82	51.60	39.69	47.53	142.58
55	60	82.96	51.65	51.60	39.81	43.20	142.58
60	56	77.77	52.66	51.60	39.23	39.60	142.58
65	53	73.25	53.11	51.60	38.21	36.56	142.58
70	50	69.28	53.19	51.60	36.93	33.95	142.58
75	47	65.75	53.01	51.60	35.48	31.68	142.58
80	45	62.60	52.65	51.60	33.95	29.70	142.58
85	43	59.77	52.17	51.60	32.38	27.96	142.58
90	41	57.20	51.60	51.60	30.80	26.40	142.58
95	39	54.87	50.97	51.60	29.23	25.01	142.58
100	38	52.74	50.31	51.60	27.68	23.76	142.58
105	36	50.78	49.62	51.60	26.18	22.63	142.58
110	35	48.98	48.93	51.60	24.71	21.60	142.58
115	34	47.32	48.23	51.60	23.28	20.66	142.58
120	33	45.77	47.53	51.60	21.90	19.80	142.58
125	32	44.33	46.84	51.60	20.57	19.01	142.58
130	31	42.99	46.16	51.60	19.28	18.28	142.58
135	30	41.74	45.49	51.60	18.03	17.60	142.58
140	29	40.56	44.84	51.60	16.83	16.97	142.58
145	28	39.46	44.20	51.60	15.67	16.39	142.58
150	28	38.42	43.57	51.60	14.55	15.84	142.58
180	24	33.26	40.14	51.60	8.60	13.20	142.58
210	21	29.42	37.22	51.60	3.73	11.32	142.58
240	19	26.45	34.73	51.60	0.00	9.57	137.88
270	17	24.06	32.59	51.60	0.00	5.05	81.83
300	16	22.11	30.73	51.60	0.00	1.24	22.31
330	15	20.48	29.10	49.58	0.00	0.00	0.00
360	14	19.09	27.66	46.75	0.00	0.00	0.00
390	13	17.90	26.37	44.27	0.00	0.00	0.00
420	12	16.86	25.22	42.08	0.00	0.00	0.00
450	11	15.94	24.90	40.84	0.00	0.00	0.00
480	11	15.13	24.90	40.03	0.00	0.00	0.00
510	10	14.41	24.90	39.31	0.00	0.00	0.00
540	10	13.75	24.90	38.65	0.00	0.00	0.00

50-YEAR EVENT (INCLUDING OFF-SITE AREAS)

PRE-DEVELOPMENT CONDITIONS

				C
NW Off-site Drainage	(Insmill Cr rear yards)	5,725	sq.m	0.52
1.4 ha	SW Off-site Drainage	2,145	sq.m	0.52
	475 Terry Fox Dr	12,270	sq.m	0.52
	Total Catchment Area:	20,140	sq.m	0.52

Time of Concentration (Tc)

Bransby Williams Formula (Used when C > 0.40)

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

Sheet Flow Distance (L):	200	m
Slope of Land (Sw):	4	%
Area (A):	2.01	ha
Time of Concentration (Sheet Flow):	8	min
Minimum Time of Concentration:	10	min
Rainfall Intensity (i):	161	mm/hr (50-year event)
50-Year Pre-Development Flow Rate (2.78AiC):	470.11	L/s

POST-DEVELOPMENT CONDITIONS

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(50-YEAR EVENT - INCLUDING OFF-SITE AREAS)

			C
Off-site Areas:	2,085	sq.m	0.24
Roof Area:	0	sq.m	1.00
Hard Area:	25	sq.m	1.00
Gravel Area:	0	sq.m	0.84
Soft Area:	425	sq.m	0.24
Total Catchment Area:	2,535	sq.m	0.25
Area (A):	2,535	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	161	mm/hr	
Runoff Coeficient (C):	0.25		
Flow Rate (2.78AiC):	28.16	L/s	

DRAINAGE AREA II

(50-YEAR EVENT - INCLUDING OFF-SITE AREAS)

			C
Off-site Areas:	4,331	sq.m	0.52
Roof Area:	1,325	sq.m	1.00
Hard Area:	3,725	sq.m	1.00
Gravel Area:	0	sq.m	0.84
Soft Area:	1,275	sq.m	0.24
Total Catchment Area:	10,656	sq.m	0.71

Water Elevation:	98.37	m
Head:	2.64	m
Centroid of ICD Orifice:	95.73	m
Invert of Outlet Pipe of MH-7:	95.69	m
Orifice Diameter:	85	mm
Orifice Area:	5,675	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	24.90	L/s
Maximum Overflow Rate:	7.97	L/s
Total Maximum Release Rate:	32.87	L/s

DRAINAGE AREA II (Continued)

(50-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	90	0.10	3.00	cu.m
CB/MH-2	260	0.20	17.33	cu.m
CB/MH-4	410	0.20	27.33	cu.m
CB/MH-5	290	0.15	14.50	cu.m
CB/MH-6	370	0.20	24.67	cu.m

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
42	3.22	2	4	0.43	136.96	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
47.429	5.152	1.46	218.82	87.53	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	96.02	0.61	0.87	cu.m
CB/MH-2	95.92	1.219	2.86	cu.m
MH-3	95.77	1.219	3.03	cu.m
CB/MH-4	95.72	1.219	3.09	cu.m
CB/MH-5	95.92	1.219	2.86	cu.m
CB/MH-6	95.84	1.219	2.95	cu.m
MH-7	95.69	1.219	3.13	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB-1	96.02	CB/MH-2	95.84	6.9	250	0.34	cu.m
CB/MH-2	95.92	MH-3	95.77	33.2	250	1.63	cu.m
MH-3	95.77	CB/MH-4	95.72	9.6	250	0.47	cu.m
CB/MH-4	95.72	MH-7	95.69	8.5	300	0.60	cu.m
CB/MH-5	95.92	CB/MH-6	95.84	22.2	300	1.57	cu.m
CB/MH-6	95.84	MH-7	95.76	23.1	300	1.63	cu.m

Maximum Volume Stored: 336.36 cu.m

Maximum Volume Required: 336.36 cu.m

DRAINAGE AREA II (Continued)

(50-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% ICD Release Rate (L/s)	50% Overflow Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	161	341.52	12.45	0.00	329.07	197.44
15	129	273.31	12.45	0.00	260.86	234.77
20	108	229.42	12.45	0.00	216.97	260.37
25	94	198.62	12.45	0.00	186.17	279.26
30	83	175.71	12.45	0.00	163.26	293.87
35	75	157.94	12.45	0.00	145.49	305.54
40	68	143.73	12.45	0.00	131.28	315.06
45	62	132.07	12.45	0.00	119.62	322.97
50	58	122.32	12.45	0.00	109.87	329.61
55	54	114.04	12.45	0.00	101.59	335.24
60	51	106.91	12.45	1.02	93.43	336.36
65	48	100.69	12.45	2.00	86.25	336.36
70	45	95.23	12.45	2.69	80.09	336.36
75	43	90.38	12.45	3.19	74.75	336.36
80	41	86.05	12.45	3.53	70.08	336.36
85	39	82.16	12.45	3.75	65.95	336.36
90	37	78.63	12.45	3.89	62.29	336.36
95	36	75.42	12.45	3.96	59.01	336.36
100	34	72.49	12.45	3.98	56.06	336.36
105	33	69.81	12.45	3.97	53.39	336.36
110	32	67.33	12.45	3.92	50.96	336.36
115	31	65.04	12.45	3.84	48.75	336.36
120	30	62.92	12.45	3.75	46.72	336.36
125	29	60.94	12.45	3.64	44.85	336.36
130	28	59.10	12.45	3.52	43.12	336.36
135	27	57.37	12.45	3.40	41.53	336.36
140	26	55.76	12.45	3.26	40.04	336.36
145	26	54.24	12.45	3.13	38.66	336.36
150	25	52.81	12.45	2.99	37.37	336.36
180	22	45.72	12.45	2.12	31.14	336.36
210	19	40.44	12.45	1.30	26.70	336.36
240	17	36.35	12.45	0.54	23.36	336.36
270	16	33.08	12.45	0.00	20.63	334.18
300	14	30.39	12.45	0.00	17.94	323.00
330	13	28.15	12.45	0.00	15.70	310.88
360	12	26.24	12.45	0.00	13.79	297.96
390	12	24.60	12.45	0.00	12.15	284.37
420	11	23.17	12.45	0.00	10.72	270.21
450	10	21.92	12.45	0.00	9.46	255.55
480	10	20.80	12.45	0.00	8.35	240.46
510	9	19.80	12.45	0.00	7.35	224.99
540	9	18.91	12.45	0.00	6.46	209.17

DRAINAGE AREA III

(50-YEAR EVENT - INCLUDING OFF-SITE AREAS)

			C
Off-site Areas:	1,454	sq.m	0.52
Roof Area:	2,070	sq.m	1.00
Hard Area:	1,725	sq.m	1.00
Gravel Area:	0	sq.m	0.84
Soft Area:	1,700	sq.m	0.24
Total Catchment Area:	6,949	sq.m	0.71

Water Elevation:	95.67	m
Head:	1.35	m
Centroid of ICD Orifice:	94.31	m
Invert of Outlet Pipe of CB/MH-14:	94.21	m
Orifice Diameter:	204	mm
Orifice Area:	32,826	sq.mm
Discharge Coefficient:	0.61	
Maximum ICD Release Rate:	103.20	L/s
Maximum Overflow Rate:	17.25	L/s
Total Maximum Release Rate:	120.44	L/s

DRAINAGE AREA III (Continued)

(50-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
22	3.22	1	2	0.43	71.70	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
49.596	2.776	1.46	128.76	51.50	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-8	94.71	0.61	0.36	cu.m
CB/MH-9	94.63	1.219	1.21	cu.m
CB-10	94.52	0.61	0.43	cu.m
CB/MH-11	94.49	1.219	1.37	cu.m
MH-12	94.33	1.219	1.56	cu.m
CB/MH-13	94.21	1.219	1.70	cu.m
CB/MH-14	93.78	1.219	2.20	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
MH-7	95.69	MH-12	95.61	21	300	0.00	cu.m
CB-8	94.71	CB/MH-9	94.63	17.8	250	0.87	cu.m
CB/MH-9	94.63	MH-12	94.33	69.6	250	3.42	cu.m
CB-10	94.52	CB/MH-11	94.49	6.1	250	0.30	cu.m
CB/MH-11	94.49	MH-12	94.30	15.2	250	0.75	cu.m
MH-12	94.33	CB/MH-13	94.21	47.2	375	5.21	cu.m

Maximum Volume Stored: 142.58 cu.m

Maximum Volume Required: 142.58 cu.m

DRAINAGE AREA III (Continued)

(50-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Inflow from Area II (L/s)	50% ICD Release Rate (L/s)	50% Overflow Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	161	222.61	24.90	51.60	0.00	195.91	117.54
15	129	178.14	24.90	51.60	0.00	151.45	136.30
20	108	149.54	24.90	51.60	4.03	118.81	142.58
25	94	129.46	24.90	51.60	7.71	95.05	142.58
30	83	114.53	24.90	51.60	8.62	79.21	142.58
35	75	102.95	24.90	51.60	8.36	67.89	142.58
40	68	93.68	24.90	51.60	7.58	59.41	142.58
45	62	86.08	24.90	51.60	6.58	52.81	142.58
50	58	79.73	24.90	51.60	5.51	47.53	142.58
55	54	74.33	24.90	51.60	4.43	43.20	142.58
60	51	69.68	26.94	51.60	5.42	39.60	142.58
65	48	65.63	28.89	51.60	6.37	36.56	142.58
70	45	62.07	30.29	51.60	6.81	33.95	142.58
75	43	58.91	31.27	51.60	6.90	31.68	142.58
80	41	56.09	31.95	51.60	6.74	29.70	142.58
85	39	53.55	32.40	51.60	6.40	27.96	142.58
90	37	51.25	32.68	51.60	5.93	26.40	142.58
95	36	49.16	32.83	51.60	5.38	25.01	142.58
100	34	47.25	32.87	51.60	4.76	23.76	142.58
105	33	45.50	32.83	51.60	4.10	22.63	142.58
110	32	43.89	32.73	51.60	3.42	21.60	142.58
115	31	42.39	32.58	51.60	2.71	20.66	142.58
120	30	41.01	32.40	51.60	2.01	19.80	142.58
125	29	39.72	32.18	51.60	1.30	19.01	142.58
130	28	38.52	31.95	51.60	0.59	18.28	142.58
135	27	37.40	31.69	51.60	0.00	17.49	141.68
140	26	36.34	31.43	51.60	0.00	16.17	135.84
145	26	35.35	31.15	51.60	0.00	14.91	129.69
150	25	34.42	30.87	51.60	0.00	13.69	123.24
180	22	29.80	29.14	51.60	0.00	7.34	79.31
210	19	26.36	27.49	51.60	0.00	2.25	28.39
240	17	23.69	25.99	49.68	0.00	0.00	0.00
270	16	21.56	24.90	46.46	0.00	0.00	0.00
300	14	19.81	24.90	44.71	0.00	0.00	0.00
330	13	18.35	24.90	43.25	0.00	0.00	0.00
360	12	17.11	24.90	42.01	0.00	0.00	0.00
390	12	16.04	24.90	40.94	0.00	0.00	0.00
420	11	15.10	24.90	40.00	0.00	0.00	0.00
450	10	14.28	24.90	39.18	0.00	0.00	0.00
480	10	13.56	24.90	38.46	0.00	0.00	0.00
510	9	12.91	24.90	37.81	0.00	0.00	0.00
540	9	12.32	24.90	37.22	0.00	0.00	0.00

2-YEAR EVENT (INCLUDING OFF-SITE AREAS)

PRE-DEVELOPMENT CONDITIONS

				C
NW Off-site Drainage	(Insmill Cr rear yards)	5,725	sq.m	0.43
1.4 ha	SW Off-site Drainage	2,145	sq.m	0.43
	475 Terry Fox Dr	12,270	sq.m	0.43
	Total Catchment Area:	20,140	sq.m	0.43

Time of Concentration (Tc)

Bransby Williams Formula (Used when C > 0.40)

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

Sheet Flow Distance (L):	200	m
Slope of Land (Sw):	4	%
Area (A):	2.01	ha
Time of Concentration (Sheet Flow):	8	min
Minimum Time of Concentration:	10	min
Rainfall Intensity (i):	77	mm/hr (2-year event)
2-Year Pre-Development Flow Rate (2.78AiC):	184.91	L/s

POST-DEVELOPMENT CONDITIONS

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(2-YEAR EVENT - INCLUDING OFF-SITE AREAS)

			C
Off-site Areas:	2,085	sq.m	0.20
Roof Area:	0	sq.m	0.90
Hard Area:	25	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	425	sq.m	0.20
Total Catchment Area:	2,535	sq.m	0.21
Area (A):	2,535	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	77	mm/hr	
Runoff Coeficient (C):	0.21		
Flow Rate (2.78AiC):	11.20	L/s	

DRAINAGE AREA II

(2-YEAR EVENT - INCLUDING OFF-SITE AREAS)

			C
Off-site Areas:	4,331	sq.m	0.43
Roof Area:	1,325	sq.m	0.90
Hard Area:	3,725	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	1,275	sq.m	0.20
Total Catchment Area:	10,656	sq.m	0.63

Water Elevation:	96.74	m
Head:	1.00	m
Centroid of ICD Orifice:	95.73	m
Invert of Outlet Pipe of MH-7:	95.69	m
Orifice Diameter:	85	mm
Orifice Area:	5,675	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	15.36	L/s
Maximum Overflow Rate:	0.00	L/s
Total Maximum Release Rate:	15.36	L/s

DRAINAGE AREA II (Continued)

(2-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	0	0.00	0.00	cu.m
CB/MH-2	0	0.00	0.00	cu.m
CB/MH-4	0	0.00	0.00	cu.m
CB/MH-5	0	0.00	0.00	cu.m
CB/MH-6	0	0.00	0.00	cu.m

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
42	2.40	2	4	0.36	102.24	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
47.429	5.152	0.68	63.04	25.22	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-1	96.02	0.61	0.27	cu.m
CB/MH-2	95.92	1.219	0.95	cu.m
MH-3	95.77	1.219	1.13	cu.m
CB/MH-4	95.72	1.219	1.19	cu.m
CB/MH-5	95.92	1.219	0.95	cu.m
CB/MH-6	95.84	1.219	1.05	cu.m
MH-7	95.69	1.219	1.22	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
CB-1	96.02	CB/MH-2	95.84	6.9	250	0.34	cu.m
CB/MH-2	95.92	MH-3	95.77	33.2	250	1.63	cu.m
MH-3	95.77	CB/MH-4	95.72	9.6	250	0.47	cu.m
CB/MH-4	95.72	MH-7	95.69	8.5	300	0.60	cu.m
CB/MH-5	95.92	CB/MH-6	95.84	22.2	300	1.57	cu.m
CB/MH-6	95.84	MH-7	95.76	23.1	300	1.63	cu.m

Maximum Volume Stored: 140.45 cu.m

Maximum Volume Required: 140.45 cu.m

DRAINAGE AREA II (Continued)

