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Technical Memorandum

Date: January 24, 2025 **Project No.:** 300058184.0000

Project Name: Forest Glade North Environmental Assessment - Stormwater Management

Client Name: Rock Developments Inc.

Submitted To: Juan Paramo, P.Eng., City of Windsor Development Engineer

Submitted By: Harjot Budwal, EIT

Reviewed By: Harold Faulkner, P.Eng.

1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) has been retained by Rock Developments Inc. to provide Environmental Assessment services for the proposed development lands on the current municipal address identified as 0 Catherine Street in Windsor.

The purpose of this memorandum is to provide a review and assessment of the stormwater management for the study area. This includes a review of existing drainage conditions, a summary of the constraints and stormwater management (SWM) requirements, recommendations regarding regional and site specific SWM approaches, and a general assessment of the Hawkins Drain conveyance capacity.

1.1 Study Area

The approximately 95 ha study area is known as the Forest Glade North Planning Area at the northwest quadrant of the intersection of Lauzon Parkway and Tecumseh Road East, bound by the CN rail line and Hawkins Drain to the north, and lands fronting Jefferson Boulevard to the west. The study area and project limits are shown in Figure 1.

Figure 1: Study Area

2.0 Alternatives to be Evaluated

The following alternatives have been evaluated in the assessment of the stormwater drainage of the study area:

1. Do nothing.

   This alternative would result in uncontrolled stormwater discharge from the development sites within the study area. This alternative is not feasible, as the Ministry of the Environment, Conservation and Parks (MECP) and City of Windsor standards for quantity control, quality control and downstream conveyance capacity would not be achieved.

2. Two regional stormwater management ponds, one on either side of the proposed Catherine Street extension.

   This alternative would provide the required stormwater management controls for quality and quantity control. However, most of the study area drains north to the Hawkins Drain, and the majority of the undeveloped lands are located north of Catherine Street. These conditions reduce the effectiveness of a second regional stormwater management pond on the south side of Catherine Street.

3. One regional stormwater management pond adjacent to the CN Rail and Hawkins Drain with on-site quality control.

   This alternative appears to be the most feasible, as a regional stormwater management pond adjacent to the CN Rail and Hawkins Drain could service the greatest portion of the study area, providing the necessary quality and quantity controls.

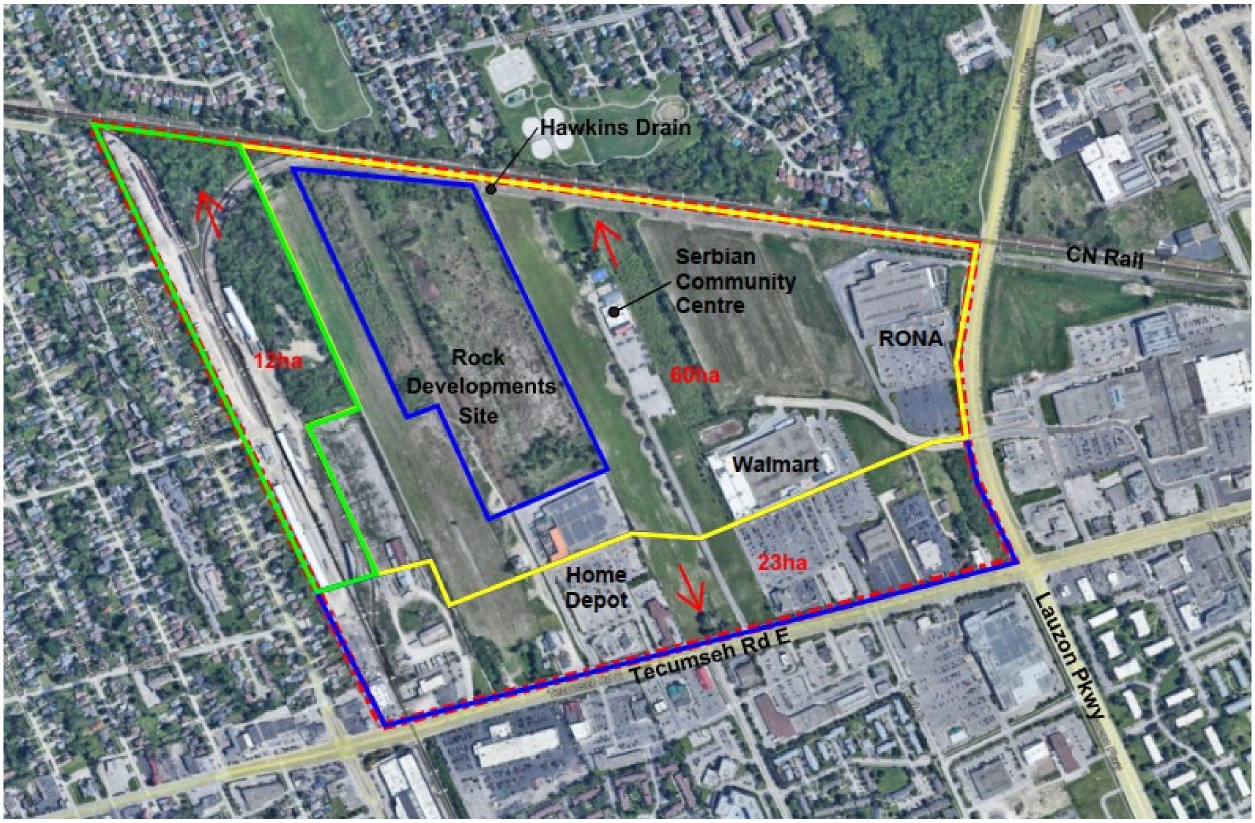
3.0 Existing Conditions

3.1 Site Context

The existing study area is generally flat and consists of various land uses. The site is primarily developed commercial, and vacant land much of which is farmed or partially used for farming, as well as railyard and environmental area comprised of mature woods and an open field. Additionally, there are a few residential units located along the Tecumseh Road East frontage, warehouse and storage uses on the western portion of the site, and a community centre with private access from Tecumseh Road East via Parkview Ave. The Catherine Street right-of-way (ROW) extends approximately one-third into the site off of Lauzon Parkway and is the only internal roadway. The Hawkins Drain is an open ditch drain that runs in an east to west direction and is located just north of the site.

Based on a general review of the existing site grading the drainage area breakdown shows approximately 23 ha development lands draining south to Tecumseh Street, 60 ha of mostly undeveloped lands and 12 ha railyard / environmental lands draining north to the Hawkins Drain.

Figure 2: Overall Drainage



3.2 Existing Stormwater Management Controls

In the existing condition, on-site SWM controls are provided for the Home Depot, Serbian Community Centre, Walmart, and RONA to various levels.

As per the Stormwater Management Report for the Home Depot prepared by A.M. Candaras Associates Inc. (2015), quantity and quality control are provided with two outlets. Home Depot outlets through an orifice-controlled storm connection to Tecumseh Road East and an orifice-controlled storage pond located just north of the building that outlets to an existing ditch which ultimately drains to the Hawkins Drain. The connection to Tecumseh Road East is limited to the five-year post-development flow and quality control is provided through catch basin goss gully traps, while the outlet to Hawkins Drain is controlled to five-year pre-development rates and quality control (70% TSS removal) provided through two oil/grit separators (OGS). Detention storage to accommodate the 100-year storm event was provided.

As per the Serbian Community Centre Expansion documents prepared by Haddad, Morgan and Associates Ltd. (2012), the area outlets to an existing ditch located on the west side of the property. Quantity control is provided by a detention pond controlling runoff to the two-year pre-development flow. Detention storage to accommodate the 100-year storm event was provided.

The Stormwater Management Design Brief prepared by Counterpoint Engineering (2003) indicates that the Walmart property drains to Tecumseh Road East. Quantity control is provided through rooftop storage and a SWM pond, designed to control flows to the five-year pre-development rate. Level 3 quality control is provided through two OGSs.

