MESP Supplementary Information Report
4134 16th Avenue Residential Development

Prepared for:
Sixteenth Land Holdings Inc.

Prepared by:
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Markham ON L3R 0B8

Project No.: 160622264

April 2018

Revision	Description	Author		Quality Check		Independent Review	
0	1st Sub.	2018-04	AP	2018-04	AP	2018-04	BJ

Sign-off Sheet

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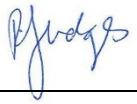
Prepared by  _____

(signature)

Amber Palmer, P.Eng.
Senior Associate, Water Resources

Reviewed by  _____

(signature)

Bob Judges
Senior Associate

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1.0 INTRODUCTION

1.1 PURPOSE

Sixteenth Land Holdings Inc. has retained Stantec Consulting Ltd. (Stantec) to prepare a Supplementary Information Report (SIR) subsequent to the October 2017 Master Environmental and Servicing Plan (MESP) and Functional Servicing and Stormwater Management Report (FSR) prepared in support of the Official Plan Amendment ("OPA") for the inclusion of lands owned by Sixteenth Land Holdings Inc. referred herein as the Subject Property into the current Markham Official Plan and in support of two draft plan of subdivision applications. The SIR provides supplementary information to support plan changes in response to preliminary comments provided by City of Markham Staff based on their review of the September 2017 draft plans and supporting documents.

This report will provide additional information on the following items:

- External Sanitary Drainage and Sewer alignment through the West Draft Plan
- External Church Sanitary Servicing Connection
- Servicing Blocks and Servicing Corridors
- Modified Right-of-Ways
- Laneways
- Overall Grading Plan
- Tree Preservation and Grading
- Angus Glen Boulevard Intersection
- SWM Pond 1 & 4 Blocks
- SWM Pond Drying Areas
- Low Impact Development (LID) Strategy
- Trails

The property is municipally known as 4134 16th Avenue, in the City of Markham, Region of York. The property is located in Part lots 16, 17 and 18, Concession 5. Except for an area adjacent to Kennedy Road, the balance of the property is currently used by its former owner York Downs Golf & Country Club for a golf course.

The current golf course use has been in operation since York Downs Golf & Country Club opened on site in the early 1970s. The current Official Plan designation of 'Private Open Space' for the areas outside of the valleylands reflects this historic golf course use.

Sixteenth Land Holdings Inc. intends to develop the property for a residential community and is submitting an OPA to redesignate the developable portion of the property from 'Private Open Space' to appropriate urban residential designations to permit the development of residential uses.

This report has been prepared in conjunction with the OPA application in support of the redesignation as proposed in the draft OPA and in the Planning Report (Gatzios Planning, August 2016 and revised October 2017). Please refer to the draft OPA and to the Planning Report for a description of the proposed Official Plan land use designations proposed for the property.

1.2 STUDY AREA

The property is municipally known as 4134 16th. Avenue, in the City of Markham, Region of York. The property is located in Part lots 16, 17 and 18, Concession 5. Except for an area adjacent to Kennedy Road, the balance of the property is currently used by its former owner York Downs Golf & Country Club for a golf course.

The property is a total of 168.64 hectares (416.72 acres) and is located on the north side of 16th. Avenue, on the west side of Kennedy Road, and has a small amount of frontage onto the east side of Warden Avenue as well. There is existing residential development surrounding the property on all sides. The location of the Subject Property is illustrated on **Figure 1.1**.

Berczy Creek traverses the western portion of the property, and Bruce Creek traverses the property in a roughly north / south direction, bisecting the property into west and east tableland areas.

1.3 PROPOSED PLAN

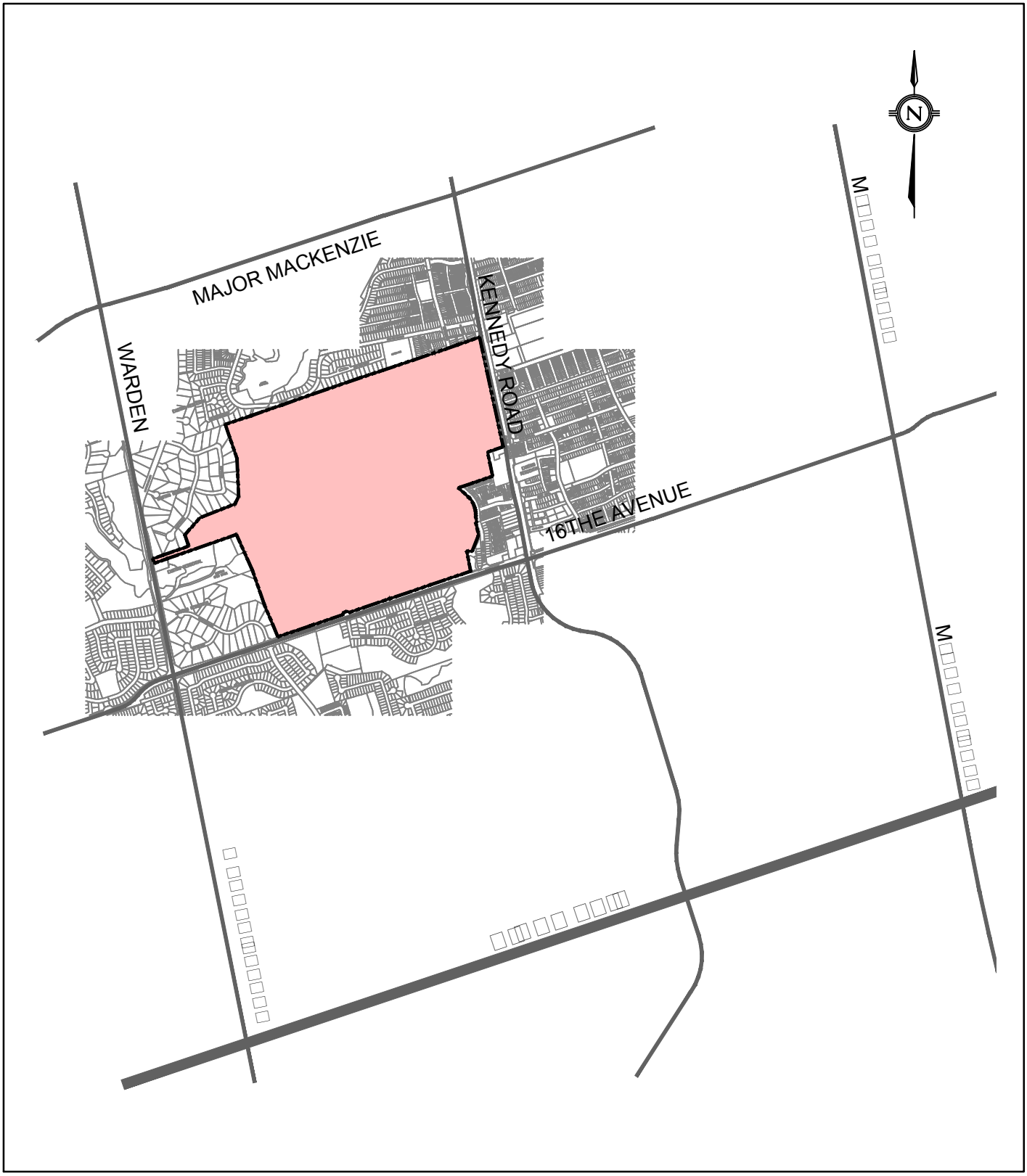
The proposed residential development is detailed in the two draft plan of subdivision applications that accompany this OPA application. There is one draft plan of subdivision for the east portion of the property and one for the west portion of the property, both draft plans are dated April 6,2018. The west draft plan of subdivision contains the valleylands associated with both Berczy Creek and Bruce Creek. References in this report to the two draft plans or to specific

lots / blocks within each, will include 'East' or 'West' to denote the appropriate area. **Figure 1.2** illustrates the development plan for the Subject Property.

The East draft plan of subdivision contains a mix of residential, open space blocks, elementary school block, parks, and SWM ponds.

The West draft plan of subdivision contains a mix of residential, mixed use, open space blocks, parks, and SWM ponds.