(2-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% ICD Release Rate (L/s)	50% Overflow Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	77	142.56	7.68	0.00	134.88	80.93
15	62	114.65	7.68	0.00	106.97	96.27
20	52	96.58	7.68	0.00	88.90	106.68
25	45	83.84	7.68	0.00	76.16	114.23
30	40	74.33	7.68	0.00	66.65	119.96
35	36	66.93	7.68	0.00	59.25	124.43
40	33	61.00	7.68	0.00	53.32	127.97
45	30	56.13	7.68	0.00	48.45	130.81
50	28	52.05	7.68	0.00	44.37	133.10
55	26	48.58	7.68	0.00	40.90	134.95
60	25	45.58	7.68	0.00	37.90	136.44
65	23	42.97	7.68	0.00	35.29	137.63
70	22	40.67	7.68	0.00	32.99	138.57
75	21	38.63	7.68	0.00	30.95	139.28
80	20	36.81	7.68	0.00	29.13	139.80
85	19	35.16	7.68	0.00	27.48	140.16
90	18	33.68	7.68	0.00	25.99	140.37
95	17	32.32	7.68	0.00	24.64	140.45
100	17	31.08	7.68	0.00	23.40	140.41
105	16	29.95	7.68	0.00	22.27	140.27
110	16	28.90	7.68	0.00	21.22	140.03
115	15	27.93	7.68	0.00	20.25	139.71
120	15	27.03	7.68	0.00	19.35	139.31
125	14	26.19	7.68	0.00	18.51	138.83
130	14	25.41	7.68	0.00	17.73	138.29
135	13	24.68	7.68	0.00	17.00	137.68
140	13	23.99	7.68	0.00	16.31	137.02
145	13	23.35	7.68	0.00	15.67	136.30
150	12	22.74	7.68	0.00	15.06	135.54
180	11	19.72	7.68	0.00	12.04	130.07
210	9	17.48	7.68	0.00	9.80	123.42
240	8	15.73	7.68	0.00	8.05	115.91
270	8	14.33	7.68	0.00	6.65	107.74
300	7	13.18	7.68	0.00	5.50	99.04
330	7	12.22	7.68	0.00	4.54	89.91
360	6	11.40	7.68	0.00	3.72	80.43
390	6	10.70	7.68	0.00	3.02	70.64
420	5	10.09	7.68	0.00	2.40	60.59
450	5	9.54	7.68	0.00	1.86	50.32
480	5	9.06	7.68	0.00	1.38	39.86
510	5	8.64	7.68	0.00	0.95	29.22
540	4	8.25	7.68	0.00	0.57	18.42

DRAINAGE AREA III

(2-YEAR EVENT - INCLUDING OFF-SITE AREAS)

			C
Off-site Areas:	1,454	sq.m	0.43
Roof Area:	2,070	sq.m	0.90
Hard Area:	1,725	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	1,700	sq.m	0.20
Total Catchment Area:	6,949	sq.m	0.63

Water Elevation:	94.71	m
Head:	0.40	m
Centroid of ICD Orifice:	94.31	m
Invert of Outlet Pipe of CB/MH-14:	94.21	m
Orifice Diameter:	204	mm
Orifice Area:	32,826	sq.mm
Discharge Coefficient:	0.61	
Maximum ICD Release Rate:	56.17	L/s
Maximum Overflow Rate:	0.00	L/s
Total Maximum Release Rate:	56.17	L/s

DRAINAGE AREA III (Continued)

(2-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
22	1.85	1	2	0.29	41.28	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
49.596	2.776	0.50	28.01	11.20	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-8	94.71	0.61	0.00	cu.m
CB/MH-9	94.63	1.219	0.10	cu.m
CB-10	94.52	0.61	0.07	cu.m
CB/MH-11	94.49	1.219	0.26	cu.m
MH-12	94.33	1.219	0.45	cu.m
CB/MH-13	94.21	1.219	0.59	cu.m
CB/MH-14	93.78	1.219	1.09	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
MH-7	95.69	MH-12	95.61	21	300	0.00	cu.m
CB-8	94.71	CB/MH-9	94.63	17.8	250	0.87	cu.m
CB/MH-9	94.63	MH-12	94.33	69.6	250	3.42	cu.m
CB-10	94.52	CB/MH-11	94.49	6.1	250	0.30	cu.m
CB/MH-11	94.49	MH-12	94.30	15.2	250	0.75	cu.m
MH-12	94.33	CB/MH-13	94.21	47.2	375	5.21	cu.m

Maximum Volume Stored: 65.59 cu.m

Maximum Volume Required: 65.59 cu.m

DRAINAGE AREA III (Continued)

(2-YEAR EVENT - INCLUDING OFF-SITE AREAS)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Inflow from Area II (L/s)	50% ICD Release Rate (L/s)	50% Overflow Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	77	93.60	15.36	28.08	0.00	80.88	48.53
15	62	75.27	15.36	28.08	0.00	62.55	56.30
20	52	63.41	15.36	28.08	0.00	50.69	60.82
25	45	55.04	15.36	28.08	0.00	42.32	63.48
30	40	48.80	15.36	28.08	0.00	36.08	64.94
35	36	43.94	15.36	28.08	0.00	31.22	65.56
40	33	40.05	15.36	28.08	0.00	27.33	65.59
45	30	36.85	15.36	28.08	0.00	24.13	65.15
50	28	34.17	15.36	28.08	0.00	21.45	64.35
55	26	31.89	15.36	28.08	0.00	19.17	63.26
60	25	29.93	15.36	28.08	0.00	17.20	61.94
65	23	28.21	15.36	28.08	0.00	15.49	60.41
70	22	26.70	15.36	28.08	0.00	13.98	58.72
75	21	25.36	15.36	28.08	0.00	12.64	56.89
80	20	24.17	15.36	28.08	0.00	11.44	54.93
85	19	23.09	15.36	28.08	0.00	10.36	52.86
90	18	22.11	15.36	28.08	0.00	9.39	50.69
95	17	21.22	15.36	28.08	0.00	8.50	48.44
100	17	20.41	15.36	28.08	0.00	7.69	46.11
105	16	19.66	15.36	28.08	0.00	6.94	43.72
110	16	18.97	15.36	28.08	0.00	6.25	41.26
115	15	18.34	15.36	28.08	0.00	5.61	38.74
120	15	17.75	15.36	28.08	0.00	5.02	36.17
125	14	17.20	15.36	28.08	0.00	4.47	33.55
130	14	16.68	15.36	28.08	0.00	3.96	30.89
135	13	16.20	15.36	28.08	0.00	3.48	28.19
140	13	15.75	15.36	28.08	0.00	3.03	25.45
145	13	15.33	15.36	28.08	0.00	2.61	22.68
150	12	14.93	15.36	28.08	0.00	2.21	19.87
180	11	12.95	15.36	28.08	0.00	0.23	2.46
210	9	11.47	15.36	26.84	0.00	0.00	0.00
240	8	10.33	15.36	25.69	0.00	0.00	0.00
270	8	9.41	15.36	24.77	0.00	0.00	0.00
300	7	8.66	15.36	24.02	0.00	0.00	0.00
330	7	8.02	15.36	23.39	0.00	0.00	0.00
360	6	7.49	15.36	22.85	0.00	0.00	0.00
390	6	7.02	15.36	22.39	0.00	0.00	0.00
420	5	6.62	15.36	21.98	0.00	0.00	0.00
450	5	6.27	15.36	21.63	0.00	0.00	0.00
480	5	5.95	15.36	21.31	0.00	0.00	0.00
510	5	5.67	15.36	21.03	0.00	0.00	0.00
540	4	5.42	15.36	20.78	0.00	0.00	0.00

5-YEAR EVENT (INCLUDING OFF-SITE AREAS)

(CARP RIVER AT 100-YEAR ELEVATION: 93.51)

PRE-DEVELOPMENT CONDITIONS

				C
NW Off-site Drainage	(Insmill Cr rear yards)	5,725	sq.m	0.43
1.4 ha	SW Off-site Drainage	2,145	sq.m	0.43
	475 Terry Fox Dr	12,270	sq.m	0.43
	Total Catchment Area:	20,140	sq.m	0.43

Time of Concentration (Tc)

Bransby Williams Formula (Used when C > 0.40)

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

Sheet Flow Distance (L):	200	m
Slope of Land (Sw):	4	%
Area (A):	2.01	ha
Time of Concentration (Sheet Flow):	8	min
Minimum Time of Concentration:	10	min
Rainfall Intensity (i):	104	mm/hr (5-year event)
2-Year Pre-Development Flow Rate (2.78AiC):	250.85	L/s

POST-DEVELOPMENT CONDITIONS

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(5-YEAR EVENT - INCLUDING OFF-SITE AREAS - CARP RIVER AT 100-YEAR ELEV.: 93.51)

			C
Off-site Areas:	2,085	sq.m	0.20
Roof Area:	0	sq.m	0.90
Hard Area:	25	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	425	sq.m	0.20
Total Catchment Area:	2,535	sq.m	0.21
Area (A):	2,535	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
Runoff Coeficient (C):	0.21		
Flow Rate (2.78AiC):	15.19	L/s	

DRAINAGE AREA II

(5-YEAR EVENT - INCLUDING OFF-SITE AREAS - CARP RIVER AT 100-YEAR ELEV.: 93.51)

			C
Off-site Areas:	4,331	sq.m	0.43
Roof Area:	1,325	sq.m	0.90
Hard Area:	3,725	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	1,275	sq.m	0.20
Total Catchment Area:	10,656	sq.m	0.63

Water Elevation:	97.24	m
Head:	1.51	m
Centroid of ICD Orifice:	95.73	m
Invert of Outlet Pipe of MH-7:	95.69	m
Orifice Diameter:	85	mm
Orifice Area:	5,675	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	18.81	L/s
Maximum Overflow Rate:	0.00	L/s
Total Maximum Release Rate:	18.81	L/s

DRAINAGE AREA II (Continued)

(5-YEAR EVENT - INCLUDING OFF-SITE AREAS - CARP RIVER AT 100-YEAR ELEV.: 93.51)

Surface Storage

CB/MH	Top Area	Depth	Volume	
CB-1	0	0.00	0.00	cu.m
CB/MH-2	0	0.00	0.00	cu.m
CB/MH-4	0	0.00	0.00	cu.m
CB/MH-5	0	0.00	0.00	cu.m
CB/MH-6	0	0.00	0.00	cu.m

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
42	2.40	2	4	0.36	102.24	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
47.429	5.152	1.18	185.49	74.20	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
34.9219166	96.02	0.61	0.45	cu.m
32.7696134	95.92	1.219	1.54	cu.m
30.8927892	95.77	1.219	1.71	cu.m
29.2403162	95.72	1.219	1.77	cu.m
27.7731362	95.92	1.219	1.54	cu.m
26.4608731	95.84	1.219	1.63	cu.m
25.279531	95.69	1.219	1.81	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
34.9219166	96.02	32.7696134	95.84	6.9	250	0.34	cu.m
32.7696134	95.92	30.8927892	95.77	33.2	250	1.63	cu.m
30.8927892	95.77	29.2403162	95.72	9.6	250	0.47	cu.m
29.2403162	95.72	25.279531	95.69	8.5	300	0.60	cu.m
27.7731362	95.92	26.4608731	95.84	22.2	300	1.57	cu.m
26.4608731	95.84	25.279531	95.76	23.1	300	1.63	cu.m

Maximum Volume Stored: 193.13 cu.m

Maximum Volume Required: 193.13 cu.m

DRAINAGE AREA II (Continued)

(5-YEAR EVENT - INCLUDING OFF-SITE AREAS - CARP RIVER AT 100-YEAR ELEV.: 93.51)

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% ICD Release Rate (L/s)	50% Overflow Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	104	193.40	9.40	0.00	183.99	110.40
15	84	155.09	9.40	0.00	145.69	131.12
20	70	130.40	9.40	0.00	120.99	145.19
25	61	113.03	9.40	0.00	103.63	155.44
30	54	100.10	9.40	0.00	90.69	163.25
35	49	90.06	9.40	0.00	80.65	169.37
40	44	82.01	9.40	0.00	72.61	174.26
45	41	75.41	9.40	0.00	66.01	178.22
50	38	69.89	9.40	0.00	60.48	181.45
55	35	65.19	9.40	0.00	55.79	184.10
60	33	61.15	9.40	0.00	51.74	186.27
65	31	57.62	9.40	0.00	48.22	188.05
70	29	54.52	9.40	0.00	45.11	189.48
75	28	51.76	9.40	0.00	42.36	190.62
80	27	49.30	9.40	0.00	39.90	191.51
85	25	47.09	9.40	0.00	37.68	192.18
90	24	45.08	9.40	0.00	35.68	192.66
95	23	43.26	9.40	0.00	33.85	192.97
100	22	41.59	9.40	0.00	32.19	193.12
105	22	40.06	9.40	0.00	30.66	193.13
110	21	38.65	9.40	0.00	29.24	193.01
115	20	37.34	9.40	0.00	27.94	192.79
120	19	36.13	9.40	0.00	26.73	192.45
125	19	35.01	9.40	0.00	25.60	192.03
130	18	33.96	9.40	0.00	24.55	191.51
135	18	32.97	9.40	0.00	23.57	190.91
140	17	32.05	9.40	0.00	22.65	190.24
145	17	31.19	9.40	0.00	21.78	189.50
150	16	30.37	9.40	0.00	20.97	188.69
180	14	26.32	9.40	0.00	16.92	182.69
210	13	23.30	9.40	0.00	13.90	175.14
240	11	20.96	9.40	0.00	11.56	166.45
270	10	19.09	9.40	0.00	9.69	156.90
300	9	17.55	9.40	0.00	8.15	146.66
330	9	16.27	9.40	0.00	6.86	135.85
360	8	15.17	9.40	0.00	5.77	124.58
390	8	14.23	9.40	0.00	4.83	112.91
420	7	13.41	9.40	0.00	4.00	100.90
450	7	12.69	9.40	0.00	3.28	88.60
480	6	12.05	9.40	0.00	2.64	76.04
510	6	11.47	9.40	0.00	2.07	63.26
540	6	10.96	9.40	0.00	1.55	50.27

DRAINAGE AREA III

(5-YEAR EVENT - INCLUDING OFF-SITE AREAS - CARP RIVER AT 100-YEAR ELEV.: 93.51)

			C
Off-site Areas:	1,454	sq.m	0.43
Roof Area:	2,070	sq.m	0.90
Hard Area:	1,725	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Soft Area:	1,700	sq.m	0.20
Total Catchment Area:	6,949	sq.m	0.63

Water Elevation:	95.03	m	
Head:	0.71	m	
Centroid of ICD Orifice:	94.31	m	
Invert of Outlet Pipe of CB/MH-14:	94.21	m	
Orifice Diameter:	204	mm	
Orifice Area:	32,826	sq.mm	
Discharge Coefficient:	0.61		
Maximum ICD Release Rate:	74.99	L/s	
Maximum Overflow Rate:	0.00	L/s	
Total Maximum Release Rate:	74.99	L/s	74.9865217

DRAINAGE AREA III (Continued)

(5-YEAR EVENT - INCLUDING OFF-SITE AREAS - CARP RIVER AT 100-YEAR ELEV.: 93.51)

Chamber Storage

No. of Chambers	Volume Per Chamber	No. of Rows	No. of End Caps	Volume Per End Cap	Volume	
22	1.85	1	2	0.29	41.28	cu.m

Clear Stone Storage

Length	Width	Depth	Volume	40% Voids	
49.596	2.776	0.82	71.20	28.48	cu.m

CB/MH Storage

CB/MH	Invert	Size	Volume	
CB-8	94.71	0.61	0.12	cu.m
CB/MH-9	94.63	1.219	0.46	cu.m
CB-10	94.52	0.61	0.19	cu.m
CB/MH-11	94.49	1.219	0.63	cu.m
MH-12	94.33	1.219	0.81	cu.m
CB/MH-13	94.21	1.219	0.95	cu.m
CB/MH-14	93.78	1.219	1.46	cu.m

Pipe Storage

From	Invert	To	Invert	Length	Diameter	Volume	
25.279531	95.69	MH-12	95.61	21	300	0.00	cu.m
CB-8	94.71	CB/MH-9	94.63	17.8	250	0.87	cu.m
CB/MH-9	94.63	MH-12	94.33	69.6	250	3.42	cu.m
CB-10	94.52	CB/MH-11	94.49	6.1	250	0.30	cu.m
CB/MH-11	94.49	MH-12	94.30	15.2	250	0.75	cu.m
MH-12	94.33	CB/MH-13	94.21	47.2	375	5.21	cu.m

Maximum Volume Stored: 84.93 cu.m

Maximum Volume Required: 84.93 cu.m

DRAINAGE AREA III (Continued)

(5-YEAR EVENT - INCLUDING OFF-SITE AREAS - CARP RIVER AT 100-YEAR ELEV.: 93.51)

Time (min)	i (mm/hr)	2.78AiC (L/s)	Inflow from Area II (L/s)	50% ICD Release Rate (L/s)	50% Overflow Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	104	126.97	18.81	37.49	0.00	108.29	64.97
15	84	101.83	18.81	37.49	0.00	83.14	74.83
20	70	85.61	18.81	37.49	0.00	66.93	80.31
25	61	74.21	18.81	37.49	0.00	55.53	83.29
30	54	65.72	18.81	37.49	0.00	47.04	84.66
35	49	59.13	18.81	37.49	0.00	40.44	84.93
40	44	53.85	18.81	37.49	0.00	35.16	84.39
45	41	49.51	18.81	37.49	0.00	30.83	83.24
50	38	45.89	18.81	37.49	0.00	27.20	81.61
55	35	42.80	18.81	37.49	0.00	24.12	79.59
60	33	40.15	18.81	37.49	0.00	21.46	77.27
65	31	37.83	18.81	37.49	0.00	19.15	74.68
70	29	35.79	18.81	37.49	0.00	17.11	71.86
75	28	33.99	18.81	37.49	0.00	15.30	68.86
80	27	32.37	18.81	37.49	0.00	13.69	65.69
85	25	30.92	18.81	37.49	0.00	12.23	62.38
90	24	29.60	18.81	37.49	0.00	10.92	58.94
95	23	28.40	18.81	37.49	0.00	9.72	55.39
100	22	27.31	18.81	37.49	0.00	8.62	51.74
105	22	26.30	18.81	37.49	0.00	7.62	47.99
110	21	25.38	18.81	37.49	0.00	6.69	44.16
115	20	24.52	18.81	37.49	0.00	5.84	40.26
120	19	23.72	18.81	37.49	0.00	5.04	36.29
125	19	22.98	18.81	37.49	0.00	4.30	32.26
130	18	22.29	18.81	37.49	0.00	3.61	28.17
135	18	21.65	18.81	37.49	0.00	2.97	24.02
140	17	21.04	18.81	37.49	0.00	2.36	19.83
145	17	20.48	18.81	37.49	0.00	1.79	15.59
150	16	19.94	18.81	37.49	0.00	1.26	11.30
180	14	17.28	18.81	36.09	0.00	0.00	0.00
210	13	15.30	18.81	34.11	0.00	0.00	0.00
240	11	13.76	18.81	32.57	0.00	0.00	0.00
270	10	12.53	18.81	31.34	0.00	0.00	0.00
300	9	11.52	18.81	30.33	0.00	0.00	0.00
330	9	10.68	18.81	29.49	0.00	0.00	0.00
360	8	9.96	18.81	28.77	0.00	0.00	0.00
390	8	9.34	18.81	28.15	0.00	0.00	0.00
420	7	8.80	18.81	27.61	0.00	0.00	0.00
450	7	8.33	18.81	27.14	0.00	0.00	0.00
480	6	7.91	18.81	26.72	0.00	0.00	0.00
510	6	7.53	18.81	26.34	0.00	0.00	0.00
540	6	7.19	18.81	26.00	0.00	0.00	0.00

DATA SHEET

HYDROSTOR™



PRODUCT DESCRIPTION : Semi-circular retention and infiltration chambers.