Based on the SWM documents prepared for the Rona site (formerly Lowes) the site outlets to Hawkins Drain. Quantity control is provided through orifice plates, inlet control devices, and controlled flow rooftop drains, to control the 100-year and five-year post-development flows to the two-year post-development rate. Quality control is provided through an OGS.

4.0 Preferred Alternative

In reviewing the alternatives listed in Section 2.0, Alternative 3 was determined preferred to achieve the necessary stormwater management controls. Preliminary conceptual design of the single regional stormwater management facility is described in Section 5.0.

5.0 Stormwater Management

5.1 Design Criteria

The relevant stormwater management design criteria documents are listed below:

- Windsor / Essex Region Stormwater Management Standards Manual, Essex Region Conservation Authority (ERCA), December 2018 (WERSM).
- Stormwater Management Planning and Design Manual, Ontario Ministry of Environment, March 2003.

5.2 Conceptual Regional Stormwater Management Facility

A conceptual regional stormwater management facility (SWMF) design has been developed based on available information to provide water quantity and quality control.

The contributing drainage area to the proposed SWMF was estimated to be 26 ha, following discussions with the City of Windsor (City). The selection of this drainage area was based on the concept that properties fronting Hawkin's Drain would outlet directly to that system with on-site controls, and that the proposed new roads and properties without frontage to the Hawkin's Drain would require an outlet through a new Regional system. For the purposes of the Environmental Assessment, a single catchment has been modeled. Further breakdown of the catchment area should be considered at detailed design to enhance the model results and set allowable release rates for each of the individual developments. Conveyance routes, including storm sewers, overland flow routes and associated easements will also be determined at detailed design.

The ERCA SWM Manual and MTO Drainage Manual Design Charts were used to determine catchment characteristics. Existing catchment land use was delineated using aerial imagery and the topographic survey, whereas per the ERCA SWM Manual, 90% impervious land use cover was assumed for the proposed condition.

For quantity control, two scenarios were assessed. For both scenarios, it was assumed that the individual sites would control the 100-year post-development flows to the two-year post-development peak flow rate. In Scenario 1, the regional pond controls the 100-year post-development flow to the agricultural release rate of 6 L/s/ha. The City recommended this reduced release rate since the Hawkins Drain outlet, the Little River, is known to be at flood risk. An outlet capacity assessment would be required to confirm if a higher release rate from the SWMF is acceptable. An outlet capacity assessment was not completed as part of this project. In Scenario 2, the regional pond controls the 100-year post-development flow to the two-year pre-development peak flow rate. Visual OTTHYMO (VO) hydrologic modeling based on the 24-hour SCS Type-II storm rainfall distribution was utilized to determine active storage requirements.

As per Essex Region Conservation Authority (ERCA) and the Upper Little River Watershed Drainage and Stormwater Management Master Plan prepared by Stantec (January 2023) criteria, normal level quality control (70% TSS removal) for the full impervious area is required. However, as a conservative approach enhanced quality control (80% TSS removal) has been provided for the Site. A catchment of approximately 26 ha drains to the proposed SWMF, with an impervious percentage of 90%. Should quality control be provided in the regional SWM pond, Table 3.2 of the MOE Manual indicates a permanent pool storage volume requirement of 223 m^3/ha or 5,802 m^3.

The SWMF is proposed at the north section of the Rock Developments site, roughly 1.21 ha in surface area. The pond was set back a minimum 15 m from the top of the Drain. Scenarios 1 and 2 have the same SWMF footprint. Refer to Figure B1 to B4 in Appendix B for SWMF drainage area, locations, and cross sections.

The pond was designed as per MOE SWM Planning & Design Manual (2003) and City and ERCA criteria, with side slopes varying from 3H:1V to 6H:1V. A summary of the SWMF design and storage requirements for both scenarios are provided in Table 1 and Table 2, respectively. Note that the pond elevations were estimated based on available 100-year water level requirements provided by WSP. Refer to Appendix B for detailed calculations.

Table 1: Regional SWMF Elevations

Scenario	Bottom Elevation (m)	Permanent Pool Elevation (m)	100-year Water Level (m)	Top Elevation (m)
1	176.00	177.20	179.70	180.00
2	177.30	178.30	179.70	180.00

Table 2: Regional SWMF Storage Summary

Scenario	Required Peak Flow (m^3/s)	Required Active Storage Volume (m^3)	Controlled Peak Flow (m^3/s)	Provided Active Storage Volume (m^3)	Required Permanent Pool Volume (m^3)	Provided Permanent Pool Volume (m^3)
1	0.16	20,150	0.16	22,190	5,802	6,539
2	0.99	11,260	0.99	13,855	5,802	7,510

The SWMF footprint was restricted by the required 15 m setback from the Hawkins Drain while maximizing the amount of developable land. Therefore, to keep the footprint small the active storage depth used in Scenario 2 was larger than the MOE recommended depth. As the footprint is restricted and the proposed depth is only 0.5 m deeper than recommended, Burnside finds this deviation acceptable.

Due to the generally flat grades of the study area, and the Hawkins Drain outlet, it is anticipated that the regional stormwater management pond will be designed with a pumped outlet. A pumping station with backup power will be required for this feature, which will allow stormwater to be pumped down to the permanent water level at the prescribed release rates. Emergency overflow from the pond will be safely conveyed to the Drain.

5.2.1 Urban Stress Test Assessment

An additional hydrologic model scenario was prepared to assess the urban stress test (US) flows per the WERSM. This emergency scenario storm is based on 150 mm total rainfall. The purpose of this analysis is to confirm that the US flows can be adequately conveyed through the stormwater management facility. To determine the elevation of the US storage within the pond, the preliminary pond rating curves for both scenarios were extended to include the additional storage available in the freeboard segment of the ponds (179.70 m to 180.00 m). Approximately 3,500 m^3 of emergency storage is available in this part of the pond. This scenario also uses DUHYD commands to represent the on-site controls (100-year post to two-year post) as noted in Section 5.2.

Analysis details are included in Appendix B. The model results are summarized in Table 3 below:

Table 3: Urban Stress Test Results

Scenario	Inlet Peak Flow (m^3/s)	Outlet Peak Flow (m^3/s)	Required Active Storage Volume (m^3)	Resulting Ponding Elevation (m)
1	5.32	0.18	22,773	179.93
2	5.32	1.07	12,104	179.78

5.3 Hawkins Drain Assessment

A high-level assessment of the Hawkins Drain was completed to establish an estimate of flow depths and impacts on the conceptual regional SWM facility. The assessment was completed up to approximately the conceptual SWM pond outlet to the Drain.

The contributing drainage area was estimated based on the Drainage Area and Parcel Information drawing included in the Repair and Improvement to the Hawkins Drain report prepared by Baird AE (2018). Refer to Figure A in Appendix A for catchment areas. Land use was delineated based on aerial imagery and the ERCA SWM Standards. Peak flows were determined using the Unit Hydrograph method in Visual OTTHYMO 6.2 (VO). However, flows from Catchment 1 were limited to the full flow capacities of the culverts that convey runoff to the Hawkins Drain.

The hydraulic assessment of the Hawkins Drain was completed using FlowMaster. A Manning's n value of 0.025 was chosen to represent a vegetated channel and the Hawkins Drain geometry and slope were based on the proposed conditions provided in the Hawkins Drain Design Drawings by Baird AE. Cross-sections near the conceptual pond outlet were considered; however, it was noted that the sections downstream of the outlet were fairly uniform. It should be noted that backwater impacts of downstream culverts were not considered in the analysis. Estimated flow depths were determined based on this analysis for comparison with the anticipated water levels in the regional stormwater management pond.

Detailed calculations and output files can be found in Appendix A.