The OPA application was submitted in September 2016. Comments were received from the City of Markham on March 13, 2017 and May 10, 2017, Toronto and Regional Conservation Authority on May 10, 2017, Region of York on March 1, 2017 and a subsequent email from Region of York on May 10, 2017 and York Region District School Board on February 16, 2017. In October 2017, Supporting Reports and drawings were updated to reflect the revised draft plans and address agencies comments. Preliminary comments have been received from City of Markham on the 2017 submission and Draft Plans. This report and appended drawings have been updated to reflect the revisions to the draft plans and address the preliminary comments provided by the City.



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

Legend

SUBJECT PROPERTY

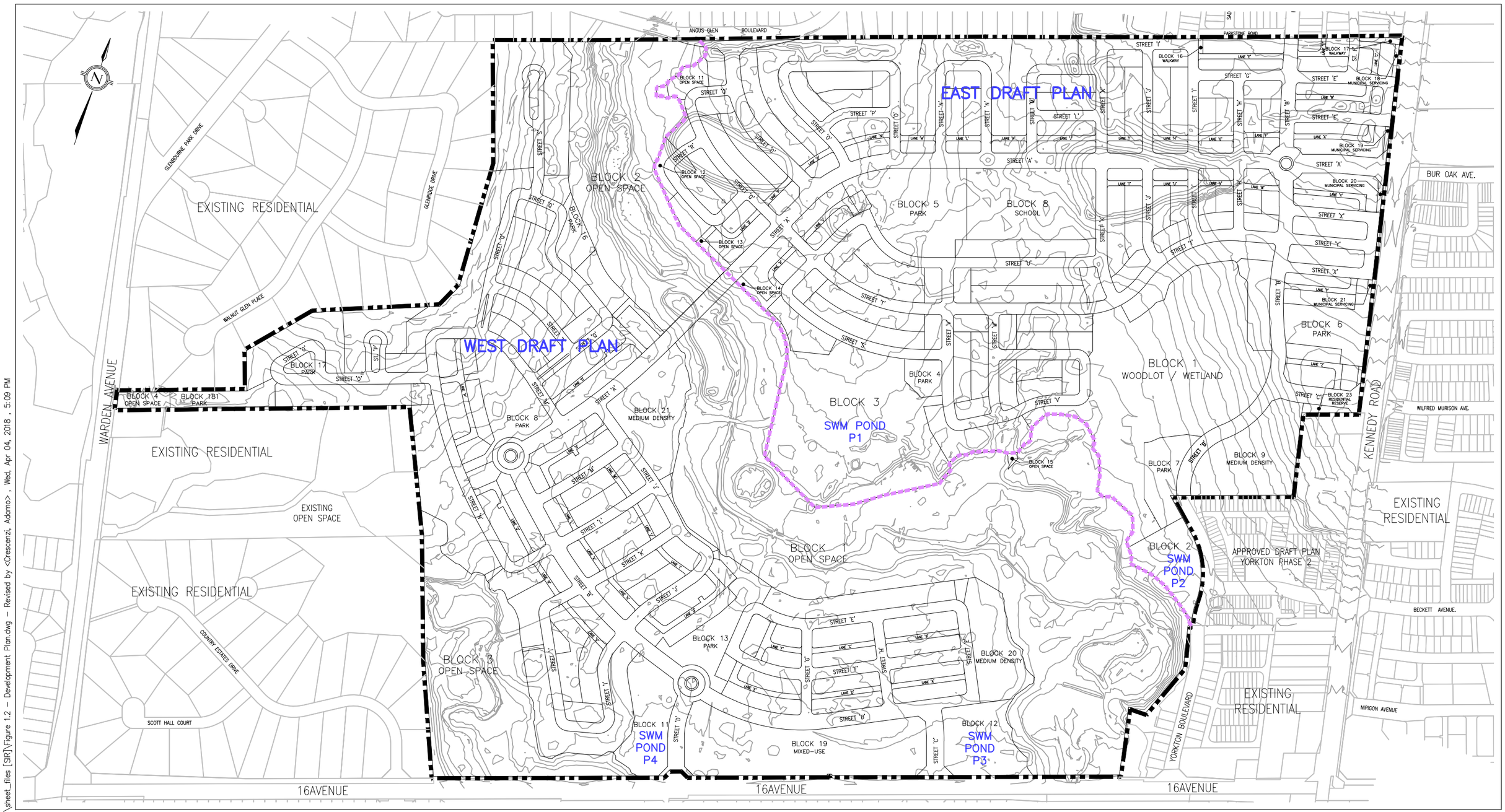
SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE

LOCATION PLAN
FOR SUBJECT PROPERTY

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 1.1 – Location Plan.dwg – Revised by <Crescenzi, Adamo> , Wed, Apr 04, 2018 , 5:08 PM



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 60 120 180 240 300

1:6000

Legend

SUBJECT PROPERTY

DIVIDE BETWEEN WEST AND EAST DRAFT PLANS

SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 1.2

DEVELOPMENT PLAN FOR SUBJECT PROPERTY

April 2018

File: V:\01606\Active\16062264\Drawing sheet_files [SIR]\Figure 1.2 – Development Plan.dwg – Revised by <Crescenzi, Adamo> , Wed, Apr 04, 2018 , 5.09 PM

2.0 SERVICING

2.1 EXTERNAL SANITARY DRAINAGE AND SEWER THROUGH WEST DRAFT PLAN

An existing external sanitary trunk is located within Angus Glen Boulevard flowing east under Bruce Creek through Royal Troon Crescent and into the existing 750 mmø trunk sanitary sewer located within an easement in the East Draft Plan. This sewer then connects to Yorkton Boulevard and ultimately connects into the 2100 mmø YDSS sanitary trunk sewer along 16th Avenue within Yorkton Boulevard (east of the Subject Property).

There are several sanitary servicing options being investigated by the City of Markham. At present there are two options for dealing with the existing sanitary syphon system located at the Angus Glen Boulevard crossing of Bruce Creek. Option 1 will maintain the siphon for original design flow, and divert some of the flow south through the West Draft Plan, whereas Option 2 will decommission the siphon (at some point in the future) and divert all of the flow through the West Draft Plan. Either option requires a separate deep sanitary trunk sewer (> 5m depth from road to obvert through the Subject Lands). For either option, a sanitary pipe is proposed within the existing buffer block parallel to Bruce Creek from Angus Glen Boulevard into Servicing Block 10W within the West Draft Plan and ultimately through the proposed road network. This separate sewer network would require a second connection into the 2100 mmø YDSS sanitary trunk sewer along 16th Avenue at the Street "D" West. This connection could be a "drop in" type connection to the YDSS. If all flows are diverted through the West Draft Plan (Option 2), the preliminary sewer size would be a 675 mm (possibly 750 mm). **Figure 2.1** illustrates a conceptual alignment of the external sanitary sewer through the West Draft Plan. **Figure 2.2** illustrates a preliminary 17m road right-of-way section with separate systems for the deep external sanitary sewer and shallow local sanitary sewers, confirming that the right of way is a sufficient size to have a separate system if required.

Consistent with the 2017 SGR, sanitary flows from the West Draft Plan and a portion of the East Draft Plan will be serviced by a local sanitary sewer system connecting to the 2100 mmø YDSS sanitary trunk sewer along 16th Avenue at Street "C" West.

2.2 EXTERNAL SANITARY DRAINAGE FROM EXISTING CHURCH THROUGH EAST DRAFT PLAN

A sanitary service connection from the existing Church property fronting Kennedy Road will be provided through Block 9E (Medium Density) to Street "B" East. The alignment of this service connection will be finalized at detailed design through the site plan process for Block 9E. The servicing connection was illustrated in **Figure 5.3** in the October 2017 FSR.