APPLICATIONS : Underground storage of runoff water with or without groundwater replenishment.

MANUFACTURING STANDARDS : ASTM F2418, ASTM F2787 et CSA B184.2.

RAW MATERIAL : ASTM D4101 Polypropylene

TECHNICAL DATA : Structural strengh : CL-625 (CSA-S6), H-25 et HS-25 (AASHTO)

CHAMBER TECHNICAL DATA

	HS31				HS75				HS180				HS290			
Length	2217	mm	87,3	in	2212	mm	87,1	in	2253	mm	88,7	in	1316	mm	51,8	in
Installed Length	2172	mm	85,5	in	2156	mm	84,9	in	2167	mm	85,3	in	1227	mm	48,3	in
Height	406	mm	16,0	in	754	mm	29,7	in	1156	mm	45,5	in	1511	mm	59,5	in
Width	864	mm	34,0	in	1295	mm	51,0	in	1976	mm	77,8	in	2553	mm	100,5	in
Volume (chamber only)	0,43	m^3	15,2	ft^3	1,32	m^3	46,6	ft^3	3,2	m^3	113,6	ft^3	3,10	m^3	109,6	ft^3
Weight	15,4	kg	34,0	lb	31,3	kg	69,0	lb	55,3	kg	122,0	lb	50,8	kg	112,0	lb

END CAP TECHNICAL DATA

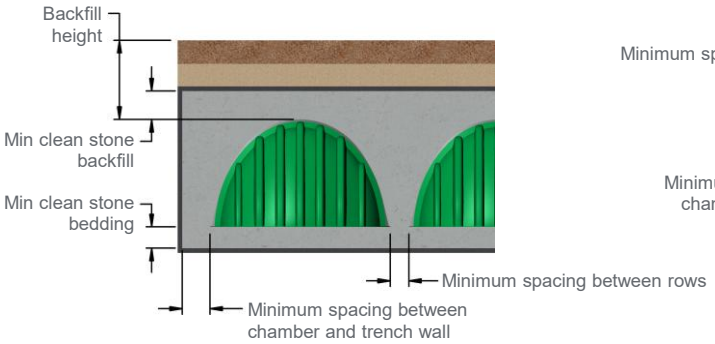
	HS31				HS75				HS180				HS290			
Length	203	mm	8,0	in	302	mm	11,9	in	610	mm	24,0	in	889	mm	35,0	in
Installed Length	175	mm	6,9	in	264	mm	10,4	in	561	mm	22,1	in	823	mm	32,4	in
Height	414	mm	16,3	in	767	mm	30,2	in	1135	mm	44,7	in	1506	mm	59,3	in
Width	864	mm	34,0	in	1295	mm	51,0	in	1994	mm	78,5	in	2388	mm	94,0	in
Volume (chamber only)	0,02	m^3	0,62	ft^3	0,10	m^3	3,42	ft^3	0,4	m^3	15,3	ft^3	1,12	m^3	39,6	ft^3
Weight	2	kg	3,8	lb	6	kg	13,2	lb	24	kg	52,0	lb	36	kg	79,9	lb
Maximum connection diameter	305	mm	12	in	610	mm	24	in	750	mm	30	in	1050	mm	42	in

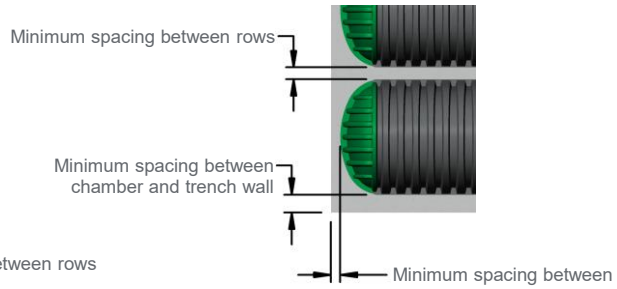
Note : Values in the tables are approximate and may change without notice.

DATA SHEET

HYDROSTOR™ (CONT'D)

SYSTEM TECHNICAL DATA





	HS31				HS75				HS180				HS290			
Min backfill height [1][2]	457	mm	18,0	in	457	mm	18,0	in	457	mm	18,0	in	610	mm	24,0	in
Max backfill height [2]	2,44	m	8,0	ft	2,44	m	8,0	ft	2,44	m	8,0	ft	2,438	m	8,0	ft
Min clean stone bedding [3]	152	mm	6,0	in	152	mm	6,0	in	229	mm	9,0	in	229	mm	9,0	in
Min clean stone backfill	152	mm	6,0	in	152	mm	6,0	in	305	mm	12,0	in	305	mm	12,0	in
Minimum spacing between rows	76	mm	3,0	in	152	mm	6,0	in	127	mm	5,0	in	216	mm	8,5	in
Minimum spacing between chamber and trench wall	305	mm	12,0	in	305	mm	12,0	in	305	mm	12,0	in	305	mm	12,0	in
Minimum spacing between end cap and trench wall	305	mm	12,0	in	305	mm	12,0	in	152	mm	6,0	in	305	mm	12,0	in
Min. retention volume [4] | Chamber	0,88	m^3	31,2	ft^3	2,12	m^3	75,0	ft^3	5,0	m^3	176,0	ft^3	4,66	m^3	164,5	ft^3
Min. retention volume [4] | End cap	0,15	m^3	5,19	ft^3	0,41	m^3	14,5	ft^3	1,3	m^3	44,8	ft^3	3,24	m^3	114,46	ft^3

Note 1: Traffic (load CL-625, H-25 or HS-25) is allowed if the height between the top of the chambers and the final elevation reaches this value at least.

Note 2: For values below the minimum or above the maximum, please contact your Soleno representative.

Note 3: The minimum seat is indicated to obtain a functional retention system. The design engineer is responsible for ensuring the stability of the foundation. In addition, for value below the minimum, please contact your Soleno representative.

Note 4: The minimum retention volumes are calculated with 40% void pourcentage in the stone.

APPLICATIONS : Retention system
Detention system

OPTIONS :
- Pretreatment unit (recommended)
- Sediment row
- Inspection port
- Diffusor and/or collector
- Flow regulator
- Control and/or bypass manholes

INSTALLATION : Visit the soleno.com to consult the installation guide.

Note : Values in the tables are approximate and may change without notice.

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

Project Name: 475 Terry Fox Dr.
Location: Ottawa, ON
OGS #: OGS

Engineer: D. B. Grey Engineering Inc.
Contact: Ryan Faith
Report Date: 7-Jul-25

Area	1.205	ha	**Rainfall Station #**	215	
Weighted C	0.71		**Particle Size Distribution**	FINE	
CDS Model	2025		**CDS Treatment Capacity**	45	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%	1.2	1.2	2.6	98.1	9.0
1.0	10.6%	19.8%	2.4	2.4	5.2	97.4	10.3
1.5	9.9%	29.7%	3.6	3.6	7.9	96.6	9.6
2.0	8.4%	38.1%	4.8	4.8	10.5	95.8	8.0
2.5	7.7%	45.8%	5.9	5.9	13.1	95.1	7.3
3.0	5.9%	51.7%	7.1	7.1	15.7	94.3	5.6
3.5	4.4%	56.1%	8.3	8.3	18.4	93.6	4.1
4.0	4.7%	60.7%	9.5	9.5	21.0	92.8	4.3
4.5	3.3%	64.0%	10.7	10.7	23.6	92.1	3.1
5.0	3.0%	67.1%	11.9	11.9	26.2	91.3	2.8
6.0	5.4%	72.4%	14.3	14.3	31.5	89.8	4.8
7.0	4.4%	76.8%	16.6	16.6	36.7	88.3	3.8
8.0	3.5%	80.3%	19.0	19.0	42.0	86.8	3.1
9.0	2.8%	83.2%	21.4	21.4	47.2	85.3	2.4
10.0	2.2%	85.3%	23.8	23.8	52.5	83.8	1.8
15.0	7.0%	92.3%	35.7	35.7	78.7	76.3	5.3
20.0	4.5%	96.9%	47.6	45.3	100.0	66.9	3.0
25.0	1.4%	98.3%	59.5	45.3	100.0	53.5	0.8
30.0	0.7%	99.0%	71.4	45.3	100.0	44.6	0.3
35.0	0.5%	99.5%	83.2	45.3	100.0	38.2	0.2
40.0	0.5%	100.0%	95.1	45.3	100.0	33.4	0.2
45.0	0.0%	100.0%	107.0	45.3	100.0	29.7	0.0
50.0	0.0%	100.0%	118.9	45.3	100.0	26.7	0.0
							89.9

Removal Efficiency Adjustment[2] = 6.5%

Predicted Net Annual Load Removal Efficiency = 83%

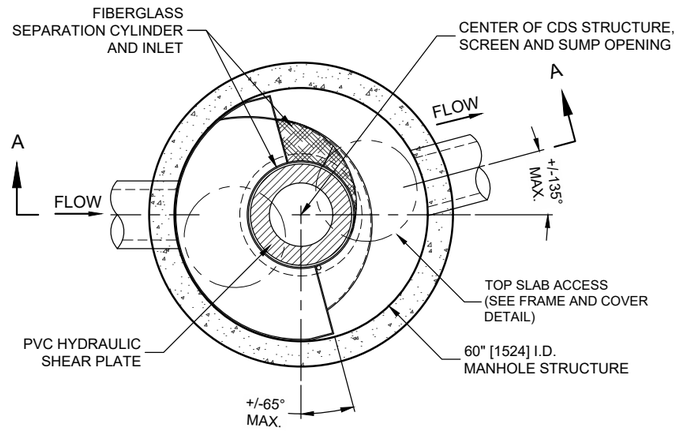
Predicted Annual Rainfall Treated = 99%

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

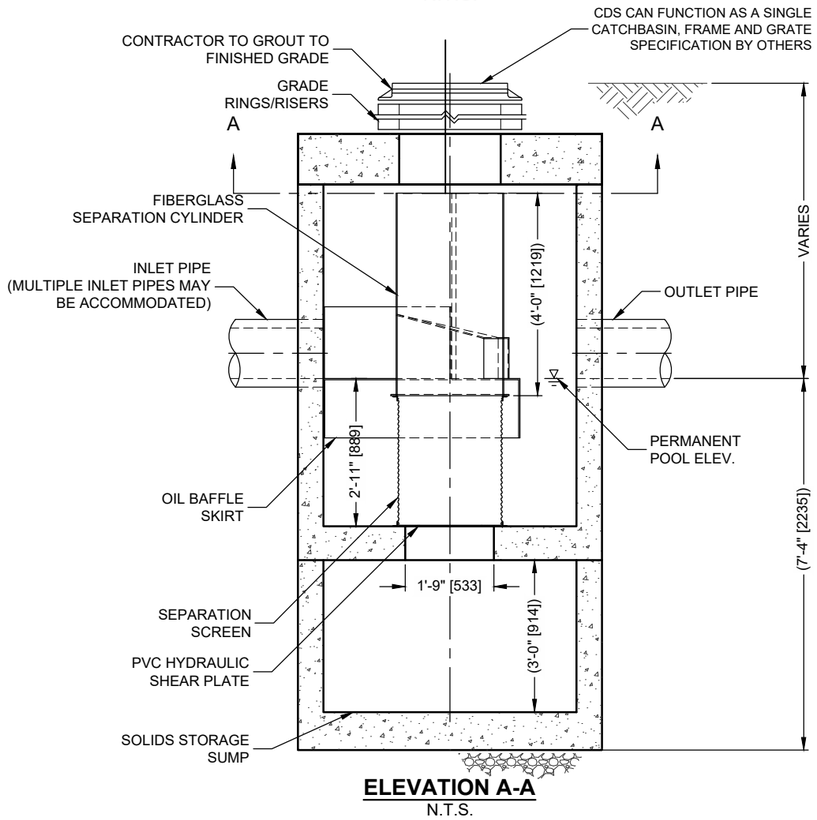
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

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

4 - CDS design and scaling based on original manufacturer model and product specifications.



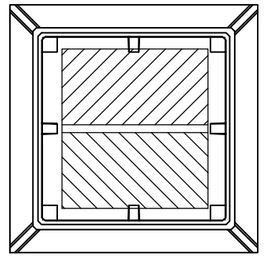
PLAN VIEW B-B
N.T.S.



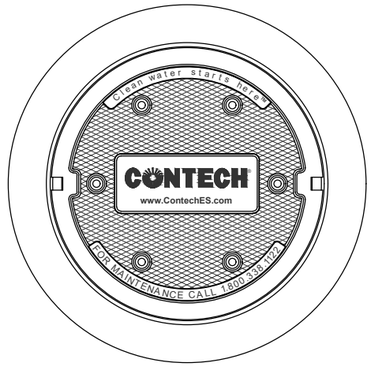
ELEVATION A-A
N.T.S.

CDS PMSU 2025-5-C DESIGN NOTES

THE STANDARD CDS PMSU 2025-5-C CONFIGURATION IS SHOWN.
ANTI-BUOYANCY SLAB MAY BE INCLUDED (NOT SHOWN).
SUMP DEPTH SHOWN IS TYPICAL, CAN BE EXTENDED AS REQUIRED.
HYDRAULIC CHARACTERISTICS VARY BASED ON PIPE SIZE, MATERIAL, AND CDS UNIT SELECTION. FOR CUSTOM HYDRAULIC ANALYSIS PLEASE CONTACT ECHELON ENVIRONMENTAL.
FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT ECHELON ENVIRONMENTAL.



FRAME AND GRATE
(DIMENSIONS VARIES)
N.T.S.



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

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 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET HS20 (AASHTO M 306) AND BE CAST WITH THE CONTECH LOGO.
6. IF REQUIRED, 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.

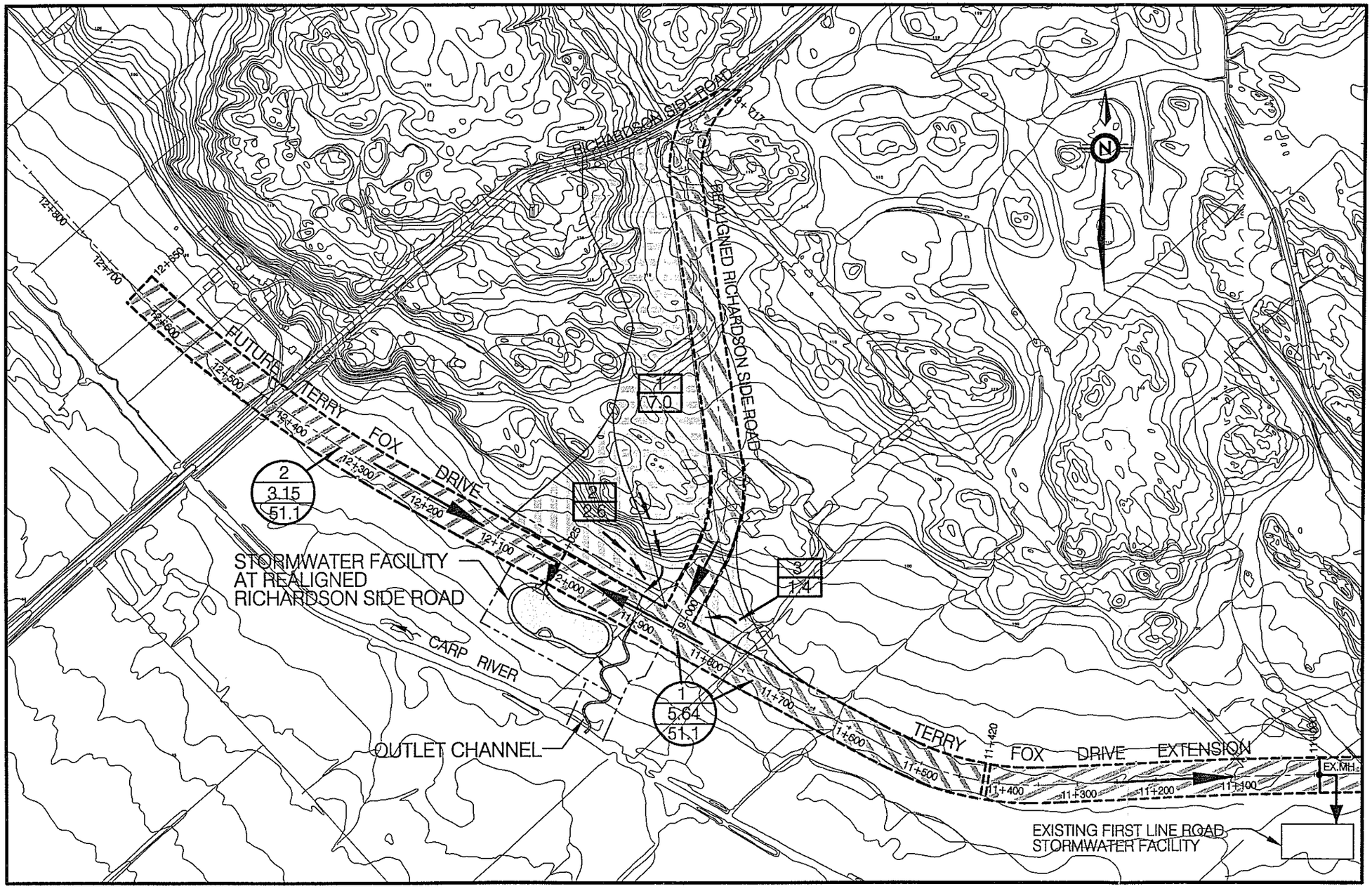
ECHELON ENVIRONMENTAL
55 ALBERT STREET, MARKHAM ON L3P2T4
CONTACT: INFO@ECHELONENVIRONMENTAL.CA
905-948-0000

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CONTECH ENGINEERED SOLUTIONS LLC

CDS PMSU 2025-5-C
ONLINE CDS
STANDARD DETAIL

DATE: 13-FEB-25
REVISION:1
DRAWN BY: PG



2 / 3.15 / 51.1 ← ID NUMBER / AREA IN ha / % IMPERVIOUS AREA

2 / 3.1 ← ID NUMBER / TRIBUTARY AREA IN ha INTERCEPTED BY CULVERT 1200 dia.