5.4 Remaining Study Area

Developed areas draining to Tecumseh Road are currently controlled on-site to the five-year pre-development peak flow rates, and on-site normal level quality control. Undeveloped lands draining toward Tecumseh Road will require SWM quality and quantity controls on-site when they are developed.

Similarly, the undeveloped lands draining north to the Hawkins Drain, but not to the regional stormwater management pond, will require on-site quantity and quality control. The level of quantity control will be determined by the City, whether the two-year pre-development or the 6 L/s/ha agricultural release rate is preferred. A normal level of quality control (70% TSS removal) will also be required on an individual site basis. However, specific land uses may require more restrictive quality control (industrial uses, etc.).

6.0 Conclusions and Recommendations

This Memo includes a preliminary conceptual design for a regional stormwater management strategy to provide quantity and quality control for the Forest Glade North Planning area. As part of this strategy a regional SWM pond is recommended to service approximately half of the

Forest Glade North Planning area draining to the Hawkins Drain. Scenarios 1 and 2 are presented dependent on the ultimate quantity control requirements determined by the City. Development sites within the tributary area of the regional pond will be required to control on-site 100-year post-development to the two-year post-development peak flow rates.

Development sites draining to the Hawkins Drain not within the regional pond catchment area will be required to provide on-site quantity control (per Scenario 1 or 2) and quality control.

Development sites within the study area draining to Tecumseh Road should provide quantity control and quality control appropriate for the land use.

We recommend the detailed design proceed with a regional SWM facility and on-site stormwater management controls as described herein.

R.J. Burnside & Associates Limited

Harjot Budwal, EIT
Engineering Assistant

Harold Faulkner, P.Eng.
Project Engineer

HB:af

Enclosure(s) Appendix A – Hawkins Drain Assessment
Appendix B – Conceptual Regional SWMF

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Appendix A

Hawkins Drain Assessment

Appendix A

LEGEND:

DRAINAGE BOUNDARY

1 ← CATCHMENT AREA ID

10.0 ha ← DRAINAGE AREA (ha)

0 50 100 200 300 400

Metres

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Client

ROCK DEVELOPMENTS

Figure Title

FOREST GLADE NORTH EA
STORMWATER MANAGEMENT

HAWKINS DRAIN DRAINAGE PLAN

Drawn	Checked	Date	Figure No.
HB	HF	OCT 2024	A
Scale		Project No.	
1:5000		300058184.0000	

File: U:\058184\000\03-PRD\FIG\SWM\058184 - FIG A Hawkins Drain Drainage Plan.dwg

Project:	**Forest Glade**
Project #:	58184
Designed By:	H.B.
Checked By:	H.F.
Date:	11/8/2024

Hawkins Drain

Preliminary Flow Depth Assessment

1 The catchment area boundary for area draining to the drain was estimated using the Drainage Area and Parcel Information drawing included in the 2018 Repair and Improvements to the Hawkins Drain drawings.
Refer to Figure A in Appendix A for the Drainage Plan.

2 VO Model Catchment Parameters

		Landuse (m2)						Total		
	Area (m2)	Paved	Gravel	Grass	Res - SF	Res - TH	Ind / Com	Area (ha)	C	TIMP
1	850,845	30,104	52,992	80,273	559,425	88,511	39,540	85	0.54	0.49
2	141,772	0	77,242	64,530	0	0	0	14	0.47	0.39
3	278,593	3,463	3,685	227,983	0	0	43,462	28	0.33	0.18

Landuse	Paved	Gravel	Grass	Res - SF	Res - TH	Ind / Com
C	0.95	0.70	0.20	0.50	0.75	0.90

3 External Flows
Flows from Catchment 1 were limited to the full flow capacities of the culverts that convey the runoff to the Drain:

Culvert Capacities

Dia. (mm)	Slope (%)	Flow (cu.m/s)
1050	0.2	1.22
600	1.0	0.61
900	1.0	1.81
1500	0.5	5.00
		8.64

8.64 cu.m/s flow used in DUHYD command in VO model
Pipe information from City Sewer Atlas

Total Flows to Drain

Storm (year)	Q (cu.m/s)	Flow Depth (m)	Elev (m)
2	6.96	1.33	178.33
5	9.71	1.55	178.55
25	11.29	1.66	178.66
100	12.07	1.71	178.71

Total flows to ADDHYD 15
FlowMaster used to determine flow depths
Drain invert at pond outlet 177.00m

2yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025
Channel Slope	0.001 m/m
Left Side Slope	2.000 H:V
Right Side Slope	2.400 H:V
Bottom Width	2.00 m
Discharge	6.96 m³/s

Results

Normal Depth	1,326.1 mm
Flow Area	6.5 m²
Wetted Perimeter	8.4 m
Hydraulic Radius	775.1 mm
Top Width	7.83 m
Critical Depth	800.4 mm
Critical Slope	0.008 m/m
Velocity	1.07 m/s
Velocity Head	0.06 m
Specific Energy	1.38 m
Froude Number	0.374
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	0.00 m/s
Upstream Velocity	0.00 m/s
Normal Depth	1,326.1 mm
Critical Depth	800.4 mm
Channel Slope	0.001 m/m
Critical Slope	0.008 m/m

5yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.025
Channel Slope	0.001 m/m
Left Side Slope	2.000 H:V
Right Side Slope	2.400 H:V
Bottom Width	2.00 m
Discharge	9.71 m³/s

Results	
Normal Depth	1,546.2 mm
Flow Area	8.4 m²
Wetted Perimeter	9.5 m
Hydraulic Radius	881.2 mm
Top Width	8.80 m
Critical Depth	953.2 mm
Critical Slope	0.008 m/m
Velocity	1.16 m/s
Velocity Head	0.07 m
Specific Energy	1.62 m
Froude Number	0.381
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	0.00 m/s
Upstream Velocity	0.00 m/s
Normal Depth	1,546.2 mm
Critical Depth	953.2 mm
Channel Slope	0.001 m/m
Critical Slope	0.008 m/m

25yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025
Channel Slope	0.001 m/m
Left Side Slope	2.000 H:V
Right Side Slope	2.400 H:V
Bottom Width	2.00 m
Discharge	11.29 m³/s

Results

Normal Depth	1,655.8 mm
Flow Area	9.3 m²
Wetted Perimeter	10.0 m
Hydraulic Radius	933.6 mm
Top Width	9.29 m
Critical Depth	1,030.2 mm
Critical Slope	0.008 m/m
Velocity	1.21 m/s
Velocity Head	0.07 m
Specific Energy	1.73 m
Froude Number	0.385
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	0.00 m/s
Upstream Velocity	0.00 m/s
Normal Depth	1,655.8 mm
Critical Depth	1,030.2 mm
Channel Slope	0.001 m/m
Critical Slope	0.008 m/m

100yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025
Channel Slope	0.001 m/m
Left Side Slope	2.000 H:V
Right Side Slope	2.400 H:V
Bottom Width	2.00 m
Discharge	12.07 m³/s

Results

Normal Depth	1,706.6 mm
Flow Area	9.8 m²
Wetted Perimeter	10.3 m
Hydraulic Radius	957.8 mm
Top Width	9.51 m
Critical Depth	1,066.1 mm
Critical Slope	0.008 m/m
Velocity	1.23 m/s
Velocity Head	0.08 m
Specific Energy	1.78 m
Froude Number	0.386
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	0.00 m/s
Upstream Velocity	0.00 m/s
Normal Depth	1,706.6 mm
Critical Depth	1,066.1 mm
Channel Slope	0.001 m/m
Critical Slope	0.008 m/m

1050mm

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013
Channel Slope	0.002 m/m
Normal Depth	1,050.0 mm
Diameter	1,050.0 mm
Discharge	1.22 m³/s