2.3 SERVICING BLOCKS AND SERVICING CORRIDORS WITHIN PARKS

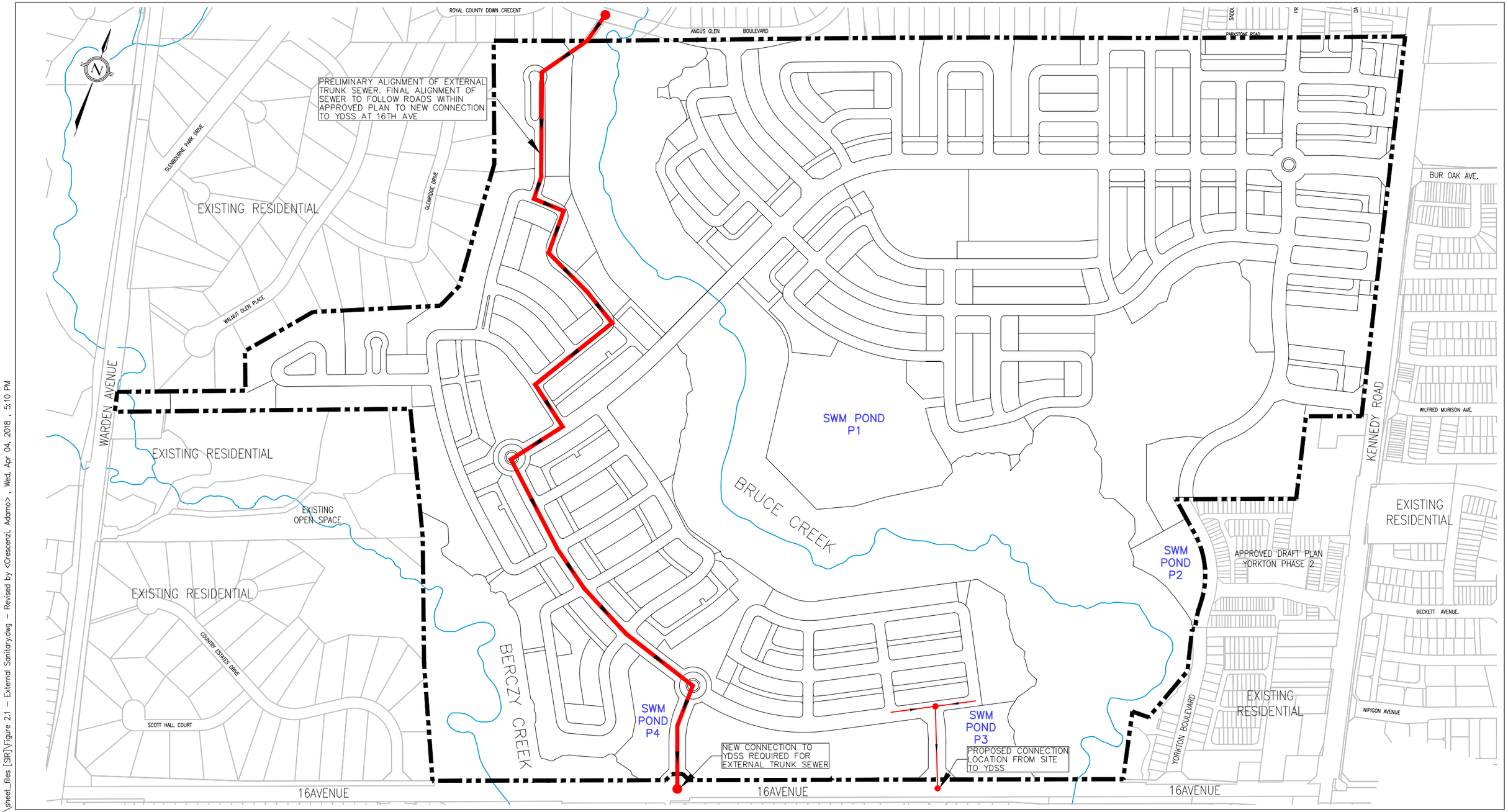
Servicing blocks and servicing corridors within parks are proposed throughout the plan. The different servicing blocks and corridors include the following:

- **Figure A1**: 6.0 m Servicing Block for lots fronting Kennedy Road
- **Figure A2**: 9.0 m Servicing Corridor for lots fronting park blocks (Block 5E, 6E, 13W, 14W, 15W) and lots fronting Bruce Creek Valley with 3 pipes

Servicing Block and corridor sections are provided in **Appendix A**.

2.3.1 Townhouse Unit Servicing

In support of the reduced frontage townhouse units within the East Draft Plan, a preliminary servicing layout was completed for Street "I" and Street "Y" to show that sidewalks, utilities, servicing leads, fire hydrants, light poles, and street trees fit within the right-of-way. **Figure 2.3** illustrates Street "I" servicing layout, and **Figure 2.4** illustrates Street "Y".



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 60 120 180 240 300

1:6000

Legend

- SUBJECT PROPERTY
- PROPOSED EXTERNAL SANITARY SEWER
- PROPOSED SANITARY SEWER

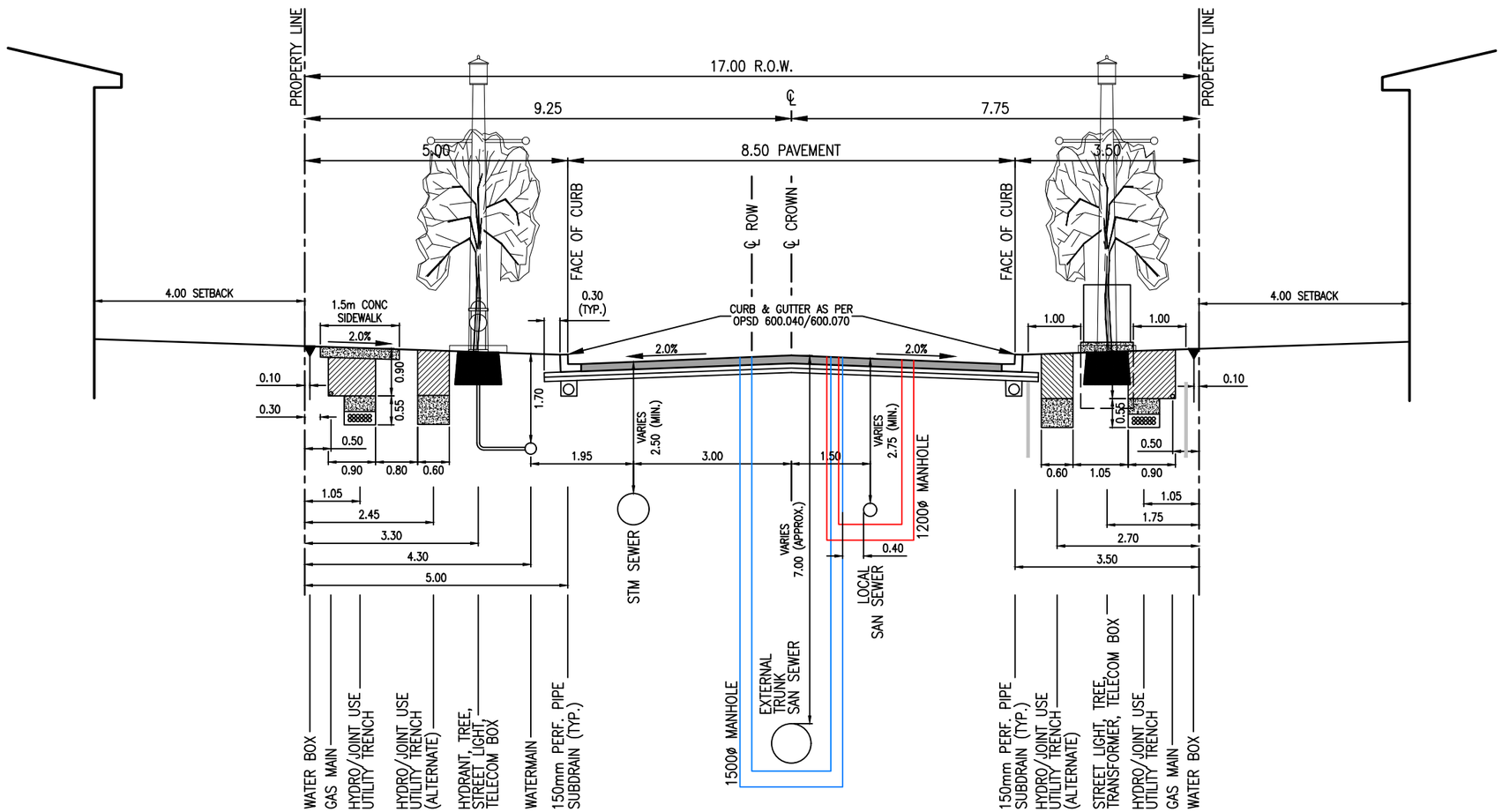
SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 2.1

CONCEPTUAL ALIGNMENT OF EXTERNAL SANITARY SEWER

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 2.1 – External Sanitary.dwg – Revised by <Crescenzi, Adamo> , Wed, Apr 04, 2018 , 5:10 PM



17.0m STREET

NOTES:

1. TYPICAL MINIMUM DEPTH OF UTILITY CROSSINGS SHALL BE 1.0M (TO CLEAR SUBDRAINS).
2. FOR SANITARY AND STORM SEWERS IN COMMON TRENCH, THE MINIMUM HORIZONTAL CLEARANCE BETWEEN THE PIPES SHALL BE 1.0m
3. THIS STANDARD IS A MODIFIED VERSION OF TOWN STANDARD MR3.