DILLON CONSULTING

TITLE: POST-DEVELOPMENT DRAINAGE CONDITIONS

PROJECT: TERRY FOX DRIVE
STORMWATER MANAGEMENT FACILITY
AT REALIGNED RICHARDSON SIDE ROAD

DATE: January, 2002

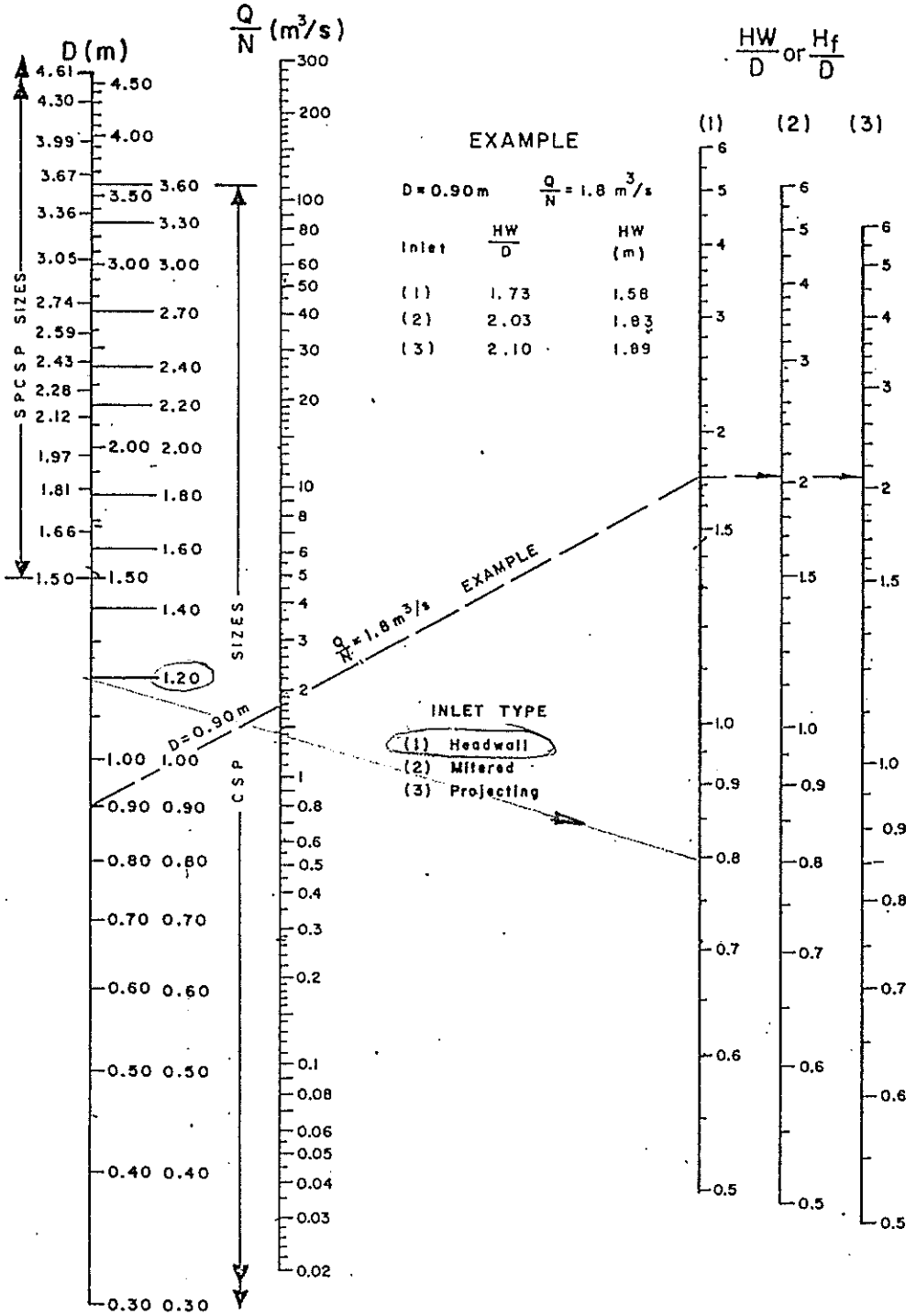
SCALE: 0m 50 100 200

FIGURE No.: 2

G:/CAD/019542/microstation/figures/proposed_drainage.dgn January 21, 2002

CROSS-CULVERT 1200 DIA

CHART D5-1G

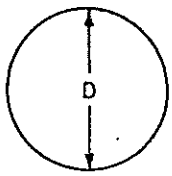


$\frac{HW}{D} = 0.8 \Rightarrow$ $H_W = 0.8 \times 1.2$

$H_W = 0.96$

Free board : $1.2 - 0.96 = 0.24$

$0.24m$



FHA 63 01
METRIC FHA 74 06 (51)

INLET CONTROL
CSP & SPCSP CULVERT

BRANSBY WILLIAMS METHOD: EXTERNAL AREAS

			OVERLAND						WATERWAY									INLET CONTROL
AREA #	AREA (ha)	C	ELEV. 1 (m)	ELEV. 2 (m)	LENGTH (m)	SLOPE	VELOCITY (m/s)	TIME (min)	ELEV. 1 (m)	ELEV. 2 (m)	LENGTH (m)	SLOPE	VELOCITY (m/s)	TIME (min)	Tc (min)	INTENSITY (mm/hr)	FLOW (m^3/s)	CSP DIAMETER (mm)
13	64.29	0.52	112	106	200	0.030	0.37	9.0	106	88	1140	0.016	0.57	33.1	44.8	65.26	6.11	2000
12	2.76	0.52	114	105	160	0.050	0.48	5.6							3.5	271.01	1.09	1000
11	2.61	0.52	114	104	250	0.040	0.43	9.8							6.0	200.27	0.76	900
10	92.41	0.42	124	116	200	0.040	0.43	7.8	116	108	1980	0.004	0.29	113.6	84.1	45.92	4.99	1800
9	20.34	0.52	118	110	200	0.040	0.43	7.8	110	102	560	0.014	0.55	17.1	27.6	85.55	2.53	1400
8	98.05	0.52	124	121	200	0.015	0.26	12.8	121	102	1050	0.018	0.61	28.5	40.2	69.33	9.90	2400
7	59.07	0.52	130	103	200	0.135	0.78	4.3	103	102	1200	0.001	0.13	151.5	46.2	64.16	5.52	2000
6	8.35	0.52	126	116	200	0.050	0.48	7.0	116	108	350	0.023	0.69	8.4	20.0	102.45	1.25	1050
4	44.89	0.52	120	106.2	200	0.069	0.56	5.9	106.2	93	480	0.028	0.76	10.6	20.1	102.15	6.68	2100
1	11.01	0.52	122	108	210	0.067	0.55	6.4	112	94	570	0.032	0.81	11.7	27.1	86.48	1.39	1200
2	13.6	0.52	122	110	200	0.060	0.52	6.4	110	93	190	0.089	1.37	2.3	11.5	139.85	2.77	1500
3	27.41	0.52	126	118	200	0.040	0.43	7.8	118	93.5	280	0.088	1.35	3.5	13.4	128.15	5.11	2000
5	17.11	0.52	114	112	200	0.010	0.21	15.6	112	104	410	0.020	0.64	10.7	23.7	93.16	2.32	1400

1200 DIA CROSS CULVERT

system flow from Ingersoll Crescent. Design calculations indicate that the 100-year overland flow at this location will be approximately 119 L/s.

The major system outlet will consist of a trapezoidal swale with a 1.0 m flat bottom, 3:1 side slopes, and a maximum depth of 0.3 m. The capacity of the swale was calculated assuming a slope of 2%.

The proposed drainage easement will have a width of 3.0 m. The overland flow width will be approximately 1.7 m at the 100-year flow depth of 0.12 m. An additional 1.0 m setback from the buildings will be provided on either side of the swale.

Culvert at Kanata Avenue and Terry Fox Drive

There is an existing 1200mm culvert at the intersection of Kanata Avenue and Terry Fox Drive. This culvert was sized as part of the design of the Realigned Richardson Side Road (RRSR) SWM Facility (Dillon, April 2002). Development of the Broughton subdivision will result in a decrease in flow to this culvert, as the majority of runoff from the subdivision will be captured by the minor system and conveyed to the RRSR SWM facility.

This culvert was originally sized to convey a 100-year peak flow of 1.39 m^3/s. Under post-development conditions, the 100-year peak flow will be reduced to approximately 0.740 m^3/s. The original design calculations are provided in Appendix B. The revised culvert design is provided in Appendix A.

Wallaceburg Court

Major system flows from Wallaceburg Court will flow overland from the cul de sac to the ditch along Richardson Side Road to the Carp River. Provisions have been included in the Future Terry Fox Drive extension to provide a culvert to convey these flows.

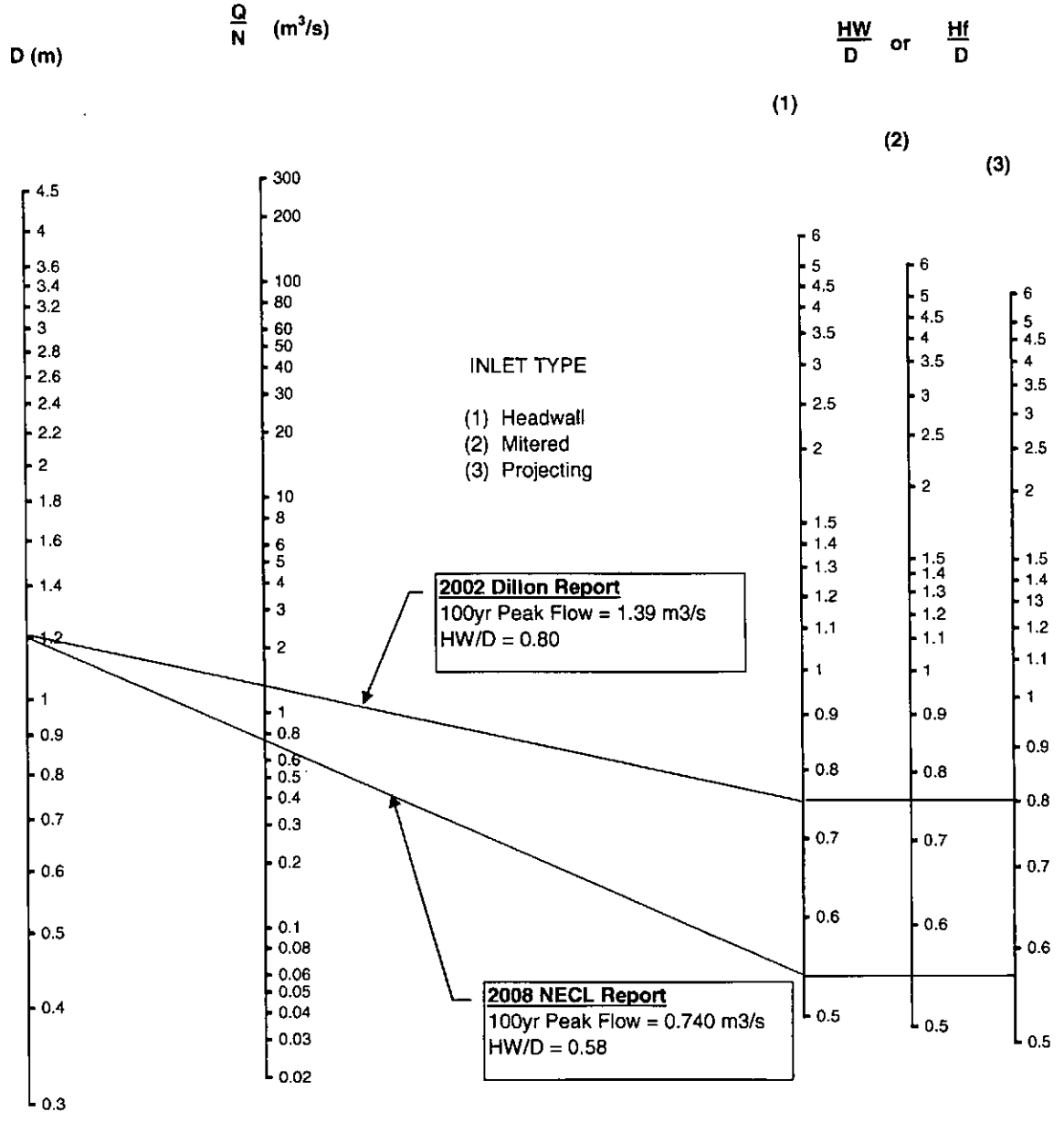
Terry Fox Drive

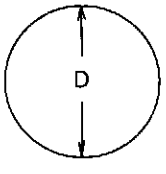
A pair of Dual CBs will be installed at the intersection of Terry Fox Drive and Tillsonburg Street to capture major system flows from the subdivision and ensure that there is no overland flow crossing Terry Fox Drive during the 1:100 year event. The 100-year overland flow at this location will be approximately 662 L/s (refer to CB design Sheet in Appendix A). MTO design Chart 4.19 indicates that these inlets will capture the 100-year overland flow at a ponding depth of approximately 0.25m. Design calculations are provided in Appendix A.

CB pair 125-126 will have connections to both the minor system sewer and a separate major system sewer designed to convey overland flow in excess of the minor system capacity under Terry Fox Drive (refer to detail on Drawing 102118-P2). An overflow weir will be installed in these CBs to isolate the connections between the minor and major system sewers. An ICD will be installed on the connection to the minor system storm sewer to restrict inflows to the minor system at this inlet. Overland flows in excess of the minor system inlet capacity will overtop the weir and be directed to the major system sewer.

The major system sewer will convey flows under Terry Fox Drive to an engineered channel that bypasses the SWM facility and outlets directly to the Carp River. Details of the bypass channel are shown on Drawings 102118-SWM1, SWM2, SWM3 and SWM4.

CHART D5-1G





INLET CONTROL
CSP & SPCSP CULVERT

peak flows using a 3-hour Chicago storm distribution. The hydrologic parameters used in the model are shown in **Table 4**.

Table 4: Hydrologic Modeling Parameters (uncontrolled areas draining to Kanata Ave)

Catchment ID	Description	Area (ha)	C	TIMP[1] %	XIMP[2] %	Average Slope %
B1	Rearyards and drainage ditch upstream of Richardson Side Rd.	1.40	0.40	29%	29%	1.0%
B2 (area 8)	Uncontrolled areas along north, east and south portion of site	0.32	0.49	41%	41%	3.5%
B3	Rearyards of Broughton Subdivision upstream 1050mm culvert	0.23	0.50	43%	43%	1.5%
B4	Rearyards of Broughton Subdivision upstream 1200mm culvert	0.98	0.50	43%	43%	2.0%
B5	Undeveloped lands east of Kanata Ave. North of Terrry Fox Dr.	1.40	0.20	Uses a NASHYD command with CN=70; Ia=5.0mm; TP=0.17hrs		
TOTAL	**-**	**4.33**	**0.37**	**24%**	**24%**	**-**

Notes:

1) *Impervious values for future development were determined using C = %imp. x 0.7 + 0.2*
2) *Values for XIMP were assumed to be equal to TIMP (directly connected impervious areas).*

Major System Flow from Broughton Subdivision (Ingersoll Crescent)

As indicated in the approved *Broughton Lands Subdivision Stormwater Management Report – Phases 1 and 2* (Novatech, July 21, 2008), Kanata Avenue serves as the major system outlet for a portion of the subdivision, including the rearyards of lots adjacent to Kanata Avenue, and major system flows from Ingersoll Crescent (approximately 119 L/s). The major system flows from Ingersoll Crescent are conveyed overland through an easement between Lots 94 and 95, and into the roadside ditch upstream of the 1200mm culvert that crosses Terry Fox Drive. The roadside ditch and 1200mm culvert was designed to serve as the major system outlet for Kanata Avenue. Downstream Terry Fox Drive drainage is conveyed to an engineered channel adjacent to the RRSR SWM Pond, which outlets to the Carp River.