Results

Discharge	1.22 m³/s
Normal Depth	1,050.0 mm
Flow Area	0.9 m²
Wetted Perimeter	3.3 m
Hydraulic Radius	262.5 mm
Top Width	0.00 m
Critical Depth	626.7 mm
Percent Full	100.0 %
Critical Slope	0.005 m/m
Velocity	1.41 m/s
Velocity Head	0.10 m
Specific Energy	1.15 m
Froude Number	(N/A)
Maximum Discharge	1.31 m³/s
Discharge Full	1.22 m³/s
Slope Full	0.002 m/m
Flow Type	Undefined

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	1,050.0 mm
Critical Depth	626.7 mm
Channel Slope	0.002 m/m
Critical Slope	0.005 m/m

600mm

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013
Channel Slope	0.010 m/m
Normal Depth	600.0 mm
Diameter	600.0 mm
Discharge	0.61 m³/s

Results

Discharge	0.61 m³/s
Normal Depth	600.0 mm
Flow Area	0.3 m²
Wetted Perimeter	1.9 m
Hydraulic Radius	150.0 mm
Top Width	0.00 m
Critical Depth	507.9 mm
Percent Full	100.0 %
Critical Slope	0.009 m/m
Velocity	2.17 m/s
Velocity Head	0.24 m
Specific Energy	0.84 m
Froude Number	(N/A)
Maximum Discharge	0.66 m³/s
Discharge Full	0.61 m³/s
Slope Full	0.010 m/m
Flow Type	Undefined

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	600.0 mm
Critical Depth	507.9 mm
Channel Slope	0.010 m/m
Critical Slope	0.009 m/m

900mm

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013
Channel Slope	0.010 m/m
Normal Depth	900.0 mm
Diameter	900.0 mm
Discharge	1.81 m³/s

Results

Discharge	1.81 m³/s
Normal Depth	900.0 mm
Flow Area	0.6 m²
Wetted Perimeter	2.8 m
Hydraulic Radius	225.0 mm
Top Width	0.00 m
Critical Depth	782.6 mm
Percent Full	100.0 %
Critical Slope	0.009 m/m
Velocity	2.85 m/s
Velocity Head	0.41 m
Specific Energy	1.31 m
Froude Number	(N/A)
Maximum Discharge	1.95 m³/s
Discharge Full	1.81 m³/s
Slope Full	0.010 m/m
Flow Type	Undefined

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	900.0 mm
Critical Depth	782.6 mm
Channel Slope	0.010 m/m
Critical Slope	0.009 m/m

1500mm

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013
Channel Slope	0.005 m/m
Normal Depth	1,500.0 mm
Diameter	1,500.0 mm
Discharge	5.00 m³/s

Results

Discharge	5.00 m³/s
Normal Depth	1,500.0 mm
Flow Area	1.8 m²
Wetted Perimeter	4.7 m
Hydraulic Radius	375.0 mm
Top Width	0.00 m
Critical Depth	1,164.1 mm
Percent Full	100.0 %
Critical Slope	0.006 m/m
Velocity	2.83 m/s
Velocity Head	0.41 m
Specific Energy	1.91 m
Froude Number	(N/A)
Maximum Discharge	5.38 m³/s
Discharge Full	5.00 m³/s
Slope Full	0.005 m/m
Flow Type	Undefined

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	1,500.0 mm
Critical Depth	1,164.1 mm
Channel Slope	0.005 m/m
Critical Slope	0.006 m/m

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Appendix B

Conceptual Regional SWMF

Project:	**Forest Glade**
Project #:	58184
Designed By:	H.B.
Checked By:	H.F.
Date:	11/27/2024

SWMF : Impervious Calculation

	Major and Minor		
CONTROLLED	*Area*	*% Impervious*	*Impervious Value Source*
Commerical	26.00	90%	
Total Area	**26.00**		
Composite Imperviousness	**90.0%**		
UNCONTROLLED	*Area*	*% Impervious*	*Notes*
Total Area	**0.00**		
Composite Imperviousness	**#DIV/0!**		

Project:	**Forest Glade**	
Project #:	58184	
Designed By:	H.B.	
Checked By:	H.F.	
Date:	11/27/2024	

SWMF: Permanent Pool Calculation

MOE Table 3.2 Water Quality Storage Requirements Based on Receiving Waters.

IMPERVIOUSNESS	90.0	%
Protection Level (1, 2, or 3)	**1**	

NOTE - 40 cu.m/ha has been removed from MOE table values for Ex. Detention Portion

Enhanced (Level 1) Protection

x Imperviousness (%)	**y** Permanent Pool StorageVolume (cu.m./ha)	**Known (x)** Imperviousness (%)	**Calc (y)** Permanent Pool StorageVolume (cu.m./ha)	Total Permanent Pool Required (cu.m)
35	100	**90.0**	**223**	**5802**
55	150			
70	185			
85	210			
95	**236**	**Extrapolated**		

Project:	**Forest Glade**
Project #:	58184
Designed By:	H.B.
Checked By:	H.F.
Date:	12/2/2024

SWMF

Soil

Brookston Clay (BC)	Soil Map of Essex County 1947
Group D	Windsor/Essex Region Stormwater Management Standards Manual (SWM Manual)

Catchment Characteristics

Existing - NasHyd

Area	26	ha	
C	0.6		MTO DC 1.07 - Clay, Rolling Cultivated
CN	86		
Initial Abstraction (IA)	8.27	mm	IA = 0.2S
Length	750	m	
Slope	0.5	%	
Tc	35.45	min	Bransby Williams Method
Tp	0.39	hours	

Proposed - StandHyd

Area	26	ha	
TIMP / XIMP	0.90		
Pervious			
CN	82		
IA	11.15	mm	IA = 0.2S
Impervious			
DPSI	2.5	mm	SWM Manual

Visual OTTHYMO Results

Regional Pond Agricultural Release Rate, Q (i.e. 6 L/s/ha)	0.156	cu.m/s
Pre-Development 2-Year Q	0.993	cu.m/s
Post-Development 2-Year Q	3.527	cu.m/s

Scenario 1 - Control 100-Year Post to Agricultural Release Rate (Assuming on site controls - 100-Year Post to 2-Year Post):

To control 100-year post to 2-year post:	6,770	m^3 on site
To control 100-year post to agricultural release rate:	20,150	m^3 in communal pond (with on site controls)

Scenario 2 - Control 100-Year Post to 2-Year Pre-Development (Assuming on site controls - 100-Year Post to 2-Year Post):

To control 100-year post to 2-year post:	6,770	m^3 on site
To control 100-year post to 2-year pre:	11,260	m^3 in communal pond (with on site controls)

Project:	**Forest Glade**	
Project #:	58184	
Designed By:	H.B.	BURNSIDE
Checked By:	H.F.	
Date:	12/2/2024	

SWMF - Scenario 1: High Level Preliminary Wet Pond Sizing

Scenario 1 - Control 100-Year Post to Agricultural Release Rate (Assuming on site controls - 100-Year Post to 2-Year Post):

VO Required Active Storage	20,150	m3		
Calculated Required Perm. Pool	5,802	m3		
Side Slopes (Perm. Pool)	3	:1		
Side Slopes (3m on Either Side of NWL)	6	:1		
Side Slopes (NWL to ToB)	5	:1		
Top of Pond	180	m		
Top of Active Storage	179.7	m	0.3m freeboard	*As provided by WSP, based on site design elevation restrictions, the maximum 100-year water level in the SWMF can be 179.78m. As the site design is conceptual, elevations may change and therefore, to be conservative the 100-year water level (i.e. Top of Active Storage) utilized in the SWMF design was assumed to be lower.
Active Storage Depth	2.5	m		
Top of Perm. Pool	177.2	m		
Perm. Pool Depth	1.2	m		
Bottom of Pond	176	m		
Area (Top of Active Storage)	11,441	m2		
Area (Top of Perm. Pool)	6,310	m2		
Area (Bot of Pond)	4,588	m2		
			> Required?	
Provided Active Storage Volume	22,190	m3	Y	
Provided Perm. Pool Volume	6,539	m3	Y	