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BEACON ENVIRONMENTAL

BURNSIDE

1:100 0 1 2 3 4 5

Legend

SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 2.2

17.0m MODIFIED ROW w/ LOCAL AND EXTERNAL SANITARY SEWER

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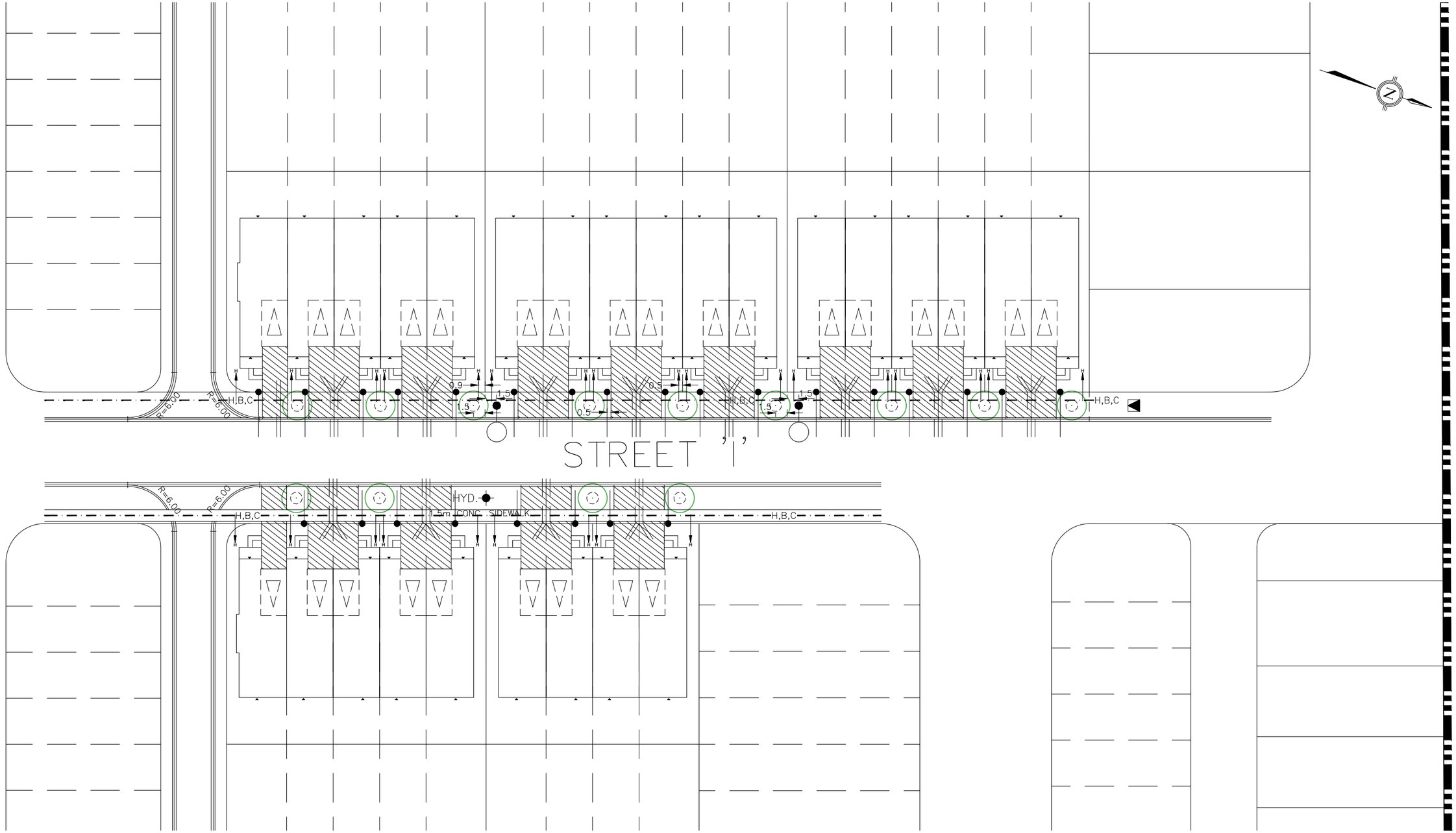
File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 2.2 – 17.0m Modified ROW.dwg – Revised by <Crescenzi, Adamo> , Wed, Apr 04, 2018 , 5:12 PM



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BEACON ENVIRONMENTAL

BURNSIDE

0 5 10 15 20 25

1:500

Legend

- SUBJECT PROPERTY
- STREET TREE
  1.0m OFFSET FROM TRUNK
- STREET LIGHT
- HYDRO SERVICE
- WATER SERVICE
- HYD. HYDRANT & VALVE
- H,B,C JOINT UTILITY TRENCH
- HYDRO TRANSFORMER
- DUAL STORM/SANITARY SERVICE
- SINGLE STORM/SANITARY SERVICE

SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

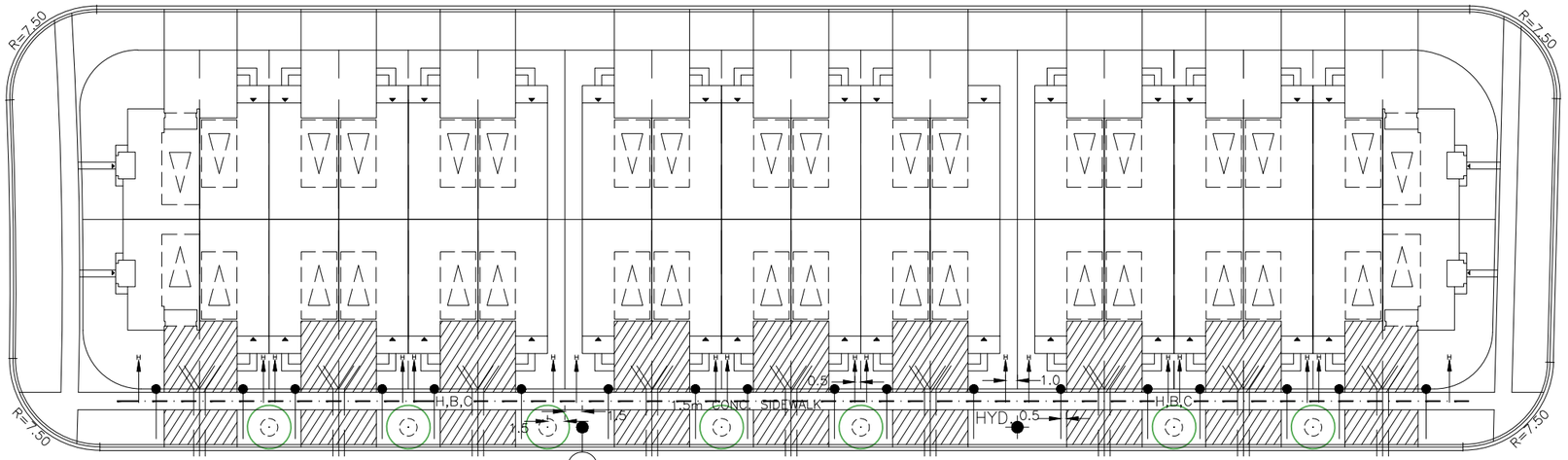
FIGURE 2.3

STREET I SERVICING LAYOUT

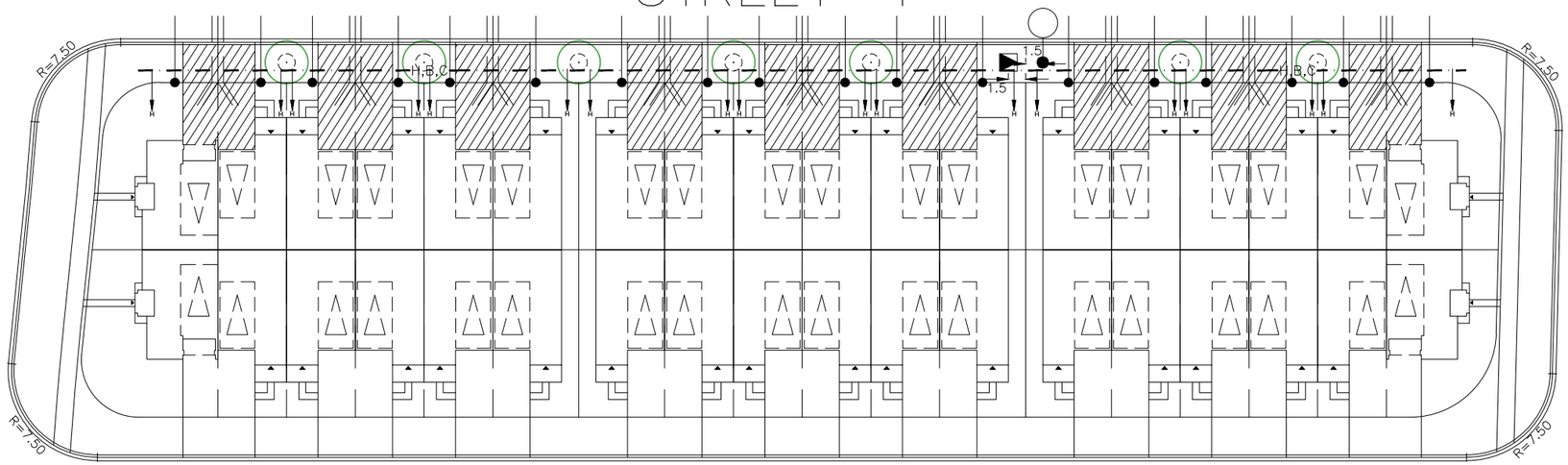
April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 2.3 – Street I Servicing.dwg – Revised by <Luk, James> , Thu, Apr 05, 2018 , 1:16 PM

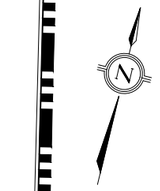
STREET 'X'



STREET 'Y'



STREET 'X'



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 5 10 15 20 25

1:500

Legend

- SUBJECT PROPERTY
- STREET TREE
- 1.0m OFFSET FROM TRUNK
- STREET LIGHT
- HYDRO SERVICE
- WATER SERVICE
- HYD. HYDRANT & VALVE
- H,B,C JOINT UTILITY TRENCH
- HYDRO TRANSFORMER
- DUAL STORM/SANITARY SERVICE
- SINGLE STORM/SANITARY SERVICE

SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 2.4

STREET Y SERVICING LAYOUT

April 2018

3.0 RIGHT-OF-WAY CROSS-SECTIONS

It is proposed that the current City of Markham standard road cross-sections are used including:

- 17.0 m RESIDENTIAL LOCAL ROAD [sidewalk one side – MARKHAM DRAWING MR3]
- 18.5 m RESIDENTIAL LOCAL ROAD [sidewalk both sides – MARKHAM DRAWING MR4]
- 23.0 m RESIDENTIAL COLLECTOR ROAD [one side parking and shared bike route – MARKHAM DRAWING MR6]
- 8.5 m and 10.0 m RESIDENTIAL LANE [MARKHAM DRAWING MR10] – only for lanes with lots fronting onto park blocks and open space blocks will implement MR10 (laneways that this standard applies are highlighted on **Figure 3.1**).

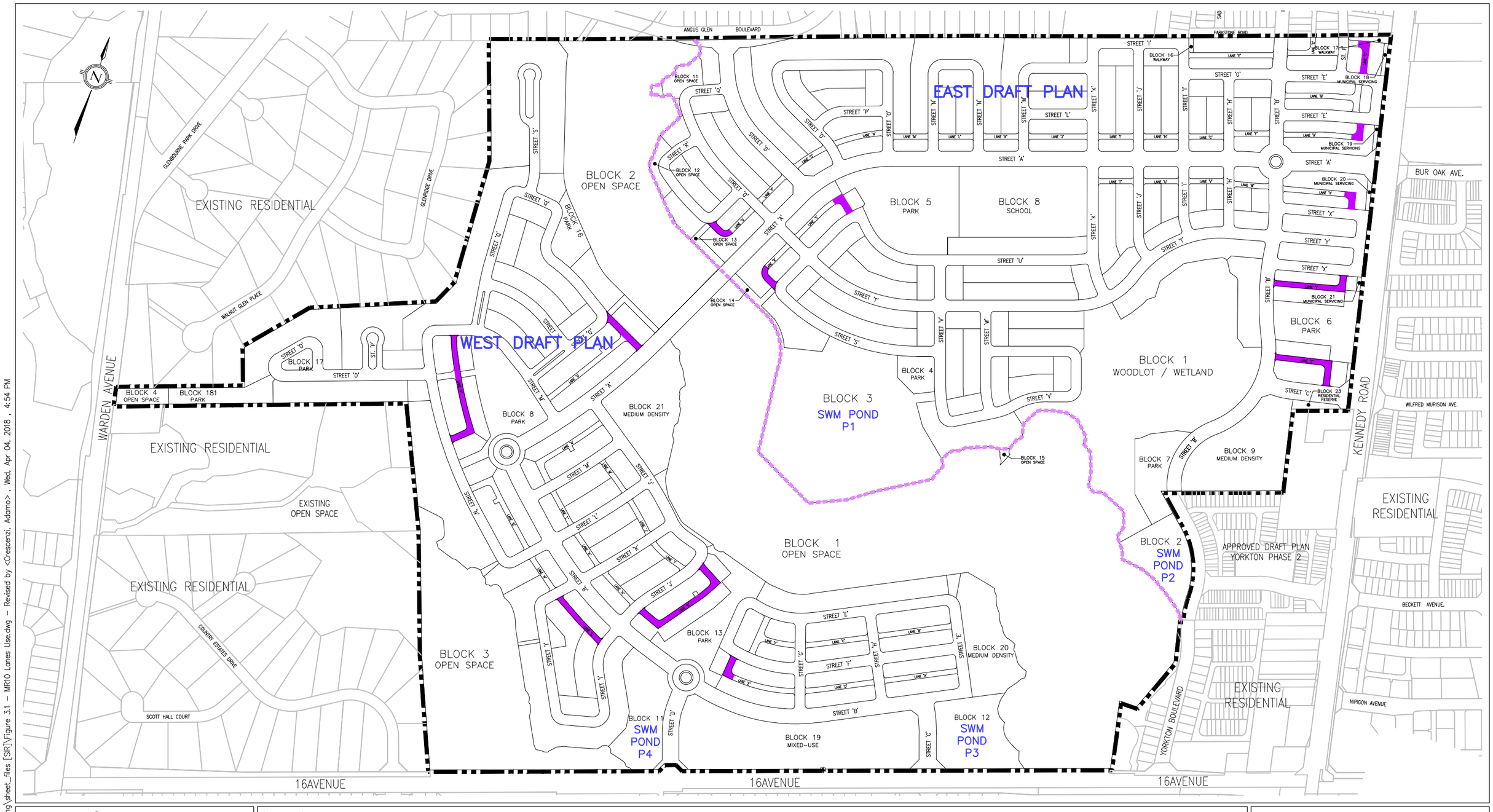
The following exceptions to the City standards are:

- **Figure B1**: Modified 8.5 m and 10.0 m RESIDENTIAL LANE [Stantec detail of MARKHAM DRAWING MR10A* - modified with larger pavement width as requested by City staff] – to be applied to all lanes except for lanes highlighted on **Figure 3.1**
- **Figure B2:** Modified 24.5 m RESIDENTIAL COLLETOR ROAD [Stantec detail of MARKHAM DRAWING MR7 – modified with a multi-use path (MUP) and/or sidewalk in each boulevard]
- **Figure B3:** 32.5 m RESIDENTIAL ENCLAVE CUL-DE-SAC [updated Stantec detail per 2017 SGR with bioretention island]
- **Figure B4:** 23.0 m RESIDENTIAL COLLECTOR ROAD [Stantec detail per 2017 SGR with one side parking and on road bike lanes for Street "B" East]

Modified right-of-way sections are provided in **Appendix B**.