Existing 1200mm Culvert Crossing Terry Fox Drive

The existing 1200mm culvert crossing Terry Fox Drive was originally sized as part of the design of the Realigned Richardson Side Road (RRSR) SWM Facility (Dillon, April 2002). The development of the Broughton subdivision resulted in decrease flow to this culvert as the majority of runoff from the subdivision will be captured by the minor system and conveyed to the RRSR SWM Facility. The culvert was originally sized to convey a 100-year peak flow of 1.390 m^3/s; however, the development of the Broughton lands will decrease peak flows to approximately 0.740 m^3/s. The anticipated 100-year post-development peak flows with the Heritage Hills development, as shown in the following section, is 1.065 m^3/s, which is below the original design. Please refer to the excerpts from the Broughton Lands Subdivision Phases 1 and 2 Stormwater Management Report (Novatech, July 21, 2008) provided in **Appendix D**.

Peak Flows and Culvert Capacities

The post-development peak flows at the culverts were simulated using the VO3 hydrologic model. The 5-year and 100-year peak flows were then compared to the full-flow capacities of the culverts, estimated using MTO inlet control nomographs (provided in **Appendix C**).

1050mm Culvert (Areas B1 – B3):

- 5-year Peak Flow: 0.204 m^3/s
- 100-year Peak Flow: 0.542 m^3/s
- Full Flow Capacity: 1.30 m^3/s

1200mm Culvert (Areas B1 – B5):

- 5-year Peak Flow: 0.366 m^3/s
- 100-year Peak Flow: 0.946 m^3/s + 0.119 m^3/s = 1.065 m^3/s
- Full-Flow Capacity: 1.80 m^3/s

Both culverts have sufficient capacity to convey the anticipated 100-year post-development peak flows in the Kanata Avenue ditch.

4.3 Total Post-Development Peak Flow

The total post-development peak flow from the site (uncontrolled + controlled) for the 1:5 year and 1:100 year storm has been calculated using the VO3 model. A summary of the post-development peak flows is provided in **Table 5**.

Table 5: Summary of Uncontrolled / Controlled Peak Flows (3-hour Chicago Storm)

Catchment ID	Uncontrolled Peak Flow (L/s)		Controlled Peak Flow (L/s)		Maximum Storage (m^3)	
	1:5 Yr	1:100 Yr	1:5 Yr	1:100 Yr	Required	Available
Area Draining to Kanata Avenue Roadside Ditch						
Area 8 (B2)	41	100	-	-	-	-
Uncontrolled Areas Draining to Battersea Crescent						
Area 1	42	83	-	-	-	-
Area 3	4	10	-	-	-	-
Area 7	19	41	-	-	-	-
Area 9	3	5	-	-	-	-
TOTAL[1] (uncontrolled)	**66**	**136**	**N/A**	**N/A**	**N/A**	**N/A**
Controlled Areas Draining to Battersea Crescent						
Area 2	37	89	22	24	54	65
Area 4	19	34	7	12	93	102
Area 5	17	30				
Area 6	23	39				
Area 10 (Roof)	37	64	12	14	46	59
TOTAL[1] (controlled)	**133**	**257**	**41**	**49**	**193**	**226**
TOTAL[1] (site)	***199***	***393***	***103***	***180***	***193***	***226***

[1] *Total peak flow is calculated using the VO3 model (ADDHYD ROUTINE), which takes into account the different times to peak for the various subcatchments.*

16-Jul-26

475 Terry Fox Drive
Ottawa, Ontario

1200mm Culvert Terry Fox Dr / 600mm Culvert Kanata Avenue

2002 Dillon DESIGN (50-YEAR)

				C
1200mm Culvert		11.01	ha	0.52
Time of Concentration:		28	min	
Rainfall Intensity (i):		87	mm/hr (50-year event)	
50-Year Design Flow Rate (2.78AiC):		1386	L/s	
		1.39	m^3/s	
(Includes flow rate from 1.4 ha via 600mm culvert)				
				C
600mm Culvert	ID 2	1.4	m^2	0.52
Time of Concentration:		28	min	
Rainfall Intensity (i):		87	mm/hr (50-year event)	
50-Year Design Flow Rate (2.78AiC):		176	L/s	
		0.176	m^3/s	

2002 DESIGN (100-YEAR)

			C
1200mm Culvert	11.01	ha	0.54
Time of Concentration:	28	min	
Rainfall Intensity (i):	96	mm/hr (100-year event)	
100-Year Design Flow Rate (2.78AiC):	1596	L/s	
	1.60	m^3/s	
(Includes flow rate from 1.4 ha via 600mm culvert)			
			C
600mm Culvert	1.4	ha	0.54
Time of Concentration:	28	min	
Rainfall Intensity (i):	96	mm/hr (100-year event)	
100-Year Design Flow Rate (2.78AiC):	203	L/s	
	0.203	m^3/s	

2016 Novatech DESIGN (100-YEAR)

1200mm Culvert

100-Year Design Flow Rate:	1.065	m^3/s
(Assumed to include	0.203	m^3/s from 1.4 ha via 600mm culvert)

100-YEAR PRE-DEVELOPMENT FLOW RATE
(2016 Novatech Design + Drainage from Insmill Cr rear yards)

600mm Culvert	1.40	ha	
Drainage from Insmill Cr rear yards	0.57	ha	C
	1.97	ha	0.54
Time of Concentration:	28	min	
Rainfall Intensity (i):	96	mm/hr (100-year event)	
100-Year PRE-DEVELOPMENT Flow Rate (2.78AiC):	285	L/s	
	0.285	m^3/s	
INCREASE FROM DESIGN:	0.082	m^3/s	
1200mm Culvert			
100-Year PRE-DEVELOPMENT Flow Rate:	1.147	m^3/s	

100-YEAR PRE-DEVELOPMENT CONDITIONS

600mm Culvert (including Insmill Cr rear yards)

				C
NW Off-site Drainage	(Insmill Cr rear yards)	5,725	sq.m	0.54
1.4 ha	SW Off-site Drainage	2,146	sq.m	0.54
	475 Terry Fox Dr	12,270	sq.m	0.54
Total Catchment Area:		20,141	sq.m	0.54

Time of Concentration (Tc)

Bransby Williams Formula (Used when C > 0.40)

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

Sheet Flow Distance (L):	200	m
Slope of Land (Sw):	4	%
Area (A):	2.01	ha
Time of Concentration (Sheet Flow):	8	min
Minimum Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr (100-year event)
100-Year PRE-DEVELOPMENT Flow Rate (2.78AiC):	540	L/s
	0.540	m^3/s

POST DEVELOPMENT CONDITIONS

				C
	SW Off-site Drainage:	2,085	sq.m	0.25
Uncontrolled Flow (Drainage Area I)	Hard Area:	25	sq.m	1.00
	Soft Area:	425	sq.m	0.25
	Total Catchment Area:	2,535	sq.m	0.26
	Time of Concentration (Sheet Flow):	10	min	
	Rainfall Intensity (i):	179	mm/hr (100-year event)	
	100-Year Post Development Flow Rate (2.78AiC):	32	L/s	
	100-Year Total Maximum Release Rate: (Drainage Area III)	183	L/s	

600mm Culvert

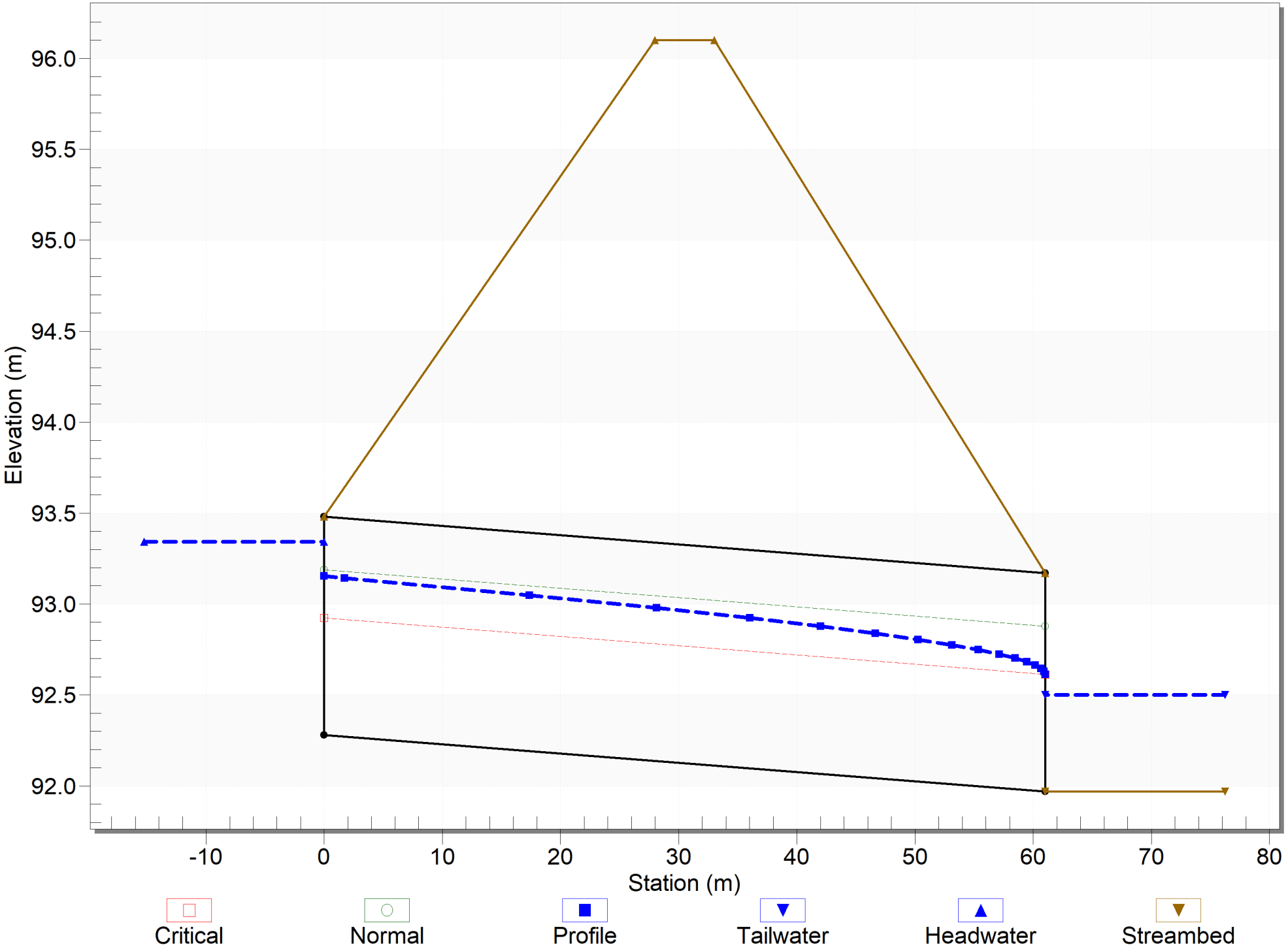
Total POST DEVELOPMENT 100-Year Flow:	215	L/s
	0.215	m^3/s
DECREASE FROM PRE:	0.070	m^3/s

1200mm Culvert

100-Year POST DEVELOPMENT Flow Rate:	1.077	m^3/s

Crossing - Terry Fox Dr 1200mm, Design Discharge - 1.39 cms

Culvert - 2002 DESIGN - 50-year - HW=93.34 - TW=92.50, Culvert Discharge - 1.39 cms



HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
Terry Fox Dr 1200mm	2002 DESIGN - 50-year - HW=93.34 - TW=92.50	1.39	1.39	93.34	0.94	1.063	0.27	0.91	0.64	0.64	2.25

Crossing Input: Terry Fox Dr 1200mm

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cms
Design Flow	1.390	cms
Maximum Flow	1.390	cms
TAILWATER DATA		
Channel Type	Enter Constant Tailwater Elevation	
Channel Invert Elevation	91.970	m
Constant Tailwater Elevation	92.500	m
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	m
Crest Length	34.000	m
Crest Elevation	96.100	m
Roadway Surface	Paved	
Top Width	5.000	m

Culvert Input: Terry Fox Dr 1200mm

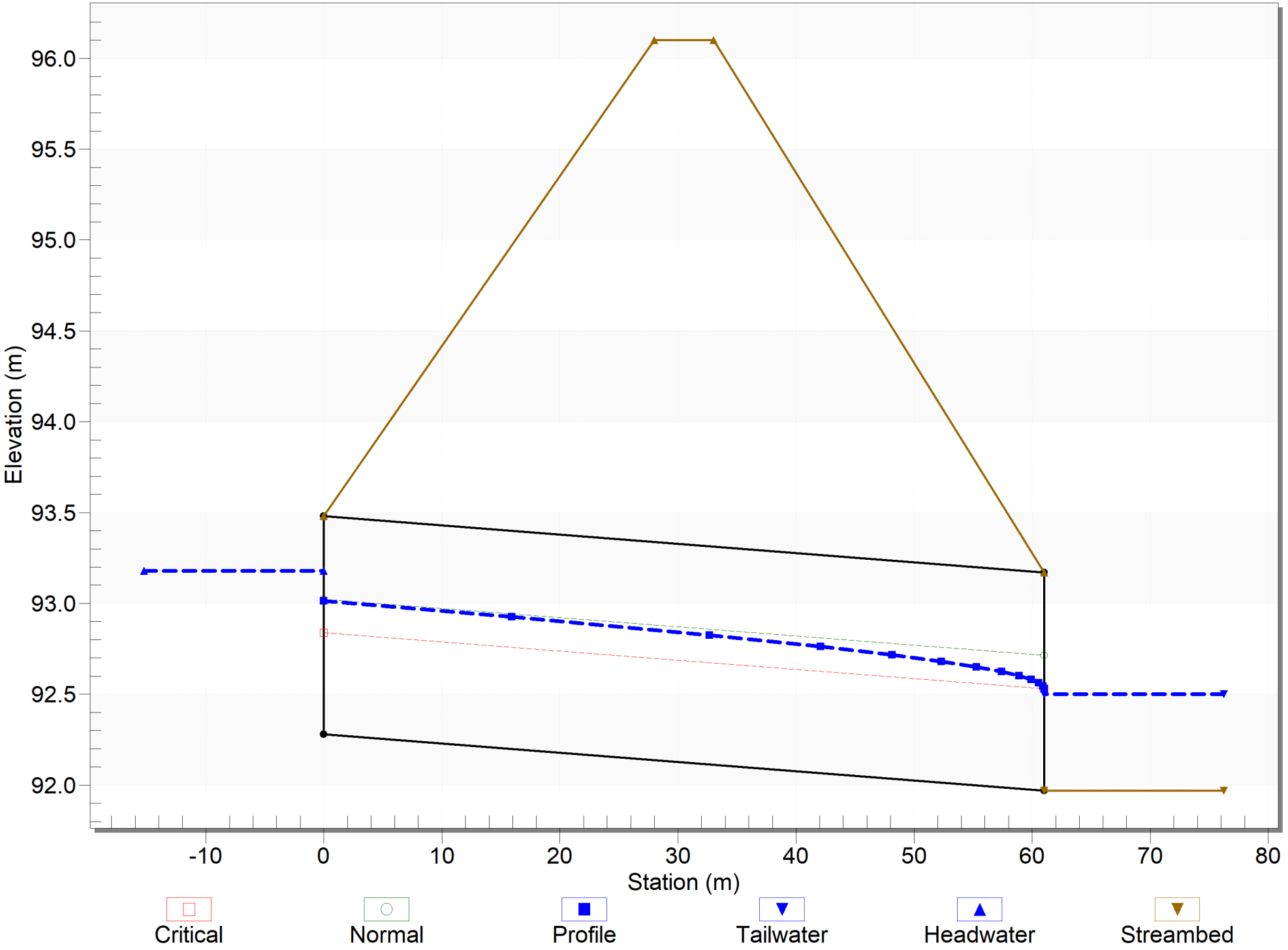
Parameter	Value	Units
CULVERT DATA		
Name	2002 DESIGN - 50-year - HW=93.34 - TW=92.50	
Shape	Circular	
Material	Corrugated Steel	
Diameter	1200.000	mm
Embedment Depth	0.000	mm
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall (Ke=0.5)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	m
Inlet Elevation	92.280	m
Outlet Station	61.000	m
Outlet Elevation	91.970	m
Number of Barrels	1	
Computed Culvert Slope	0.005082	m/m

Table 2 - Culvert Summary Table: 2002 DESIGN - 50-year - HW=93.34 - TW=92.50

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	92.50	0.00	0.220	0.06	0-NF	0.00	0.00	0.53	0.53	0.00	0.00
0.14	0.14	92.59	0.27	0.312	0.08	3-M1t	0.25	0.20	0.53	0.53	0.29	0.00
0.28	0.28	92.71	0.38	0.432	0.11	3-M1t	0.35	0.28	0.53	0.53	0.58	0.00
0.42	0.42	92.81	0.47	0.532	0.14	3-M1t	0.43	0.34	0.53	0.53	0.87	0.00
0.56	0.56	92.90	0.55	0.621	0.16	3-M1t	0.50	0.40	0.53	0.53	1.15	0.00
0.70	0.70	92.98	0.62	0.702	0.18	3-M2t	0.57	0.45	0.53	0.53	1.44	0.00
0.83	0.83	93.06	0.69	0.778	0.20	3-M2t	0.64	0.49	0.53	0.53	1.73	0.00
0.97	0.97	93.13	0.76	0.851	0.22	2-M2c	0.70	0.53	0.53	0.53	2.00	0.00
1.11	1.11	93.20	0.82	0.923	0.23	2-M2c	0.77	0.57	0.57	0.53	2.09	0.00
1.25	1.25	93.27	0.88	0.993	0.25	2-M2c	0.83	0.61	0.61	0.53	2.17	0.00
1.39	1.39	93.34	0.94	1.063	0.27	2-M2c	0.91	0.64	0.64	0.53	2.25	0.00
4.04	3.92	96.12	2.32	3.837	0.97	7-M2c	1.20	1.06	1.06	0.53	3.70	0.00