Project:	**Forest Glade**
Project #:	58184
Designed By:	H.B.
Checked By:	H.F.
Date:	12/2/2024

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SWMF - Scenario 2: High Level Preliminary Wet Pond Sizing

Scenario 2 - Control 100-Year Post to 2-Year Pre-Development (Assuming on site controls - 100-Year Post to 2-Year Post):

VO Required Active Storage	11,260	m3		
Calculated Required Perm. Pool	5,802	m3		
Side Slopes (Perm. Pool)	3	:1		
Side Slopes (3m on Either Side of NWL)	6	:1		
Side Slopes (NWL to ToB)	5	:1		
Top of Pond	180	m		
Top of Active Storage	179.7	m	0.3m freeboard	*As provided by WSP, based on site design elevation restrictions, the maximum 100-year water level in the SWMF can be 179.78m. As the site design is conceptual, elevations may change and therefore, to be conservative the 100-year water level (i.e. Top of Active Storage) utilized in the SWMF design was assumed to be lower.
Active Storage Depth	1.4	m		
Top of Perm. Pool	178.3	m		
Perm. Pool Depth	1	m		
Bottom of Pond	177.3	m		
Area (Top of Active Storage)	11,441	m2		
Area (Top of Perm. Pool)	8,352	m2		
Area (Bot of Pond)	6,667	m2		
			> Required?	
Provided Active Storage Volume	13,855	m3	Y	
Provided Perm. Pool Volume	7,510	m3	Y	

Project:	**Forest Glade**
Project #:	58184
Designed By:	H.B.
Checked By:	H.F.
Date:	1/24/2025

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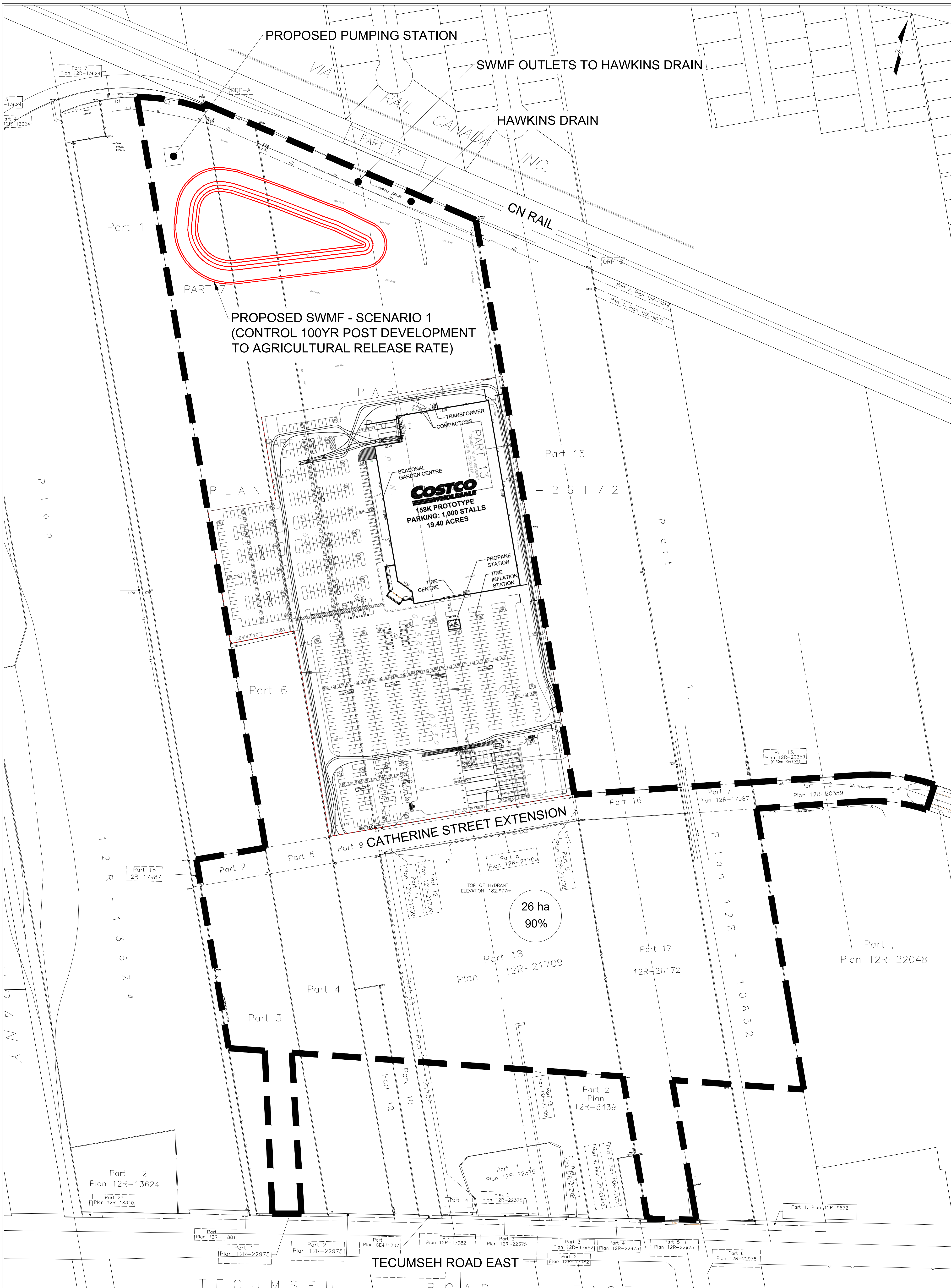
Urban Stress Test Assessment

Area (Top of Active Storage) 179.70m	11,442	m2
Area (Top of Pond) 180.00m	12,102	m2
Volume Between 100yr WL and Top of Pond	3,532	m3

		Scenario 1			
Elevation (m)	Additional Volume (m3)	Total Active Volume (m3)	Approx. Pond Discharge (m3/s)	Scenario 2 Total Active Volume (m3)	Approx. Pond Discharge (m3/s)
179.70	0	20,150	0.16	11,260	0.99
179.73	294	20,444	0.16	11,554	1.02
179.75	589	20,739	0.16	11,849	1.04
179.78	883	21,033	0.16	12,143	1.07
179.80	1,177	21,327	0.17	12,437	1.10
179.83	1,472	21,622	0.17	12,732	1.12
179.85	1,766	21,916	0.17	13,026	1.15
179.88	2,060	22,210	0.17	13,320	1.17
179.90	2,354	22,504	0.18	13,614	1.20
179.93	2,649	22,799	0.18	13,909	1.22
179.95	2,943	23,093	0.18	14,203	1.25
179.98	3,237	23,387	0.18	14,497	1.27
180.00	3,532	23,682	0.19	14,792	1.30



LEGEND:

DRAINAGE BOUNDARY

10 ha / 50%: DRAINAGE AREA (ha), % IMPERVIOUSNESS

0 60 120 180 240
Metres

BURNSIDE

Client: ROCK DEVELOPMENTS

Figure Title: FOREST GLADE NORTH EA STORMWATER MANAGEMENT

SWMF PLAN - SCENARIO 1

Drawn	Checked	Date	Figure No.
HB	HF	DEC 2024	B1
Scale: 1:3000		Project No.: 300058184.0000	