3.1 LANE LENGTHS

Some of the proposed lanes within the Subject Property exceed the City standard of 120 m. Based on discussions with City staff, additional snow storage areas are required for lanes that exceed this length. There are 4 lanes (G, N, O, Q) within the West Draft Plan that include snow storage areas (7.0 m x 7.4 m).



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 60 120 180 240 300

1:6000

Legend

- SUBJECT PROPERTY
- DIVIDE BETWEEN WEST AND EAST DRAFT PLANS
- 8.5m AND 10m LANES WITH UTILITIES (MR10 ONLY 5.5m PAVEMENT)
- ALL OTHER 8.5m AND 10m LANES ARE WITHOUT UTILITIES (MR10A* MODIFIED, SEE FIGURE B1)

SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 3.1

LANES USING CITY STANDARD MR10 (UTILITIES)

April 2018

File: V:\01606\Active\160622264\Drawing sheet_files [SIR]\Figure 3.1 – MR10 Lanes Use.dwg – Revised by <Crescenzi, Adamo> , Wed, Apr 04, 2018 , 4:54 PM

4.0 GRADING

4.1 OVERALL GRADING

Drawing 4.1 replaces Drawing 5.1 within the SGR of the MESP. This plan reflects the revised draft plans and the surrounding boundary conditions including existing roads, existing Bruce Creek and Berczy Creek valley features, existing natural features, and existing adjacent developments.

This updated grading plan generally conforms to the 2017 SGR grading design thereby ensuring the proposed drainage boundaries throughout the Subject Lands remain the same. Therefore, updates to the hydrology modeling, pipe sizing, and pond block sizing are not necessary.

4.2 GRADING AND TREE PRESERVATION

4.2.1 Park Block 15 West

The proposed plan has relocated Park Block 15W in an effort to preserve an existing linear hedgerow of significant trees. **Figure 4.2** is a preliminary grading plan illustrating the proposed grades of the surrounding roads and lots matching into the existing grades at the tree protection zone (TPZ) limit. A TPZ of an 11m radius was used for all trees within this hedgerow based on the TPZ for the largest tree. This grading plan confirms that preservation of these trees is feasible, with more details to be provided at detailed design.

4.2.2 Street "O" West (abutting Glenburn Townhouses)

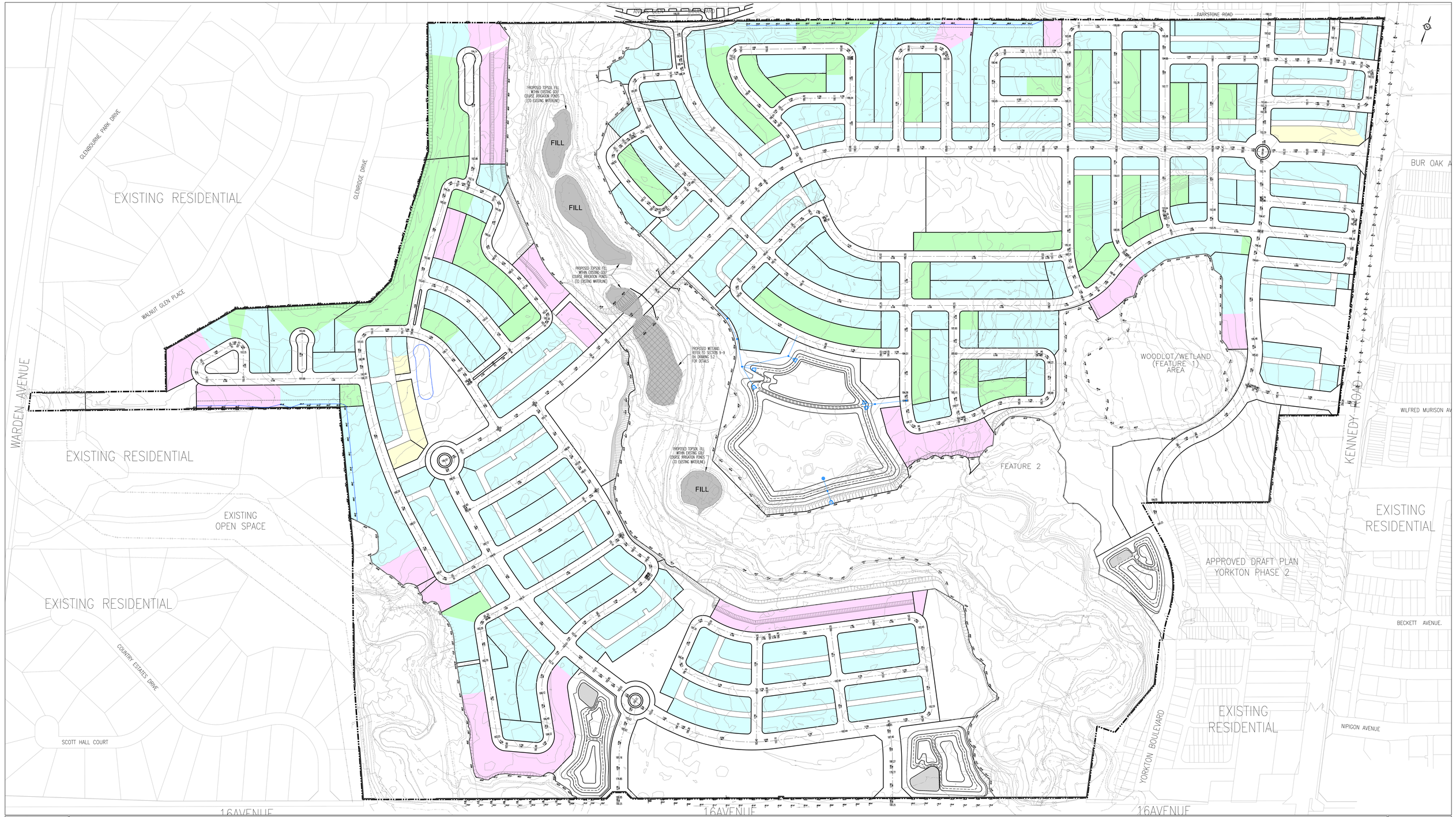
For lots located along Street "O" West, additional lot depth has been provided (from 31 m to 35 m) to maintain existing grades at the back of lot allowing for tree preservation along the fence line. **Figure 4.3** is a preliminary grading plan illustrating the existing and proposed grades, existing trees within a TPZ area, and rear yard setbacks.

4.2.1 Rear Lots abutting North Property Line East

For lots located along Street "M" and "N" and "O" East, additional lot depth has been provided (from 31 m to 3 5m) to maintain existing grades at the back of lot allowing for tree preservation along the fence line. **Figure 4.4** and **4.5**is a preliminary grading plan illustrating the existing and proposed grades, existing trees within a TPZ area, and rear yard setbacks.

4.3 INTERSECTION OF STREET "D" EAST AND ANGUS GLEN

The revised draft plan proposes a modified intersection of Street "D" East and Angus Glen Boulevard. **Figure 4.5** shows an illustrative plan with a laneway introduced at the edge of the existing north curb limit of Angus Glen Boulevard along with a landscaped island complete with pedestrian walkways. The main roadway for Angus Glen Boulevard has been shifted south to accommodate the laneway and island. A detailed grading and servicing design for this intersection will be provided at detailed design.