Crossing - Terry Fox Dr 1200mm, Design Discharge - 1.06 cms

Culvert - 2016 DESIGN - 100-year - HW=93.18 - TW=92.50, Culvert Discharge - 1.06 cms



HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
Terry Fox Dr 1200mm	2016 DESIGN - 100-year - HW=93.18 - TW=92.50	1.06	1.06	93.18	0.80	0.898	0.23	0.74	0.56	0.56	2.06

Crossing Input: Terry Fox Dr 1200mm

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cms
Design Flow	1.065	cms
Maximum Flow	1.065	cms
TAILWATER DATA		
Channel Type	Enter Constant Tailwater Elevation	
Channel Invert Elevation	91.970	m
Constant Tailwater Elevation	92.500	m
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	m
Crest Length	34.000	m
Crest Elevation	96.100	m
Roadway Surface	Paved	
Top Width	5.000	m

Culvert Input: Terry Fox Dr 1200mm

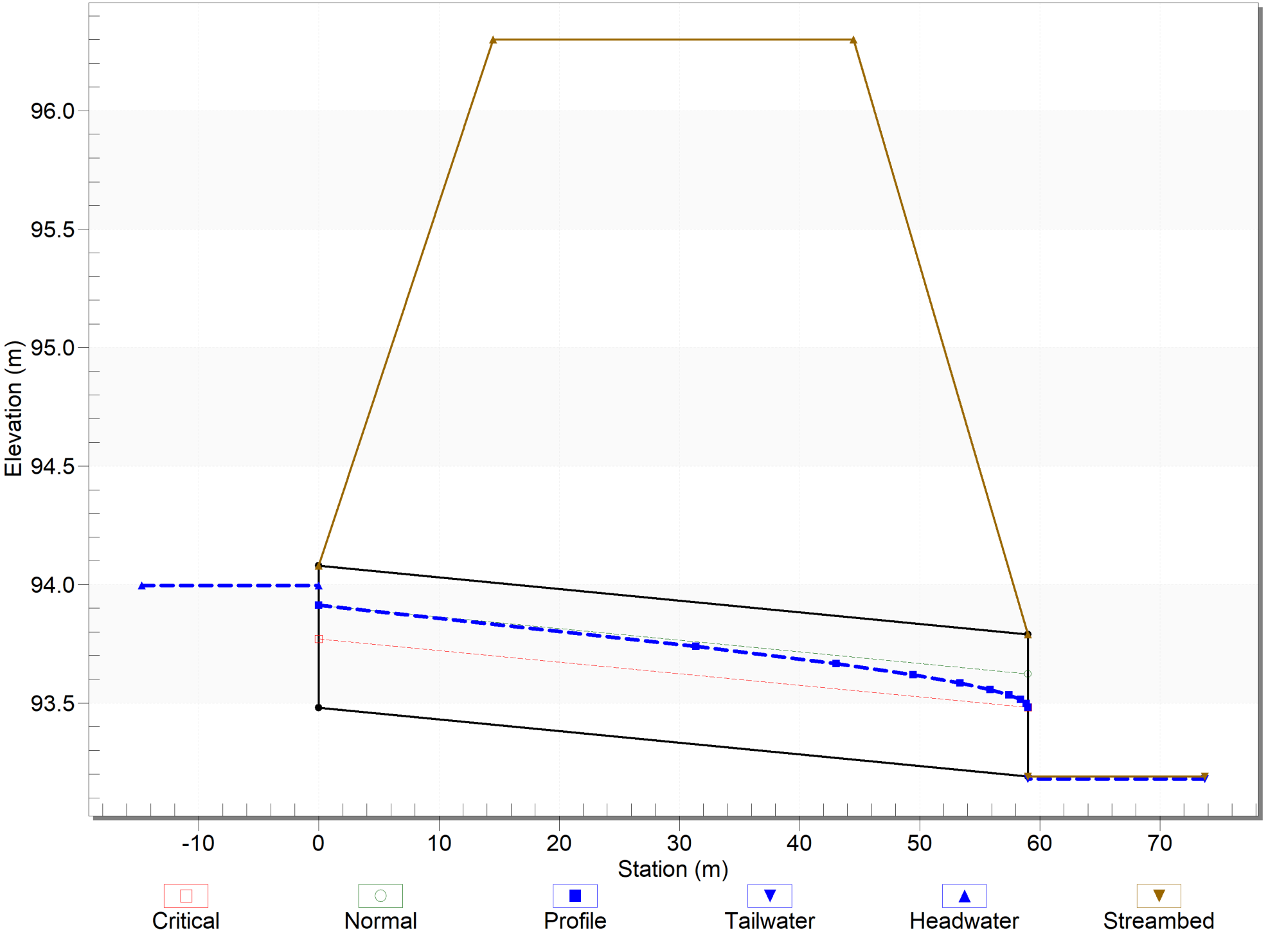
Parameter	Value	Units
CULVERT DATA		
Name	2016 DESIGN - 100-year - HW=93.18 - TW=92.50	
Shape	Circular	
Material	Corrugated Steel	
Diameter	1200.000	mm
Embedment Depth	0.000	mm
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall (Ke=0.5)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	m
Inlet Elevation	92.280	m
Outlet Station	61.000	m
Outlet Elevation	91.970	m
Number of Barrels	1	
Computed Culvert Slope	0.005082	m/m

Table 2 - Culvert Summary Table: 2016 DESIGN - 100-year - HW=93.18 - TW=92.50

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	92.50	0.00	0.220	0.06	0-NF	0.00	0.00	0.53	0.53	0.00	0.00
0.11	0.11	92.56	0.23	0.282	0.07	3-M1t	0.22	0.17	0.53	0.53	0.22	0.00
0.21	0.21	92.66	0.33	0.378	0.10	3-M1t	0.30	0.24	0.53	0.53	0.44	0.00
0.32	0.32	92.74	0.41	0.463	0.12	3-M1t	0.37	0.30	0.53	0.53	0.66	0.00
0.43	0.43	92.82	0.48	0.538	0.14	3-M1t	0.44	0.35	0.53	0.53	0.88	0.00
0.53	0.53	92.89	0.54	0.607	0.15	3-M1t	0.49	0.39	0.53	0.53	1.11	0.00
0.64	0.64	92.95	0.59	0.670	0.17	3-M2t	0.55	0.43	0.53	0.53	1.33	0.00
0.75	0.75	93.01	0.65	0.731	0.19	3-M2t	0.60	0.46	0.53	0.53	1.55	0.00
0.85	0.85	93.07	0.70	0.788	0.20	3-M2t	0.65	0.50	0.53	0.53	1.77	0.00
0.96	0.96	93.12	0.75	0.843	0.21	3-M2t	0.69	0.53	0.53	0.53	1.99	0.00
1.06	1.06	93.18	0.80	0.898	0.23	2-M2c	0.74	0.56	0.56	0.53	2.06	0.00
3.97	3.91	96.11	2.32	3.830	0.97	7-M2c	1.20	1.06	1.06	0.53	3.69	0.00

Crossing - Kanata Ave 600mm, Design Discharge - 0.20 cms

Culvert - DESIGN - 100-year - HW=94.00 - TW=93.18, Culvert Discharge - 0.20 cms



HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
Kanata Ave 600mm	DESIGN - 100-year - HW=94.00 - TW=93.18	0.20	0.20	94.00	0.45	0.516	0.26	0.43	0.29	0.29	1.49

Crossing Input: Kanata Ave 600mm

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cms
Design Flow	0.203	cms
Maximum Flow	0.203	cms
TAILWATER DATA		
Channel Type	Enter Constant Tailwater Elevation	
Channel Invert Elevation	93.190	m
Constant Tailwater Elevation	93.180	m
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	m
Crest Length	3.000	m
Crest Elevation	96.300	m
Roadway Surface	Paved	
Top Width	30.000	m

Culvert Input: Kanata Ave 600mm

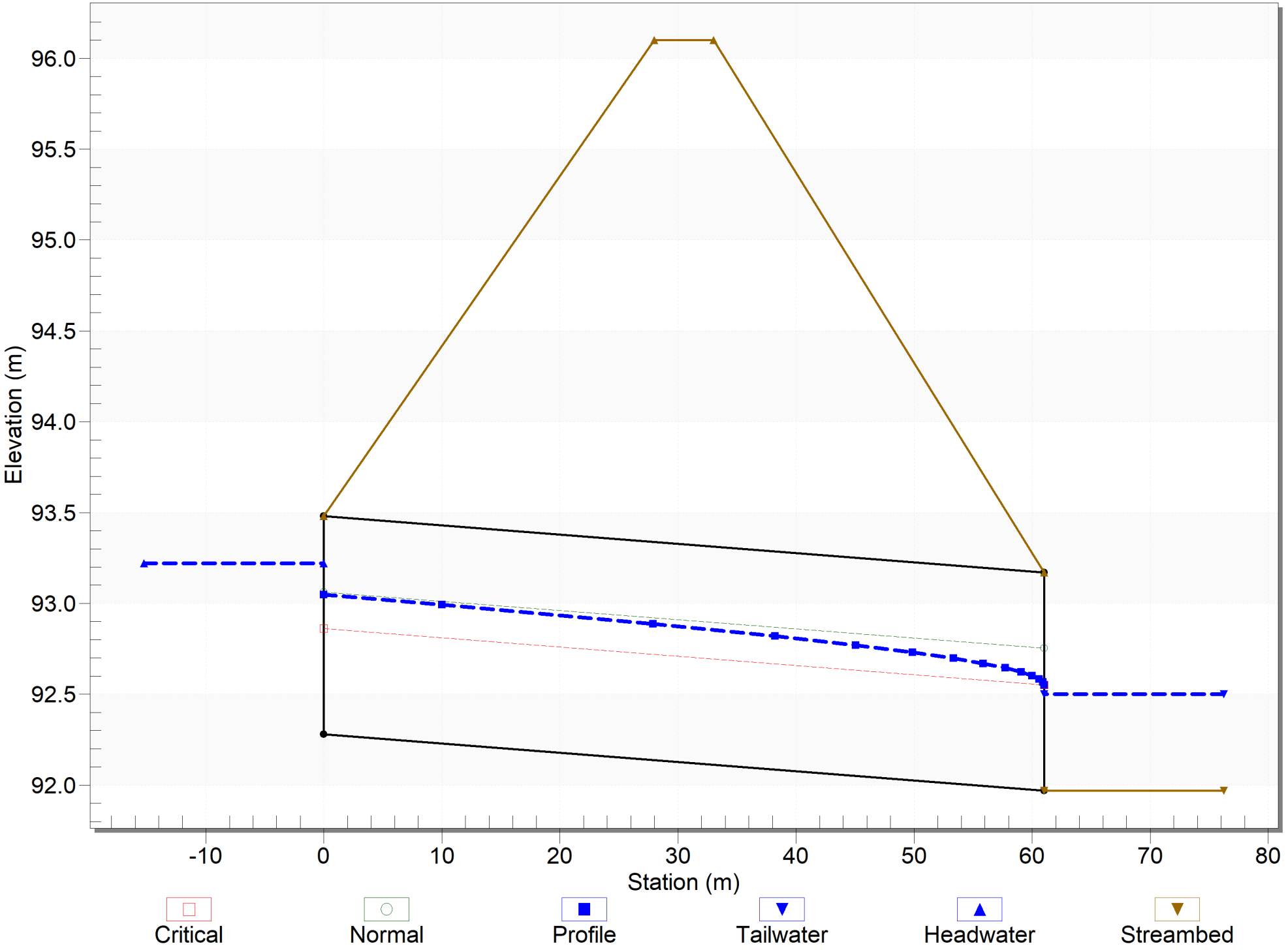
Parameter	Value	Units
CULVERT DATA		
Name	DESIGN - 100-year - HW=94.00 - TW=93.18	
Shape	Circular	
Material	Corrugated PE	
Diameter	600.000	mm
Embedment Depth	0.000	mm
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Thin Edge Projecting (Ke=0.9)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	m
Inlet Elevation	93.480	m
Outlet Station	59.000	m
Outlet Elevation	93.190	m
Number of Barrels	1	
Computed Culvert Slope	0.004915	m/m

Table 2 - Culvert Summary Table: DESIGN - 100-year - HW=94.00 - TW=93.18

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	93.48	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	-0.01	0.00	0.00
0.02	0.02	93.62	0.13	0.144	0.07	2-M2c	0.12	0.09	0.09	-0.01	0.78	0.00
0.04	0.04	93.69	0.19	0.207	0.10	2-M2c	0.17	0.13	0.13	-0.01	0.93	0.00
0.06	0.06	93.74	0.23	0.256	0.13	2-M2c	0.21	0.16	0.16	-0.01	1.04	0.00
0.08	0.08	93.78	0.27	0.299	0.15	2-M2c	0.24	0.18	0.18	-0.01	1.13	0.00
0.10	0.10	93.82	0.30	0.338	0.17	2-M2c	0.28	0.20	0.20	-0.01	1.21	0.00
0.12	0.12	93.86	0.33	0.375	0.19	2-M2c	0.31	0.22	0.22	-0.01	1.27	0.00
0.14	0.14	93.89	0.36	0.411	0.21	2-M2c	0.34	0.24	0.24	-0.01	1.33	0.00
0.16	0.16	93.92	0.39	0.444	0.23	2-M2c	0.37	0.26	0.26	-0.01	1.39	0.00
0.18	0.18	93.96	0.42	0.479	0.24	2-M2c	0.40	0.28	0.28	-0.01	1.44	0.00
0.20	0.20	94.00	0.45	0.516	0.26	2-M2c	0.43	0.29	0.29	-0.01	1.49	0.00
0.65	0.63	96.32	1.25	2.843	1.44	7-M2c	0.60	0.51	0.51	-0.01	2.44	0.00

Crossing - Terry Fox Dr 1200mm, Design Discharge - 1.15 cms

Culvert - PRE - 100-year - HW=93.22 - TW=92.50, Culvert Discharge - 1.15 cms



HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
Terry Fox Dr 1200mm	PRE - 100-year - HW=93.22 - TW=92.50	1.15	1.15	93.22	0.83	0.940	0.24	0.78	0.58	0.58	2.11

Crossing Input: Terry Fox Dr 1200mm

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cms
Design Flow	1.147	cms
Maximum Flow	1.147	cms
TAILWATER DATA		
Channel Type	Enter Constant Tailwater Elevation	
Channel Invert Elevation	91.970	m
Constant Tailwater Elevation	92.500	m
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	m
Crest Length	34.000	m
Crest Elevation	96.100	m
Roadway Surface	Paved	
Top Width	5.000	m

Culvert Input: Terry Fox Dr 1200mm

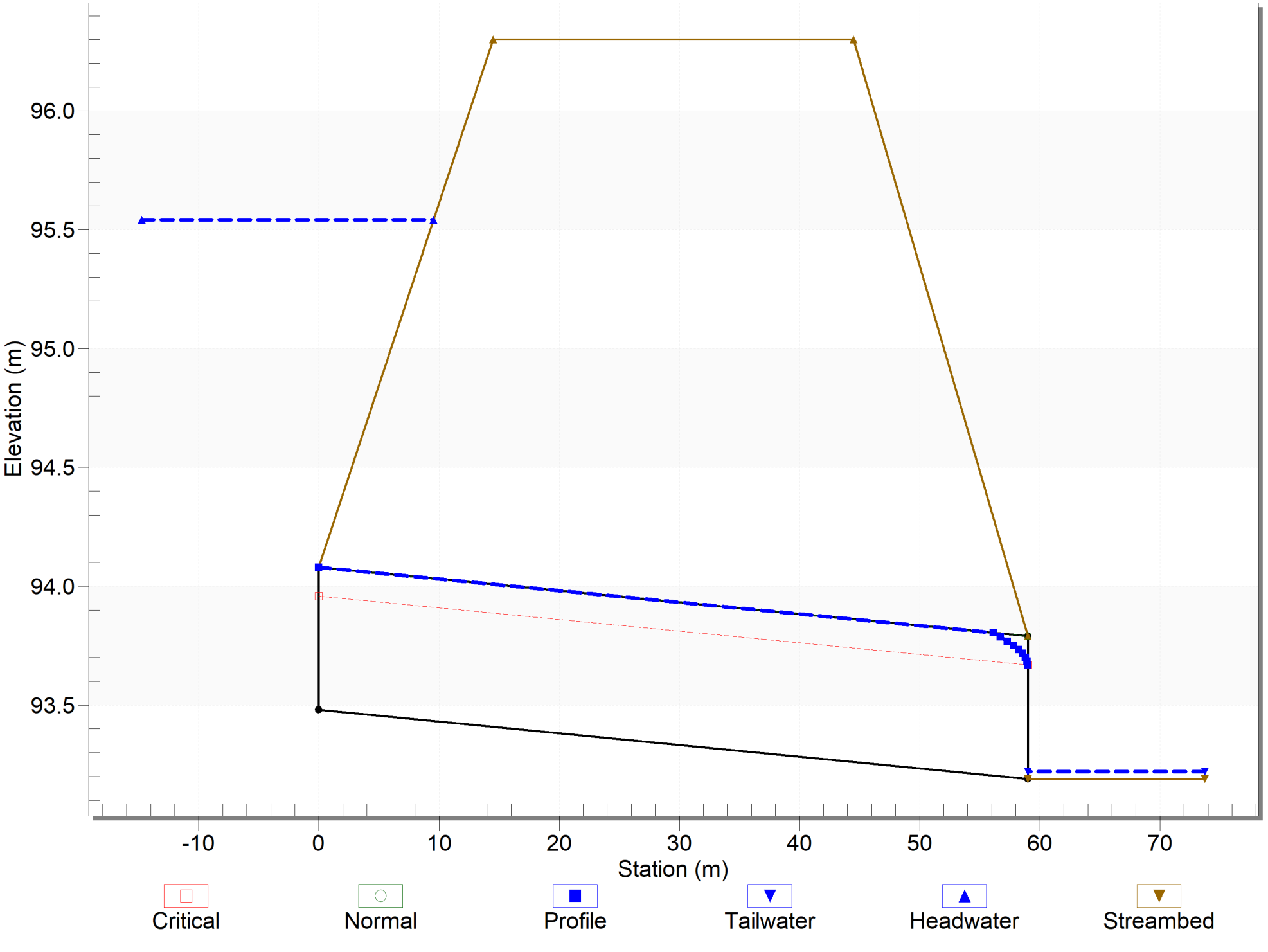
Parameter	Value	Units
CULVERT DATA		
Name	PRE - 100-year - HW=93.22 - TW=92.50	
Shape	Circular	
Material	Corrugated Steel	
Diameter	1200.000	mm
Embedment Depth	0.000	mm
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall (Ke=0.5)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	m
Inlet Elevation	92.280	m
Outlet Station	61.000	m
Outlet Elevation	91.970	m
Number of Barrels	1	
Computed Culvert Slope	0.005082	m/m