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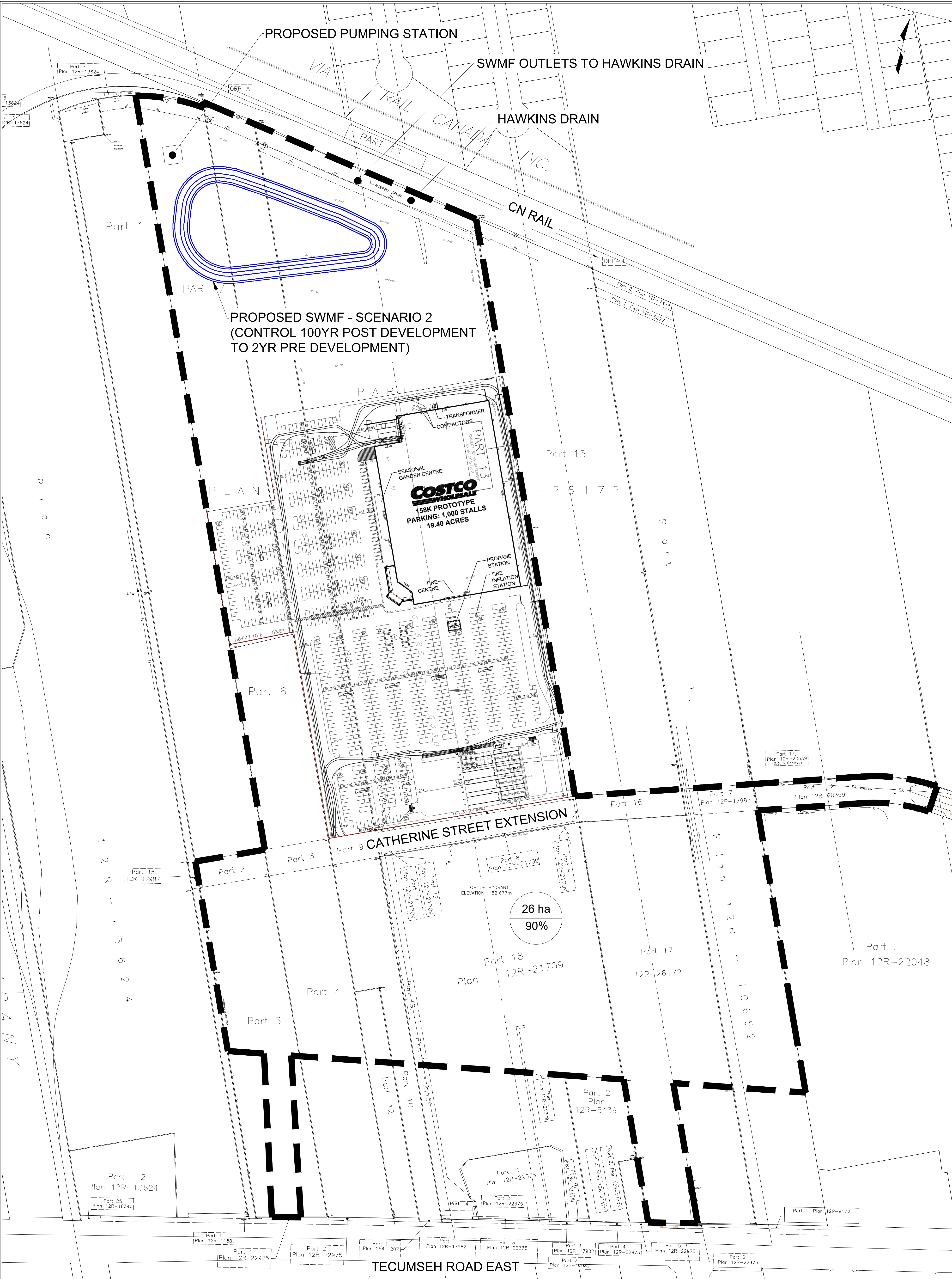

LEGEND:

DRAINAGE BOUNDARY

10 ha — DRAINAGE AREA (ha)

50% — % IMPERVIOUSNESS

0 60 120 180 240

Metres

BURNSIDE

Client: ROCK DEVELOPMENTS

Figure Title: FOREST GLADE NORTH EA STORMWATER MANAGEMENT

SWMF PLAN - SCENARIO 2

Drawn	Checked	Date	Figure No.
HB	HF	DEC 2024	B2
Scale: 1:3000		Project No.: 300058184.0000	

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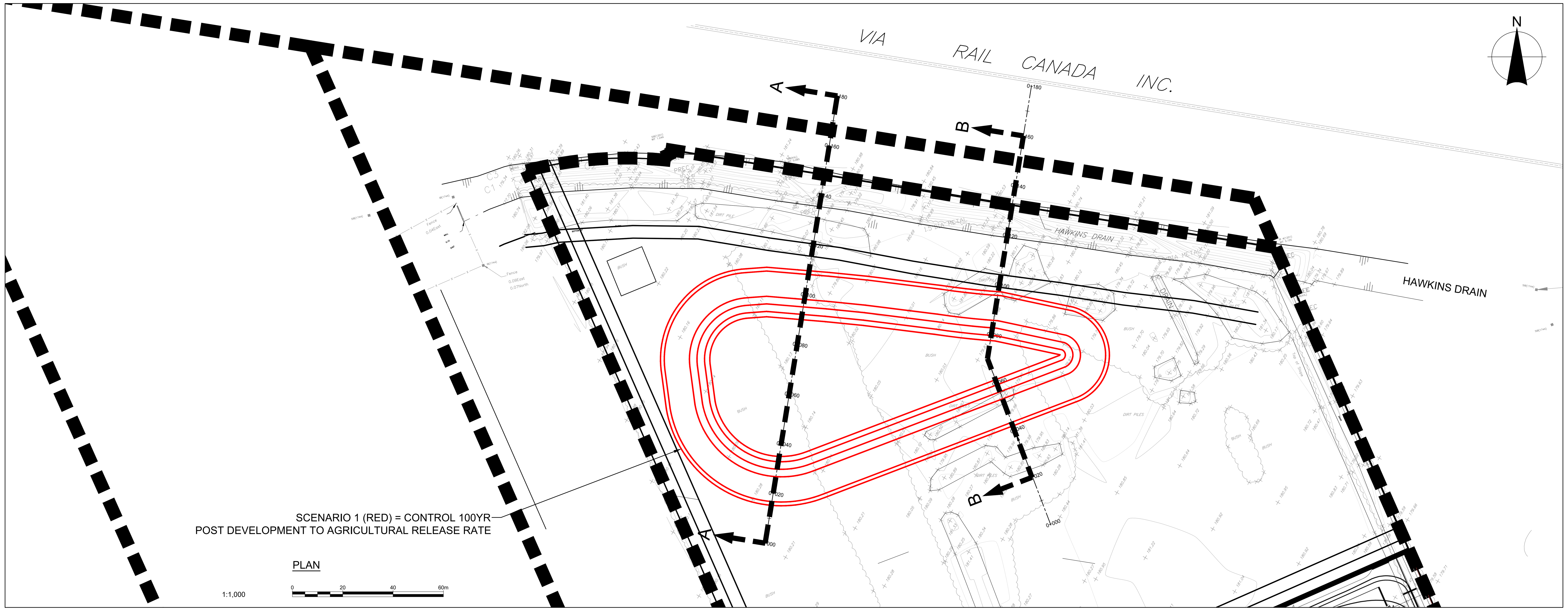