Stantec
BEACON ENVIRONMENTAL
BURNSIDE

1:500

Legend

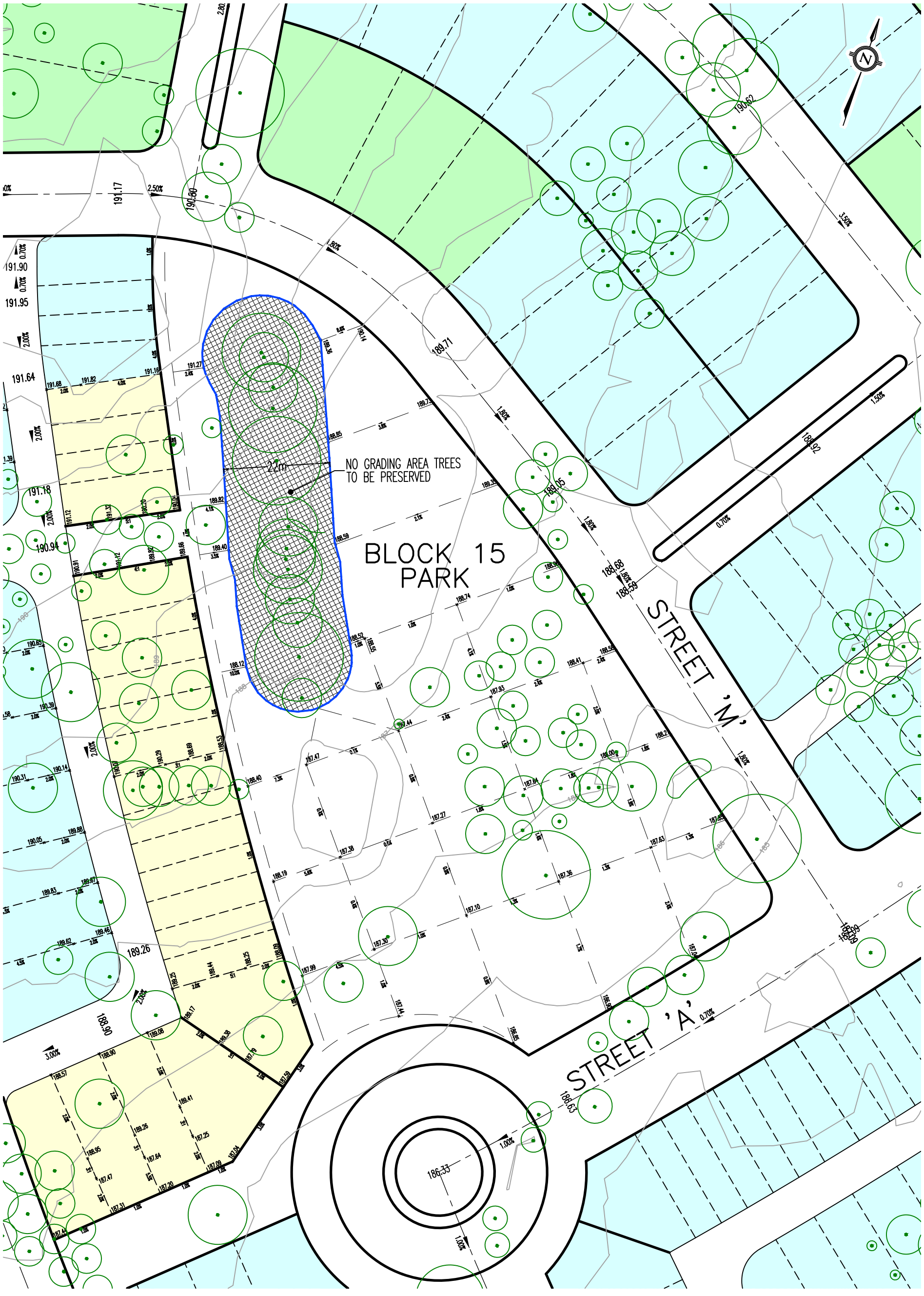
- SUBJECT PROPERTY
- LIMIT OF PROPOSED GRADING
- LIMIT OF OPTIONAL CUT GRADING DESIGN
- 182.65 PROPOSED ELEVATION
- 1.5% PROPOSED SLOPE
- 182.65 EXISTING ELEVATION
- PROPOSED TOPSOIL FILL WITHIN GOLF COURSE IRRIGATION PONDS
- PROPOSED 3:1 SLOPE
- PROPOSED DRAINAGE DIRECTION (2.0% - 30%)
- PROPOSED BACK SPLIT DRAIN LOT
- PROPOSED FRONT DRAINING LOT
- PROPOSED FRONT WALKOUT LOT
- PROPOSED REAR WALKOUT LOT

SUPPLEMENTAL INFORMATION REPORT (SIR)
E/LM 16TH AVENUE
RESIDENTIAL DEVELOPMENT

DRAWING 4.1
GRADING PLAN

April 2016

File: N:\21606\Active\216062204\Drawing\sheet_files [SIR]\Figure 4.0 - Grading.dwg - Plotted by: Giovanni, Adamo - Fri, Apr 08, 2016 - 3:09 PM



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

1:750 0 7.5 15 22.5 30 37.5

Legend

182.65	PROPOSED ELEVATION
0.70%	PROPOSED SLOPE
182.65	EXISTING ELEVATION
	PROPOSED 3:1 SLOPE
	PROPOSED DRAINAGE DIRECTION (2.0% – 3.0%)
	REAR YARD SETBACK LIMIT
	LIMIT OF GRADING FOR TREE PRESERVATION
	NO GRADING AREA TREES TO BE PRESERVED

SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 4.2

PRELIMINARY GRADING OF BLOCK 15W

April 2018

File: V:\0160\Active\160622264\Drawing\sheet_files [SIR]\Figure 4.0 – Grading.dwg – Revised by <Crescenzi, Adamo> , Fri, Apr 06, 2018 , 3:06 PM

STREET 'O'

STREET 'P'

STREET 'N'

END OF WALL

RETAINING WALL

WALL HEIGHT = 3.13m

WALL HEIGHT = 3.32m

WALL HEIGHT = 2.33m

WALL HEIGHT = 2.22m

WALL HEIGHT = 1.82m

END OF WALL

REAR YARD SETBACK

1.5m

MAINTAIN EX.GRADES

LIMIT OF GRADING FOR TREE PRESERVATION

MAINTAIN EX.GRADES

NO GRADING AREA TREES TO BE PRESERVED

MAINTAIN EX.GRADES

EXISTING OPEN SPACE

Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 7.5 15 22.5 30 37.5

1:750

Legend

182.65 PROPOSED ELEVATION

0.70% PROPOSED SLOPE

182.65 EXISTING ELEVATION

PROPOSED 3:1 SLOPE

PROPOSED DRAINAGE DIRECTION (2.0% – 3.0%)

REAR YARD SETBACK LIMIT

LIMIT OF GRADING FOR TREE PRESERVATION

NO GRADING AREA TREES TO BE PRESERVED

SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 4.3

PRELIMINARY GRADING OF STREET 'O' WEST

April 2018

ANGUS GLEN BOULEVARD

EDGE OF VEGETATION

LIMIT OF GRADING FOR TREE PRESERVATION

NO GRADING AREA TREES TO BE PRESERVED

EXISTING RESIDENTIAL

REAR YARD SETBACK

STREET 'O'

STREET 'P'

STREET 'N'

Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 7.5 15 22.5 30 37.5

1:750

Legend

182.65	PROPOSED ELEVATION
0.70%	PROPOSED SLOPE
182.65	EXISTING ELEVATION
	PROPOSED 3:1 SLOPE
	PROPOSED DRAINAGE DIRECTION (2.0% – 3.0%)
	REAR YARD SETBACK LIMIT
	LIMIT OF GRADING FOR TREE PRESERVATION
	NO GRADING AREA TREES TO BE PRESERVED

SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 4.4

PRELIMINARY GRADING OF STREET 'O' EAST

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 4.0 – Grading.dwg – Revised by <Crescenzi, Adamo>, Fri, Apr 06, 2018, 3:04 PM

EXISTING RESIDENTIAL

LIMIT OF GRADING FOR TREE PRESERVATION

NO GRADING AREA TREES TO BE PRESERVED

REAR YARD SETBACK

STREET 'N'

STREET 'M'

STREET 'L'

STREET 'K'

STREET 'N'

STREET 'M'

Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 7.5 15 22.5 30 37.5

1:750

Legend

182.65 PROPOSED ELEVATION

0.70% PROPOSED SLOPE

182.65 EXISTING ELEVATION

PROPOSED 3:1 SLOPE

PROPOSED DRAINAGE DIRECTION (2.0% – 3.0%)