Table 2 - Culvert Summary Table: PRE - 100-year - HW=93.22 - TW=92.50

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	92.50	0.00	0.220	0.06	0-NF	0.00	0.00	0.53	0.53	0.00	0.00
0.11	0.11	92.57	0.24	0.289	0.07	3-M1t	0.22	0.18	0.53	0.53	0.24	0.00
0.23	0.23	92.67	0.35	0.393	0.10	3-M1t	0.32	0.25	0.53	0.53	0.48	0.00
0.34	0.34	92.76	0.43	0.481	0.12	3-M1t	0.39	0.31	0.53	0.53	0.71	0.00
0.46	0.46	92.84	0.50	0.560	0.14	3-M1t	0.45	0.36	0.53	0.53	0.95	0.00
0.57	0.57	92.91	0.56	0.632	0.16	3-M1t	0.51	0.41	0.53	0.53	1.19	0.00
0.69	0.69	92.98	0.62	0.698	0.18	3-M2t	0.57	0.45	0.53	0.53	1.43	0.00
0.80	0.80	93.04	0.68	0.762	0.19	3-M2t	0.62	0.48	0.53	0.53	1.67	0.00
0.92	0.92	93.10	0.73	0.822	0.21	3-M2t	0.68	0.52	0.53	0.53	1.91	0.00
1.03	1.03	93.16	0.78	0.882	0.22	2-M2c	0.73	0.55	0.55	0.53	2.04	0.00
1.15	1.15	93.22	0.83	0.940	0.24	2-M2c	0.78	0.58	0.58	0.53	2.11	0.00
3.96	3.91	96.11	2.32	3.829	0.97	7-M2c	1.20	1.06	1.06	0.53	3.69	0.00

Crossing - Kanata Ave 600mm, Design Discharge - 0.54 cms

Culvert - PRE - 100-year - HW=95.54 - TW=93.22, Culvert Discharge - 0.54 cms



HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
Kanata Ave 600mm	PRE - 100-year - HW=95.54 - TW=93.22	0.54	0.54	95.54	0.86	2.061	1.05	0.60	0.48	0.48	2.22

Crossing Input: Kanata Ave 600mm

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cms
Design Flow	0.538	cms
Maximum Flow	0.538	cms
TAILWATER DATA		
Channel Type	Enter Constant Tailwater Elevation	
Channel Invert Elevation	93.190	m
Constant Tailwater Elevation	93.220	m
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	m
Crest Length	3.000	m
Crest Elevation	96.300	m
Roadway Surface	Paved	
Top Width	30.000	m

Culvert Input: Kanata Ave 600mm

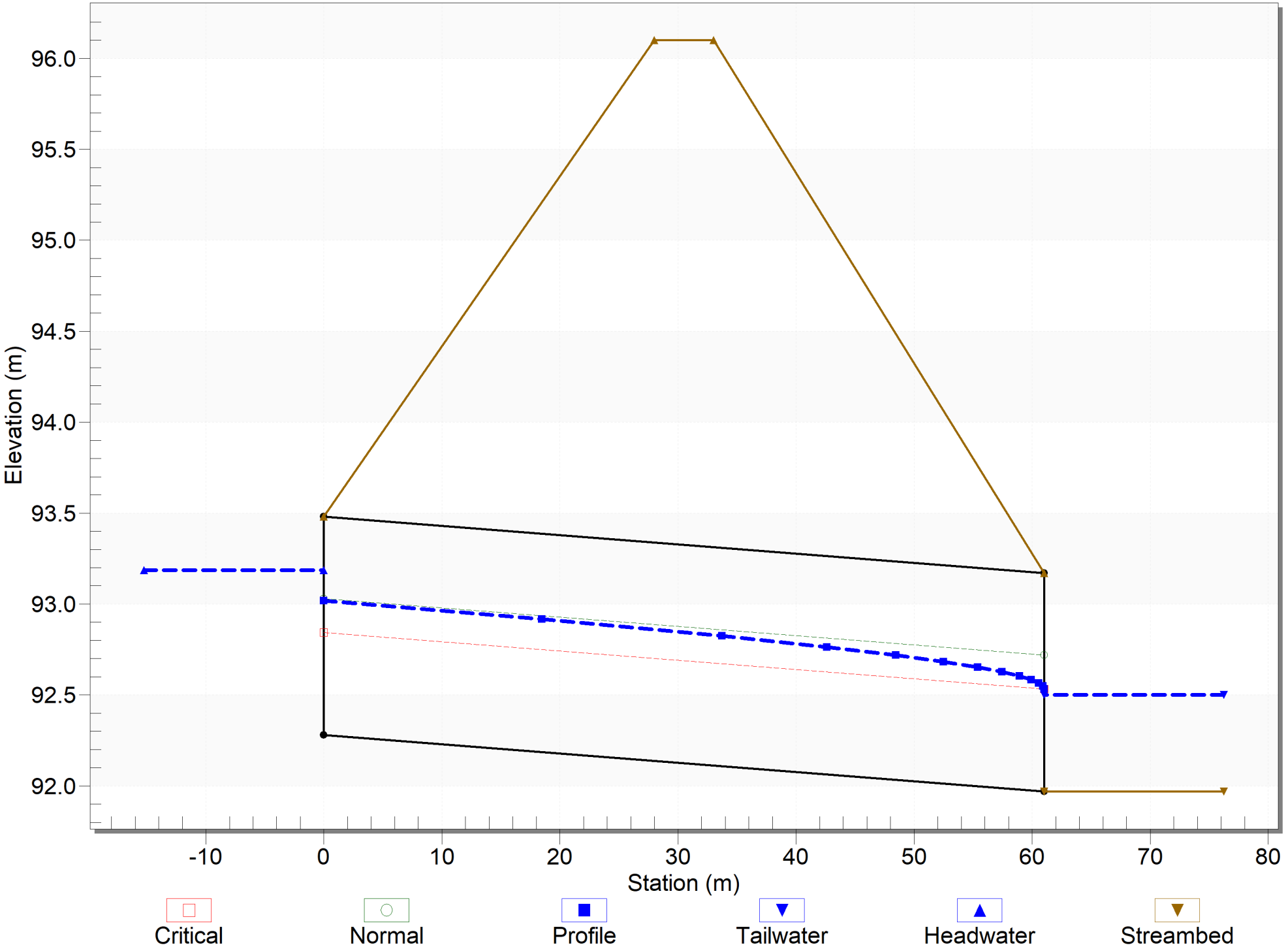
Parameter	Value	Units
CULVERT DATA		
Name	PRE - 100-year - HW=95.54 - TW=93.22	
Shape	Circular	
Material	Corrugated PE	
Diameter	600.000	mm
Embedment Depth	0.000	mm
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall (Ke=0.5)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	m
Inlet Elevation	93.480	m
Outlet Station	59.000	m
Outlet Elevation	93.190	m
Number of Barrels	1	
Computed Culvert Slope	0.004915	m/m

Table 2 - Culvert Summary Table: PRE - 100-year - HW=95.54 - TW=93.22

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	93.48	0.00	0.000	0.00	0-NF	0.00	0.00	0.03	0.03	0.00	0.00
0.05	0.05	93.71	0.20	0.231	0.12	2-M2c	0.20	0.15	0.15	0.03	1.01	0.00
0.11	0.11	93.82	0.29	0.336	0.17	2-M2c	0.29	0.21	0.21	0.03	1.23	0.00
0.16	0.16	93.91	0.36	0.426	0.22	2-M2c	0.37	0.26	0.26	0.03	1.39	0.00
0.22	0.22	93.99	0.43	0.515	0.26	2-M2c	0.45	0.30	0.30	0.03	1.52	0.00
0.27	0.27	94.10	0.50	0.617	0.31	7-M2c	0.60	0.34	0.34	0.03	1.64	0.00
0.32	0.32	94.30	0.56	0.819	0.42	7-M2c	0.60	0.37	0.37	0.03	1.76	0.00
0.38	0.38	94.56	0.63	1.079	0.55	7-M2c	0.60	0.40	0.40	0.03	1.87	0.00
0.43	0.43	94.86	0.70	1.375	0.70	7-M2c	0.60	0.43	0.43	0.03	1.98	0.00
0.48	0.48	95.19	0.78	1.707	0.87	7-M2c	0.60	0.46	0.46	0.03	2.10	0.00
0.54	0.54	95.54	0.86	2.061	1.05	7-M2c	0.60	0.48	0.48	0.03	2.22	0.00
0.68	0.64	96.34	1.06	2.862	1.45	7-M2c	0.60	0.52	0.52	0.03	2.48	0.00

Crossing - Terry Fox Dr 1200mm, Design Discharge - 1.08 cms

Culvert - POST - 100-year - HW=93.19 - TW=92.50, Culvert Discharge - 1.08 cms



HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
Terry Fox Dr 1200mm	POST - 100-year - HW=93.19 - TW=92.50	1.08	1.08	93.19	0.80	0.905	0.23	0.75	0.56	0.56	2.07

Crossing Input: Terry Fox Dr 1200mm

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cms
Design Flow	1.078	cms
Maximum Flow	1.078	cms
TAILWATER DATA		
Channel Type	Enter Constant Tailwater Elevation	
Channel Invert Elevation	91.970	m
Constant Tailwater Elevation	92.500	m
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	m
Crest Length	34.000	m
Crest Elevation	96.100	m
Roadway Surface	Paved	
Top Width	5.000	m

Culvert Input: Terry Fox Dr 1200mm

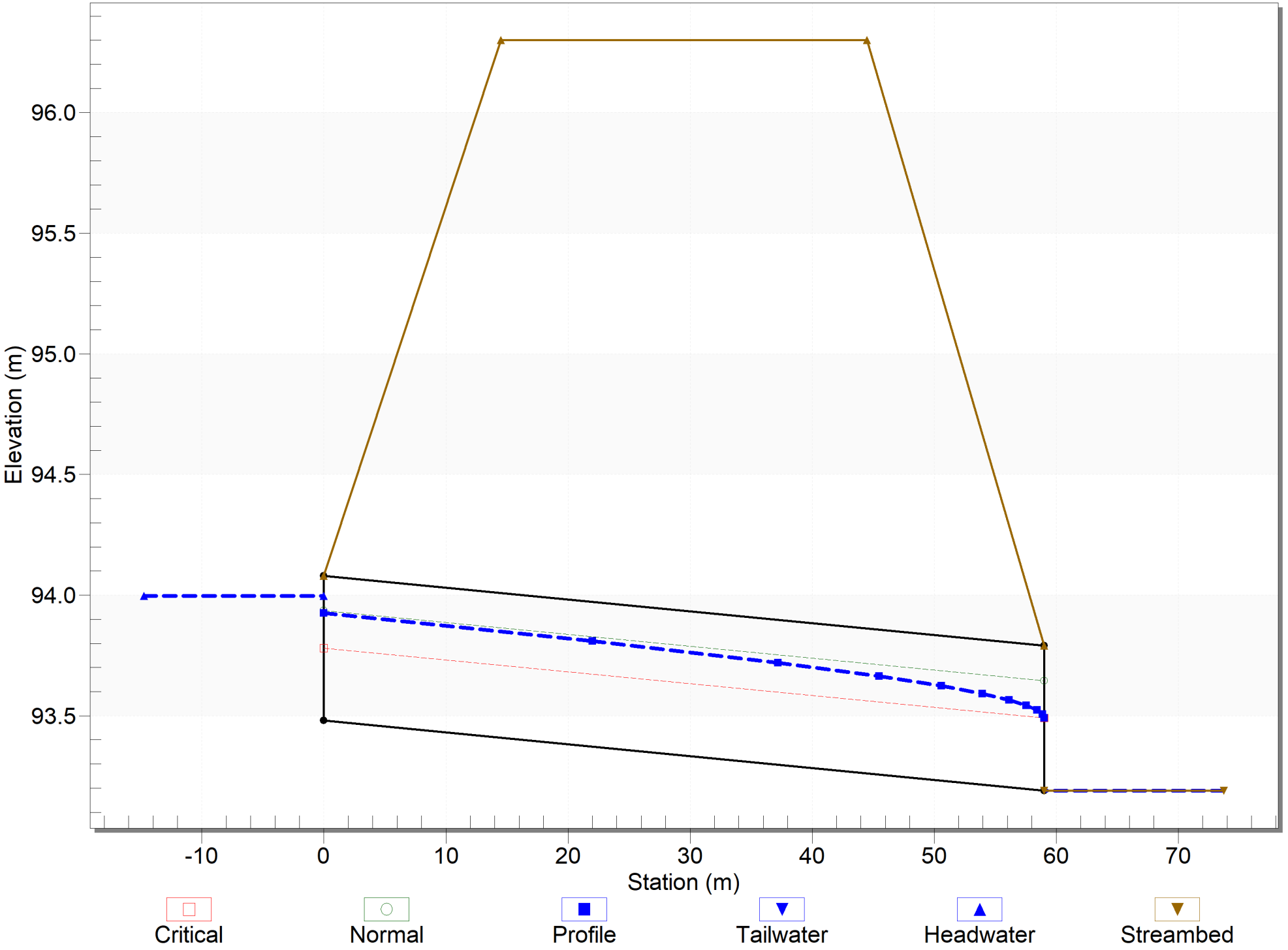
Parameter	Value	Units
CULVERT DATA		
Name	POST - 100-year - HW=93.19 - TW=92.50	
Shape	Circular	
Material	Corrugated Steel	
Diameter	1200.000	mm
Embedment Depth	0.000	mm
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall (Ke=0.5)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	m
Inlet Elevation	92.280	m
Outlet Station	61.000	m
Outlet Elevation	91.970	m
Number of Barrels	1	
Computed Culvert Slope	0.005082	m/m

Table 2 - Culvert Summary Table: POST - 100-year - HW=93.19 - TW=92.50

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	92.50	0.00	0.220	0.06	0-NF	0.00	0.00	0.53	0.53	0.00	0.00
0.11	0.11	92.56	0.23	0.283	0.07	3-M1t	0.22	0.17	0.53	0.53	0.22	0.00
0.22	0.22	92.66	0.33	0.380	0.10	3-M1t	0.31	0.25	0.53	0.53	0.45	0.00
0.32	0.32	92.75	0.41	0.467	0.12	3-M1t	0.38	0.30	0.53	0.53	0.67	0.00
0.43	0.43	92.82	0.48	0.542	0.14	3-M1t	0.44	0.35	0.53	0.53	0.90	0.00
0.54	0.54	92.89	0.54	0.611	0.16	3-M1t	0.50	0.39	0.53	0.53	1.12	0.00
0.65	0.65	92.95	0.60	0.675	0.17	3-M2t	0.55	0.43	0.53	0.53	1.34	0.00
0.75	0.75	93.02	0.65	0.735	0.19	3-M2t	0.60	0.47	0.53	0.53	1.57	0.00
0.86	0.86	93.07	0.70	0.794	0.20	3-M2t	0.65	0.50	0.53	0.53	1.79	0.00
0.97	0.97	93.13	0.75	0.850	0.22	2-M2c	0.70	0.53	0.53	0.53	2.00	0.00
1.08	1.08	93.19	0.80	0.905	0.23	2-M2c	0.75	0.56	0.56	0.53	2.07	0.00
4.02	3.92	96.11	2.32	3.835	0.97	7-M2c	1.20	1.06	1.06	0.53	3.70	0.00

Crossing - Kanata Ave 600mm, Design Discharge - 0.22 cms

Culvert - POST - 100-year - HW=94.00 - TW=93.19, Culvert Discharge - 0.22 cms



HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
Kanata Ave 600mm	POST - 100-year - HW=94.00 - TW=93.19	0.22	0.22	94.00	0.43	0.516	0.26	0.46	0.30	0.30	1.52

Crossing Input: Kanata Ave 600mm

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cms
Design Flow	0.216	cms
Maximum Flow	0.216	cms
TAILWATER DATA		
Channel Type	Enter Constant Tailwater Elevation	
Channel Invert Elevation	93.190	m
Constant Tailwater Elevation	93.190	m
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	m
Crest Length	3.000	m
Crest Elevation	96.300	m
Roadway Surface	Paved	
Top Width	30.000	m