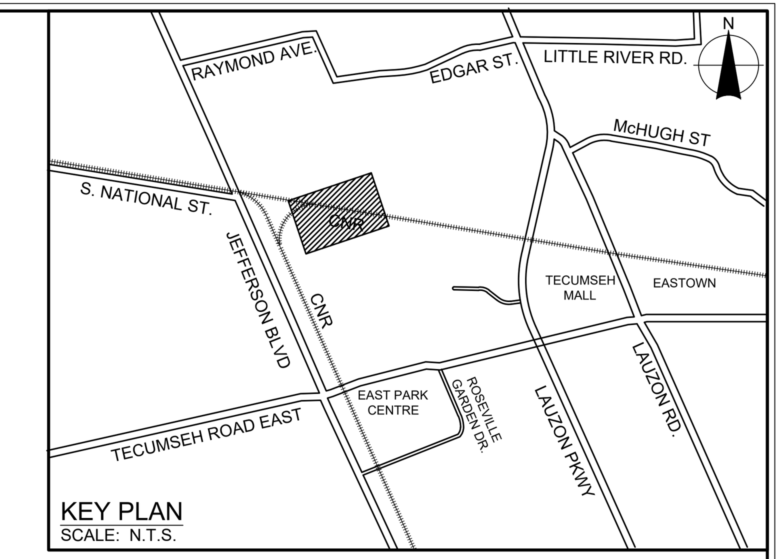

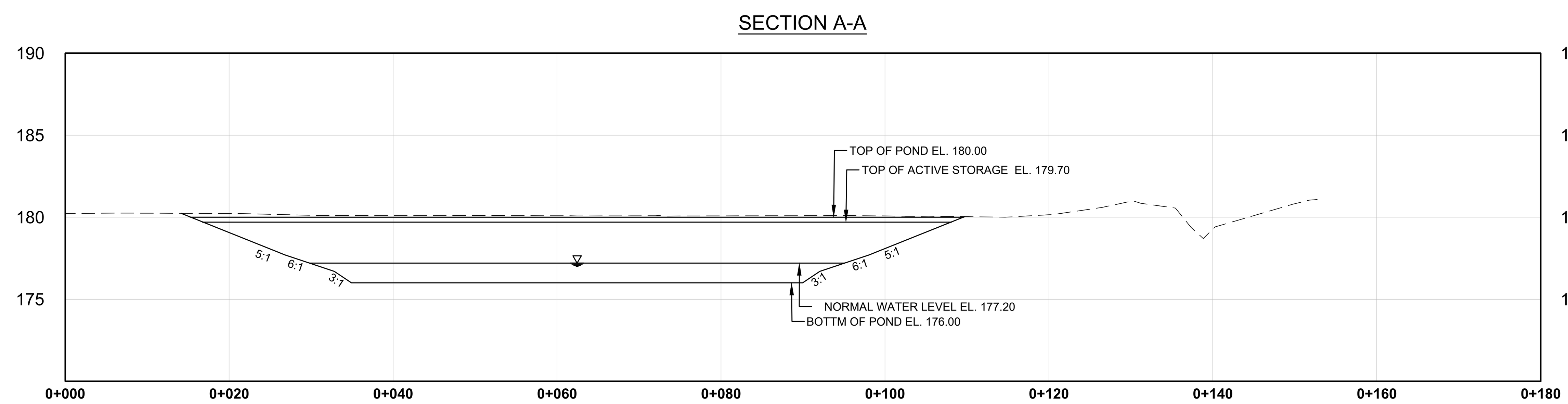

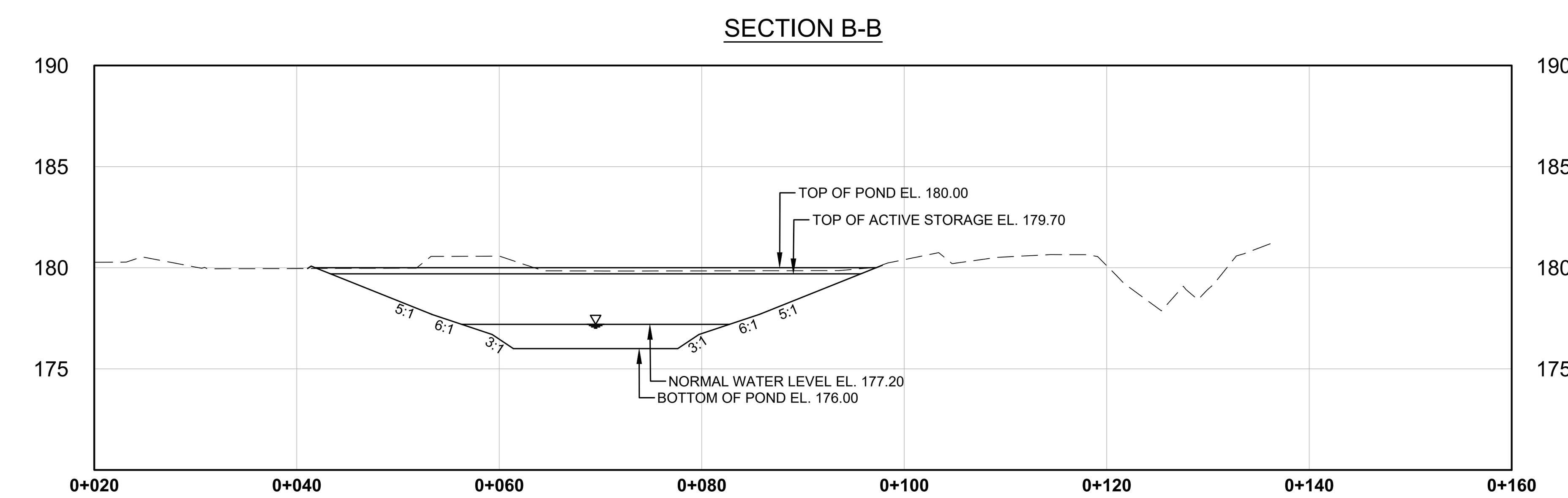

SECTIONS

1:500 HOR. 0 5.0 10.0 20.0 30.0m

1:250 VER. 0 5.0 10.0 15.0m

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NOT FOR CONSTRUCTION

No.	Issue / Revision	Date	Auth.
#	#	#	#
#	#	#	#
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BURNSIDE

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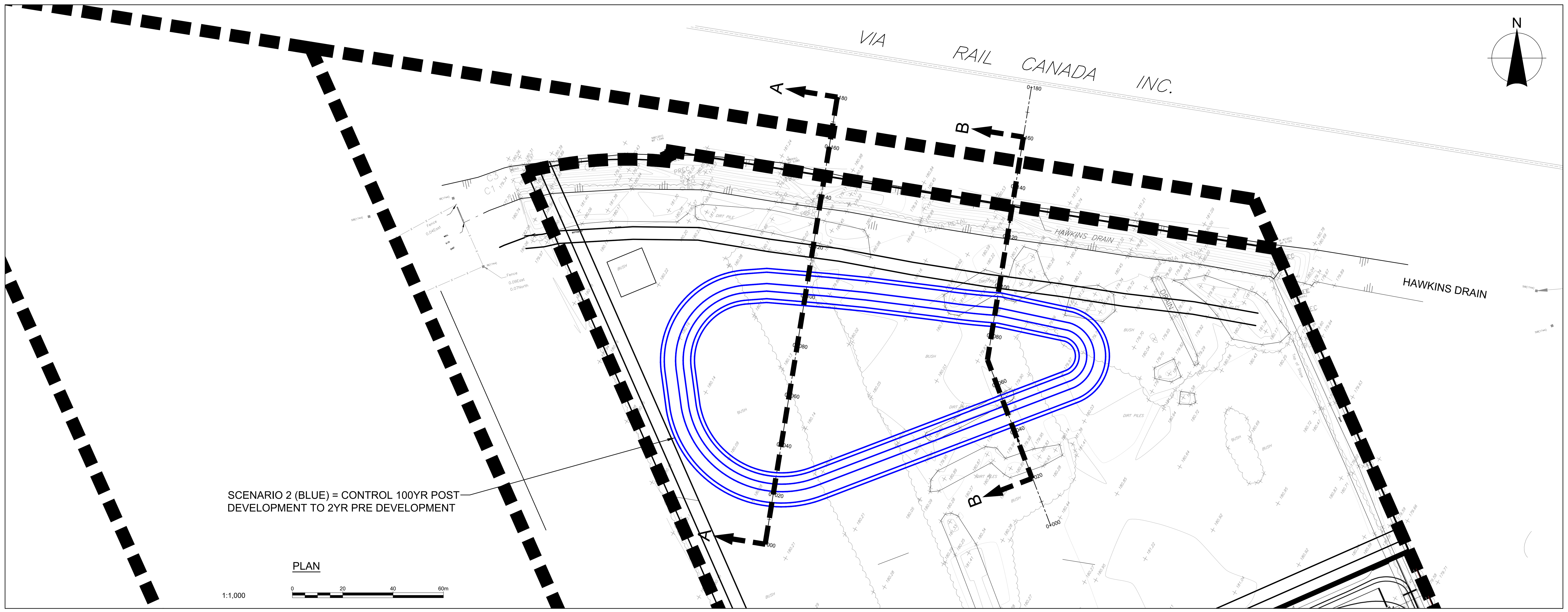
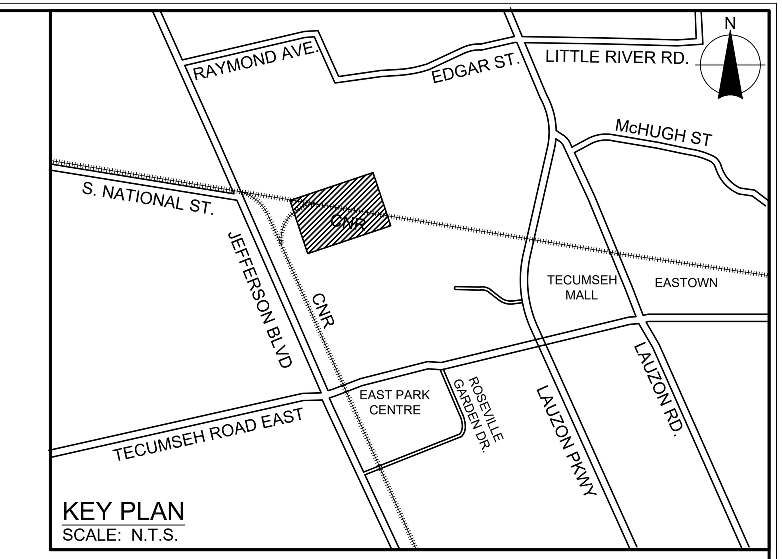
Client
ROCK DEVELOPMENTS INC.