Culvert Input: Kanata Ave 600mm

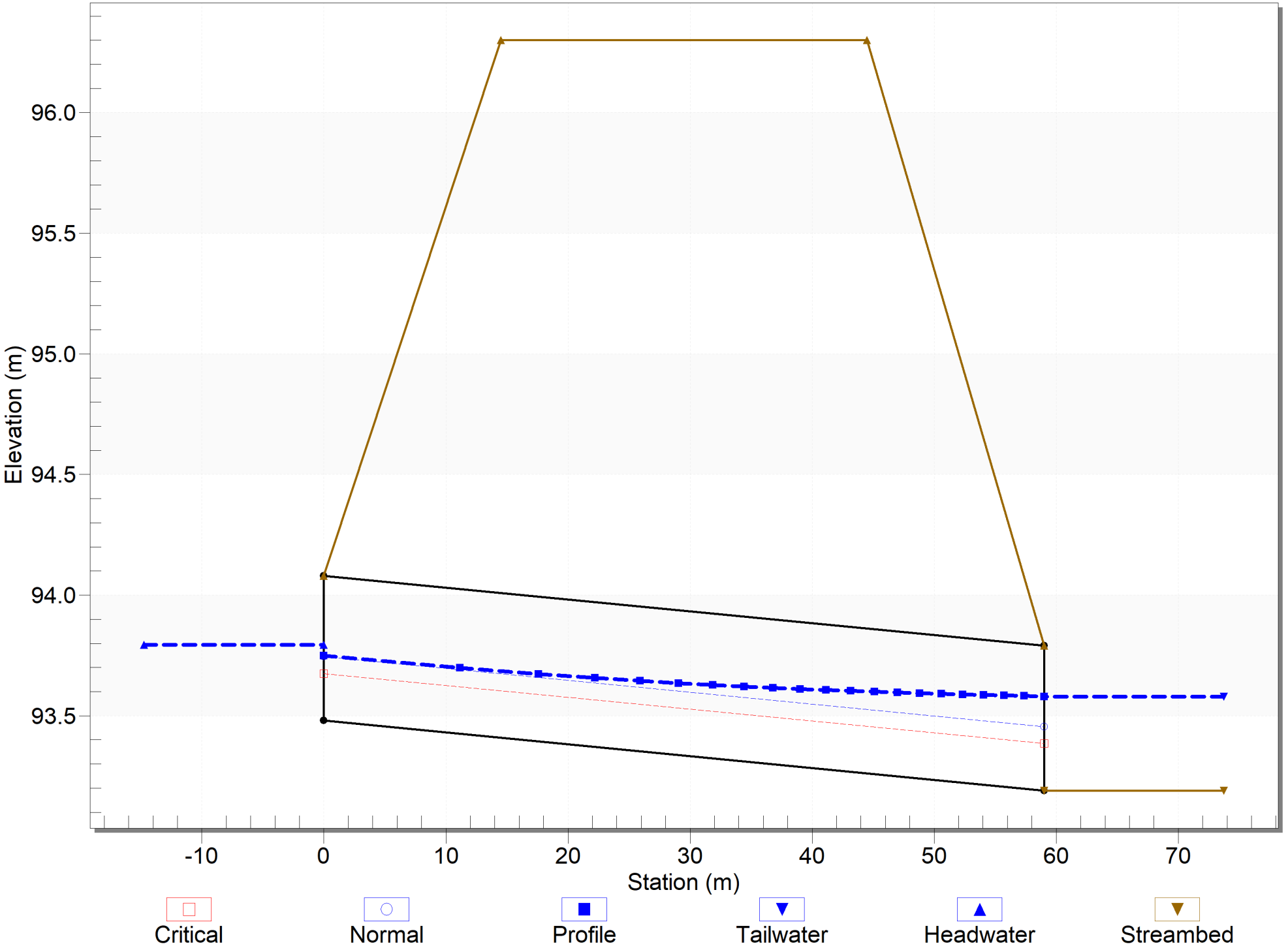
Parameter	Value	Units
CULVERT DATA		
Name	POST - 100-year - HW=94.00 - TW=93.19	
Shape	Circular	
Material	Corrugated PE	
Diameter	600.000	mm
Embedment Depth	0.000	mm
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall (Ke=0.5)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	m
Inlet Elevation	93.480	m
Outlet Station	59.000	m
Outlet Elevation	93.190	m
Number of Barrels	1	
Computed Culvert Slope	0.004915	m/m

Table 2 - Culvert Summary Table: POST - 100-year - HW=94.00 - TW=93.19

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	93.48	0.00	0.000	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.02	93.62	0.12	0.144	0.07	2-M2c	0.12	0.09	0.09	0.00	0.79	0.00
0.04	0.04	93.69	0.18	0.205	0.10	2-M2c	0.17	0.13	0.13	0.00	0.95	0.00
0.06	0.06	93.73	0.22	0.254	0.13	2-M2c	0.22	0.16	0.16	0.00	1.06	0.00
0.09	0.09	93.78	0.26	0.297	0.15	2-M2c	0.25	0.19	0.19	0.00	1.15	0.00
0.11	0.11	93.82	0.29	0.336	0.17	2-M2c	0.29	0.21	0.21	0.00	1.23	0.00
0.13	0.13	93.85	0.32	0.374	0.19	2-M2c	0.32	0.23	0.23	0.00	1.30	0.00
0.15	0.15	93.89	0.35	0.410	0.21	2-M2c	0.35	0.25	0.25	0.00	1.36	0.00
0.17	0.17	93.93	0.38	0.446	0.23	2-M2c	0.38	0.27	0.27	0.00	1.42	0.00
0.19	0.19	93.96	0.41	0.479	0.24	2-M2c	0.42	0.28	0.28	0.00	1.47	0.00
0.22	0.22	94.00	0.43	0.516	0.26	2-M2c	0.46	0.30	0.30	0.00	1.52	0.00
0.67	0.64	96.33	1.05	2.850	1.45	7-M2c	0.60	0.52	0.52	0.00	2.48	0.00

Crossing - Kanata Ave 600mm, Design Discharge - 0.09 cms

Culvert - POST - 5-year - HW=93.79 - TW=93.58, Culvert Discharge - 0.09 cms



HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
Kanata Ave 600mm	POST - 5-year - HW=93.79 - TW=93.58	0.09	0.09	93.79	0.27	0.313	0.16	0.26	0.19	0.39	0.48

Crossing Input: Kanata Ave 600mm

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cms
Design Flow	0.094	cms
Maximum Flow	0.094	cms
TAILWATER DATA		
Channel Type	Enter Constant Tailwater Elevation	
Channel Invert Elevation	93.190	m
Constant Tailwater Elevation	93.580	m
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	m
Crest Length	3.000	m
Crest Elevation	96.300	m
Roadway Surface	Paved	
Top Width	30.000	m

Culvert Input: Kanata Ave 600mm

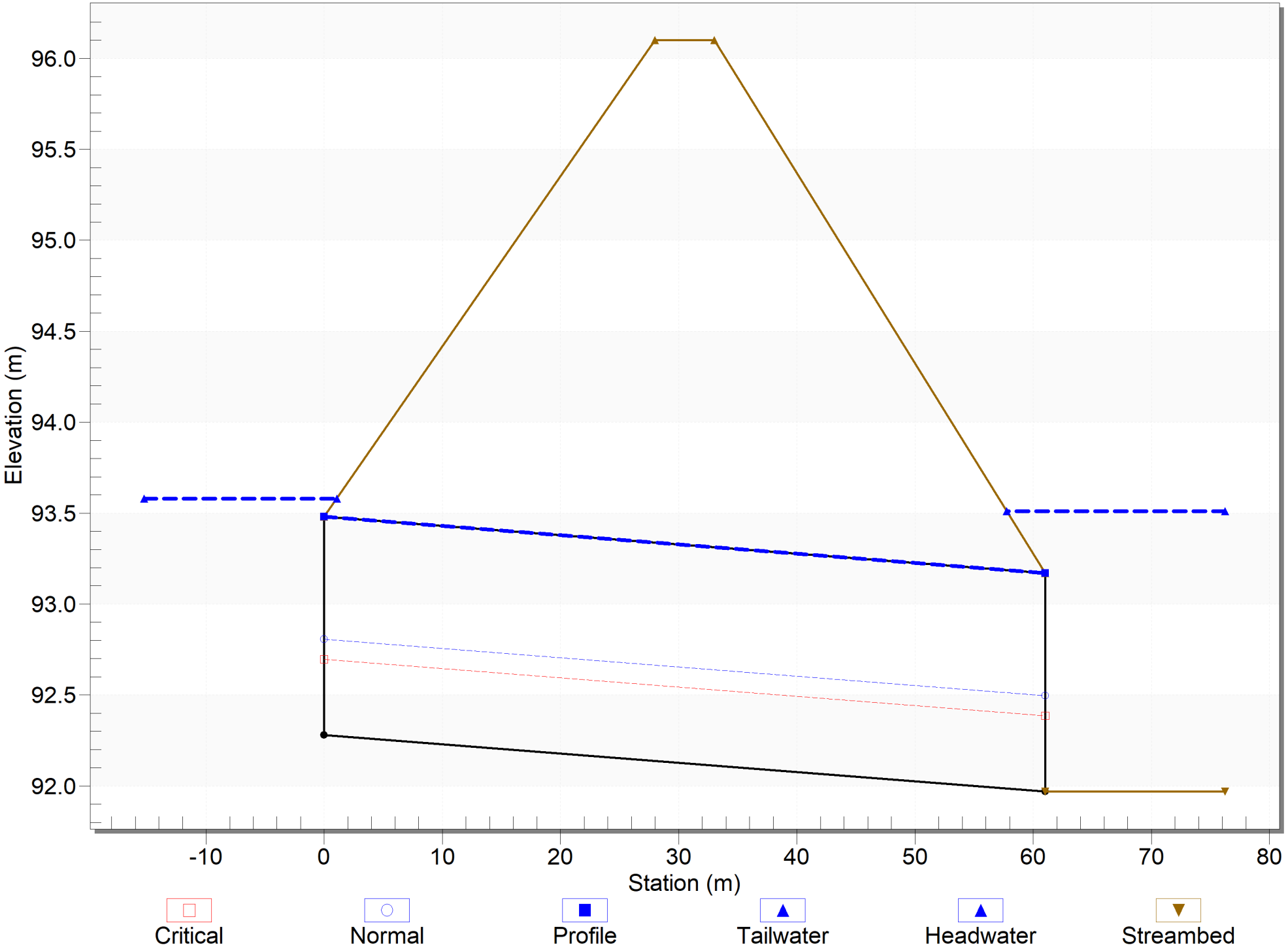
Parameter	Value	Units
CULVERT DATA		
Name	POST - 5-year - HW=93.79 - TW=93.58	
Shape	Circular	
Material	Corrugated PE	
Diameter	600.000	mm
Embedment Depth	0.000	mm
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall (Ke=0.5)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	m
Inlet Elevation	93.480	m
Outlet Station	59.000	m
Outlet Elevation	93.190	m
Number of Barrels	1	
Computed Culvert Slope	0.004915	m/m

Table 2 - Culvert Summary Table: POST - 5-year - HW=93.79 - TW=93.58

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	93.58	0.00	0.100	0.05	0-NF	0.00	0.00	0.39	0.39	0.00	0.00
0.01	0.01	93.60	0.08	0.115	0.06	3-M1t	0.08	0.06	0.39	0.39	0.05	0.00
0.02	0.02	93.62	0.12	0.143	0.07	3-M1t	0.11	0.09	0.39	0.39	0.10	0.00
0.03	0.03	93.65	0.14	0.170	0.09	3-M1t	0.14	0.11	0.39	0.39	0.14	0.00
0.04	0.04	93.68	0.17	0.196	0.10	3-M1t	0.16	0.12	0.39	0.39	0.19	0.00
0.05	0.05	93.70	0.19	0.219	0.11	3-M1t	0.18	0.14	0.39	0.39	0.24	0.00
0.06	0.06	93.72	0.21	0.236	0.12	3-M1t	0.20	0.15	0.39	0.39	0.29	0.00
0.07	0.07	93.74	0.22	0.256	0.13	3-M1t	0.22	0.16	0.39	0.39	0.34	0.00
0.08	0.08	93.76	0.24	0.275	0.14	3-M1t	0.23	0.17	0.39	0.39	0.39	0.00
0.08	0.08	93.77	0.25	0.294	0.15	3-M1t	0.25	0.18	0.39	0.39	0.43	0.00
0.09	0.09	93.79	0.27	0.313	0.16	3-M1t	0.26	0.19	0.39	0.39	0.48	0.00
0.65	0.64	96.32	1.05	2.836	1.44	7-M2c	0.60	0.52	0.52	0.39	2.47	0.00

Crossing - Terry Fox Dr 1200mm, Design Discharge - 0.60 cms

Culvert - POST - 5-year - HW=93.58 - TW=93.51, Culvert Discharge - 0.60 cms



HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
Terry Fox Dr 1200mm	POST - 5-year - HW=93.58 - TW=93.51	0.60	0.60	93.58	0.57	1.300	0.33	0.53	0.42	1.20	0.53

Crossing Input: Terry Fox Dr 1200mm

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cms
Design Flow	0.600	cms
Maximum Flow	0.600	cms
TAILWATER DATA		
Channel Type	Enter Constant Tailwater Elevation	
Channel Invert Elevation	91.970	m
Constant Tailwater Elevation	93.510	m
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	m
Crest Length	34.000	m
Crest Elevation	96.100	m
Roadway Surface	Paved	
Top Width	5.000	m

Culvert Input: Terry Fox Dr 1200mm

Parameter	Value	Units
CULVERT DATA		
Name	POST - 5-year - HW=93.58 - TW=93.51	
Shape	Circular	
Material	Corrugated Steel	
Diameter	1200.000	mm
Embedment Depth	0.000	mm
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall (Ke=0.5)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	m
Inlet Elevation	92.280	m
Outlet Station	61.000	m
Outlet Elevation	91.970	m
Number of Barrels	1	
Computed Culvert Slope	0.005082	m/m

Table 2 - Culvert Summary Table: POST - 5-year - HW=93.58 - TW=93.51

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	93.51 93.51	0.00	1.230	0.31	0-NF	0.00	0.00	1.20	1.54	0.00 0.05	0.00
0.06	0.06	93.51 93.52	0.17	1.231	0.31	4-FFf	0.16	0.13	1.20	1.54	0.11 0.16	0.00
0.12	0.12	93.52 93.53	0.25	1.233	0.31	4-FFf	0.23	0.18	1.20	1.54	0.21 0.27	0.00
0.18	0.18	93.54 93.54	0.30	1.236	0.31	4-FFf	0.28	0.22	1.20	1.54	0.32 0.37	0.00
0.24	0.24	93.56 93.57	0.35	1.241	0.32	4-FFf	0.32	0.26	1.20	1.54	0.42 0.48	0.00
0.30	0.30	93.58 96.11	0.40	1.248	0.32	4-FFf	0.36	0.29	1.20	1.54	0.53 3.22	0.00
0.36	0.36		0.44	1.255	0.32	4-FFf	0.40	0.32	1.20	1.54		0.00
0.42	0.42		0.47	1.265	0.32	4-FFf	0.43	0.35	1.20	1.54		0.00
0.48	0.48		0.51	1.275	0.32	4-FFf	0.47	0.37	1.20	1.54		0.00
0.54	0.54		0.54	1.287	0.33	4-FFf	0.50	0.39	1.20	1.54		0.00
0.60	0.60		0.57	1.300	0.33	4-FFf	0.53	0.42	1.20	1.54		0.00
3.71	3.65		2.12	3.831	0.97	4-FFf	1.20	1.04	1.20	1.54		0.00

D.B. Gray Engineering Inc.

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

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Ottawa, Ontario K1T 4E9

613-425-8044
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STORM SEWER CALCULATIONS

Rational Method

2-YEAR EVENT

(including off-site drainage)

Project: 475 Terry Fox Drive
6-Storey Apartment Buildings
Ottawa, Ontario

Date: July 8, 2026

Manning's Roughness Coefficient: 0.013

Location		Individual					Cumulative				Sewer Data							
From	To	Roof C = 0.90 (ha)	Hard C = 0.90 (ha)	Off-Site C = 0.43 (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}
CB-1	CB/MH-2	0.0050	0.0375		0.0075	0.1105	0.1105	10.00	77	8.49	6.9	250	250	2.5	1.92	94.03	0.06	9%
CB/MH-2	MH-3	0.0625	0.0800		0.0075	0.3607	0.4712	10.06	77	36.08	33.2	250	250	0.432	0.80	39.09	0.69	92%
MH-3	CB/MH-4					0.0000	0.4712	10.75	74	34.88	9.6	250	250	0.432	0.80	39.09	0.20	89%
CB/MH-4	MH-7	0.0225	0.0550		0.0175	0.2036	0.6748	10.96	73	49.48	8.5	300	300	0.34	0.80	56.39	0.18	88%
CB/MH-5	CB/MH-6	0.0425	0.1450	0.1382	0.0700	0.6732	0.6732	10.00	77	51.71	22.2	300	300	0.34	0.80	56.39	0.46	92%
CB/MH-6	MH-7		0.0550	0.2949	0.0225	0.5026	1.1759	10.46	75	88.27	23.1	375	375	0.34	0.93	102.23	0.42	86%
MH-7	MH-12							11.13	73	15.36	21.0	300	300	0.34	0.80	56.39	0.44	27%
CB-8	CB/MH-9	0.0350	0.0075		0.0150	0.1147	0.1147	10.00	77	8.81	17.8	250	250	0.432	0.80	39.09	0.37	23%
CB/MH-9	MH-12	0.0200	0.0100	0.1454	0.0475	0.2753	0.3900	10.37	75	29.40	69.6	250	250	0.432	0.80	39.09	1.46	75%
CB-10	CB/MH-11	0.0150			0.0025	0.0389	0.0389	10.00	77	2.99	6.1	250	250	0.432	0.80	39.09	0.13	8%
CB/MH-11	MH-12	0.0475	0.0950		0.0375	0.3774	0.4163	10.13	76	31.77	15.2	250	250	1.0	1.21	59.47	0.21	53%
MH-12	MH-13						0.8063	11.83	70	72.14	47.2	375	375	0.25	0.79	87.67	0.99	82%
MH-13	CB/MH-14							12.82	67	72.14	22 - Soleno HydroStor HS180 Chambers							
CB/MH-14	MH-15	0.0895	0.0600		0.0675	0.4116		12.82	67	56.16	19.7	450	456	2.39	2.80	456.61	0.12	12%
MH-15	CB/MH-16							12.94	67	56.16	7.1	450	456	0.195	0.80	130.43	0.15	43%