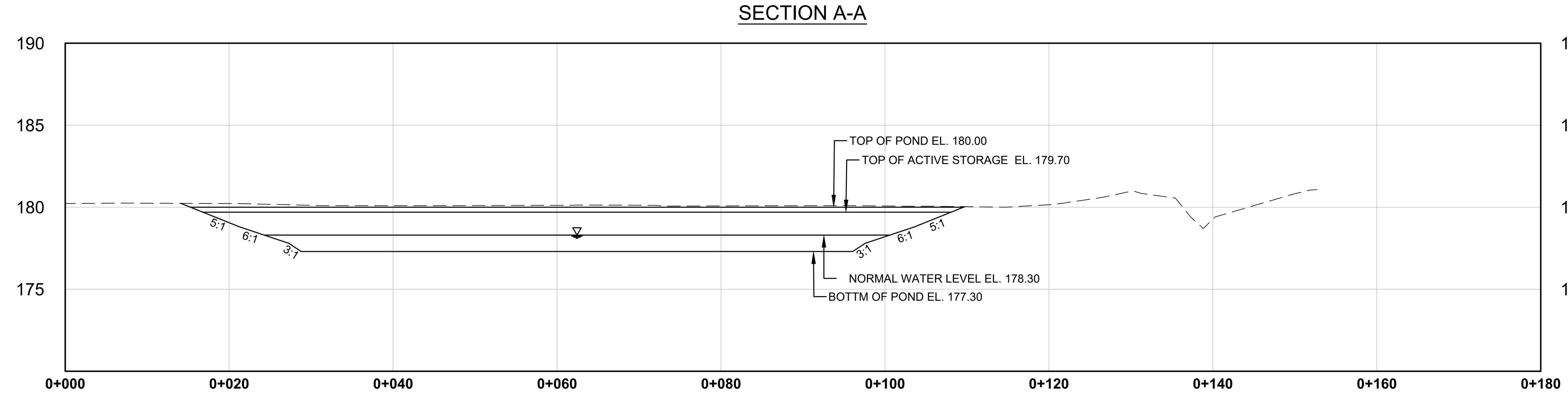
Drawing Title
CITY OF WINDSOR, FOREST GLADE NORTH PLANNING AREA
CONCEPTUAL REGIONAL SWM POND SCENARIO 1- HAWKINS DRAIN

Drawn	Checked	Designed	Checked	Date	Drawing No.
M.Z.	H.F.	H.B.	H.F.	24/12/04	FIG-1
Project No. 300058184		Contract No.		Revision No. 2	
Scale					

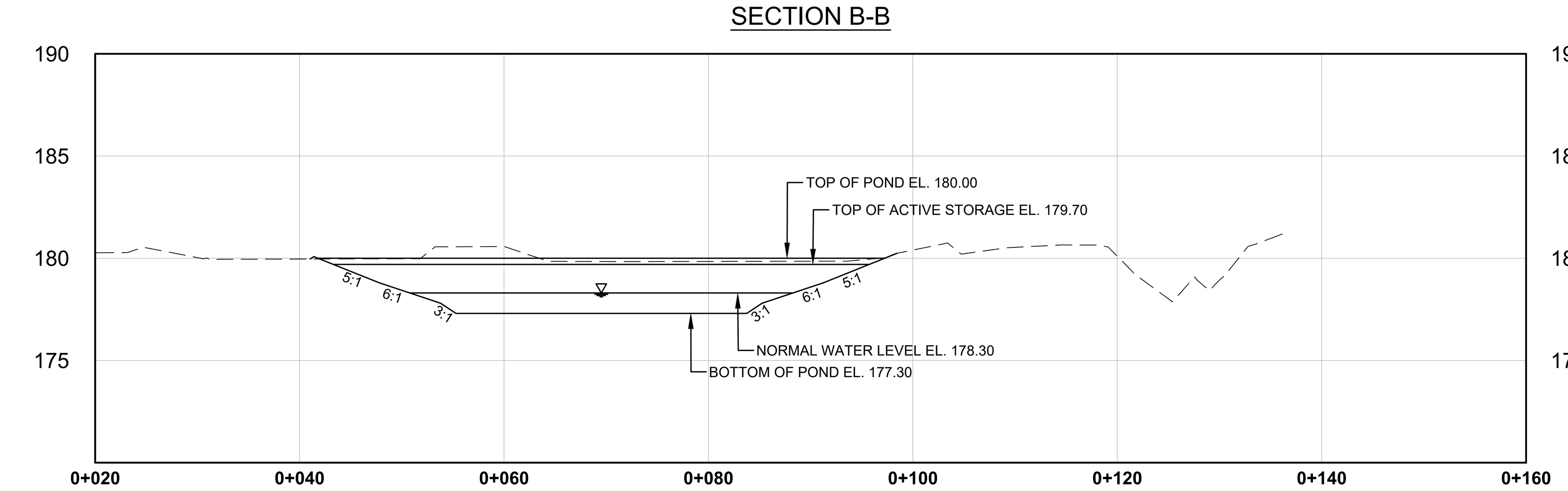




SECTION A-A



SECTION B-B



SECTIONS

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1:250 VER. 0 5.0 10.0 15.0m

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Drawing Title
CITY OF WINDSOR, FOREST GLADE NORTH PLANNING AREA
CONCEPTUAL REGIONAL SWM POND SCENARIO 2 - HAWKINS DRAIN

Drawn	Checked	Designed	Checked	Date	Drawing No.
M.Z.	H.F.	H.B.	H.F.	24/12/04	FIG-2
Project No. 300058184		Contract No.		Revision No. 2	
Scale					

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