REAR YARD SETBACK LIMIT

LIMIT OF GRADING FOR TREE PRESERVATION

NO GRADING AREA TREES TO BE PRESERVED

SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 4.5

PRELIMINARY GRADING OF STREET 'N' & 'M' EAST

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 4.0 – Grading.dwg – Revised by <Crescenzi, Adamo> , Fri, Apr 06, 2018 , 3:03 PM

Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 7.5 15 22.5 30 37.5

1:750

Legend

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FIGURE 4.6

PRELIMINARY INTERSECTION OF ST. 'D' & ANGUS GLEN BLVD

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 4.0 – Grading.dwg – Revised by <Crescenzi, Adamo> , Fri, Apr 06, 2018 , 3:03 PM

5.0 STORMWATER MANGEMENT

5.1 SWM POND 1, 3 & 4

Pond Blocks 11W (Pond 4), 12W (Pond 3) and 3E (Pond 1) have been adjusted for a modified road and lot layout. Pond Block 11 W (Pond 4) is larger than the 2017 draft plan and is therefore sufficiently sized. Pond Block 12W (pond 3) is 1.357 ha (compared to 1.379 ha the 2017 draft plan) and continues to be sufficiently sized. Pond Block 3 E (Pond 1) is 5.762 ha (compared to 5.782 ha in the 2017 draft plan) and continues to be sufficiently sized. Pond Block 2 (Pond 2) remains the same. Calculations summarizing the available and required storage volumes for each pond are provided in **Appendix C**. Since the required volumes are available within the pond blocks, modeling updates are not needed until detailed design.

The proposed grading for Pond 1 along the valley interface remains unchanged from the 2017 SGR, therefore no updates the hydraulic modeling or floodplain cut and fill are needed until detailed design.

5.2 SWM POND CLEANOUTS AND DRYING AREAS

Several meetings and discussions have been held with City staff regarding SWM Pond cleanouts and drying areas. Based on additional assessments and information circulated to staff, we recommend that the ponds for the Subject Property be cleaned out when forebay volume is 50% full. The ponds within the Subject Property have been sized to satisfy the MNRF Redside Dace checklist and as a result the permanent pool is oversized. If using the 75% TSS removal efficiency as the trigger for a cleanout, the cleanout frequencies are very long, and cleanout volumes are excessive (with forebays 100% full). Since all of the ponds outlet to RSD habitat, the pond cleanout activities are currently restricted to a 10 week window of July 1 to September 15. This window restricts the available time for mobilization, dewatering, moving material to a drying area, drying time, off site export, restoration, and demobilization all which can be impacted by rain delays. As a result, clean outs for these ponds are recommended on a more timely basis to ensure sufficient time is available to complete the necessary work within the construction window.

City staff have requested that drying areas be incorporated into the SWM Ponds. As noted in the 2003 MOECC Stormwater Management Planning and Design Manual, sediment drying areas while preferable, should only be incorporated into the design when it imposes no additional land requirements. On this basis, we reviewed the pond grading designs to see if drying areas could be incorporated without increasing the land requirements. SWM Ponds 2 to 4 are able to provide drying areas within the blocks assuming a 10 -13 year cleanout frequency (based on the 50% forebay volume cleanout method). The drying areas are sized assuming a storage height of 0.87 m (provided by temporary jersey barriers lined with filter fabric) and are set above the extended

detention water level within the blocks near the access road and draining to the forebay (where possible). Pond 1 is unable to provide a drying area without additional land. Therefore, Pond 1 requires the use of temporary containers located on the access road to dry material within the pond block, or the implementation of bypass pipes. Pond 1 bypass pipes would be sized to convey a 2 year storm, installed from inlet manhole (with sluice gates) and directed into the main cell at 0.2%, allowing the pond forebay to be off-line so it can be used as a drying area during cleanout. This design also ensures that the pond continues to provide flood control during cleanout if required.

Figure 5.1 to 5.4 illustrate the proposed grading plans for Ponds 1 to 4 incorporating bypass pipes for Pond 1 and drying areas within Ponds 2 to 4. Sediment accumulation and pond cleanout frequency calculations are included in **Appendix D**.

5.3 WATER BALANCE AND LID STRATEGY

The 2017 MESP/FSR completed a site wide Water Balance for pre-development, post-development (no mitigation), and post-development with mitigation. Several Low Impact Development (LID) measures were proposed as part of the mitigation plan. The goal of the mitigation plan was to maintain pre-development infiltration volumes on an annual basis for the Subject Property (both east and west draft plans), improve annual volumetric evapotranspiration and minimize the surplus in runoff.

The 2017 *Hydrogeological Assessment and Water Balance Report* established a unit target by setting a required depth of rain to be captured from roof tops throughout the year and infiltrated to achieve the site wide water balance. *Table 2.16* in the SGR summarized the infiltration rate targets by land use from the *Hydrogeological Assessment and Water Balance Report*. The target depth of infiltration over the Subject Property ranged from 106 to 113 mm Imp-ha/year or 2 mm Imp-ha/event.

In addition, a feature based annual water balance assessment was undertaken for the woodlot/wetland (Feature 1). This assessment calculated the annual volumetric infiltration, evapotranspiration, and runoff conditions under existing conditions based on the pre-development drainage area to the feature. A post-development water balance assessment was undertaken to ensure that surface runoff to the feature is maintained and ensure that the infiltration total is also maintained to the extent feasible (targets summarized in *Table 2.17* of the SGR).

The LID strategy presented in the 2017 MESP/FSR was able to achieve and exceed the site wide infiltration target as well as feature based infiltration and runoff targets through the implementation of following:

- Collection of clean roof water from private lots to LID's on private lots (increased top soil depths and amended soils within single or townhouse units; infiltration galleries within the medium density, high density, and mixed-use blocks). LID measures were sized for 25 mm Imp-ha/event for select areas.

- Collection of clean roof water from private lots to LID's within public lands (perforated RLC within road right-of-way, bio-retention facilities and infiltration facility within road right-of-way, infiltration galleries within park). LID measures were sized for 25 mm Imp-ha/event for select areas.

- Collection of clean roof water from private lots to the woodlot/wetland (Feature 1) and Wetland compensation "Area E," both preserved within public lands (runoff provided through solid RLC pipe to features). LID measures were sized for 25 mm Imp-ha/event for select areas.

5.3.1.1 City of Markham Draft Low Impact Development Guideline

In March 2018, the City of Markham released a Draft Low Impact Development (LID) Guideline. City staff requested that the proposed development application follow the draft guidelines to the extent possible.

The key principle of the LID Guideline is that "public treats public" and "private treats private." In essence, runoff from public lands (including parks, schools, pond blocks, and roads) are treated with LID's located in public lands (i.e. parks or pond blocks), and runoff from private lots are treated by private lot LID's. The City is responsible for the operations and maintenance of LID's on public lands, and private residents or companies are responsible for the operations and maintenance of LID's on private lands.

This Guideline provides a Matrix of LID types, reviewed by an inter-departmental committee that the City will consider for implementation on public lands. All LID types fall into 4 main categories; soil amendments (applicable to all areas), Group A - underground LID (infiltration gallery, soak away pit / infiltration trench), Group B - vegetated surface LID (bioretention rain garden, vegetated swale, stormwater planter, biofilter or filter strip), and Group C - Other LID (rainwater harvesting, permeable pavement, green roof, tree root support system) with a preference for Group A, followed by B and then C.

Options for additional infrastructure can be considered for sites with constraints in Park Blocks, Pond Blocks and Buffer or Open Space blocks. These constraints may limit runoff from reaching these blocks (i.e. small or no upstream drainage area) and/or have physical constraints preventing infiltration (i.e. high groundwater table). The additional infrastructure could be a separate shallow third pipe system designed to collect road drainage and direct it to an LID facility within the approved blocks, or an additional SWM LID block in a desirable location where no constraints exist, or a combination of the two options.

5.3.1.2 Feasibility Assessment of City's Draft LID Guideline

A review of the City' Draft LID Guideline was undertaken to assess the feasibility of following the draft guidelines for this application. Some of the LID measures proposed in the MESP/FSR are recommended within the draft guidelines, however there are some fundamental differences between the two strategies which may prevent this development application from following the draft LID Guideline (still to be finalized by the City).

Following the City's strategy of private lots treat private drainage, the following LID types can be implemented (individually or in combination) to satisfy the 2 mm Imp-ha/event target:

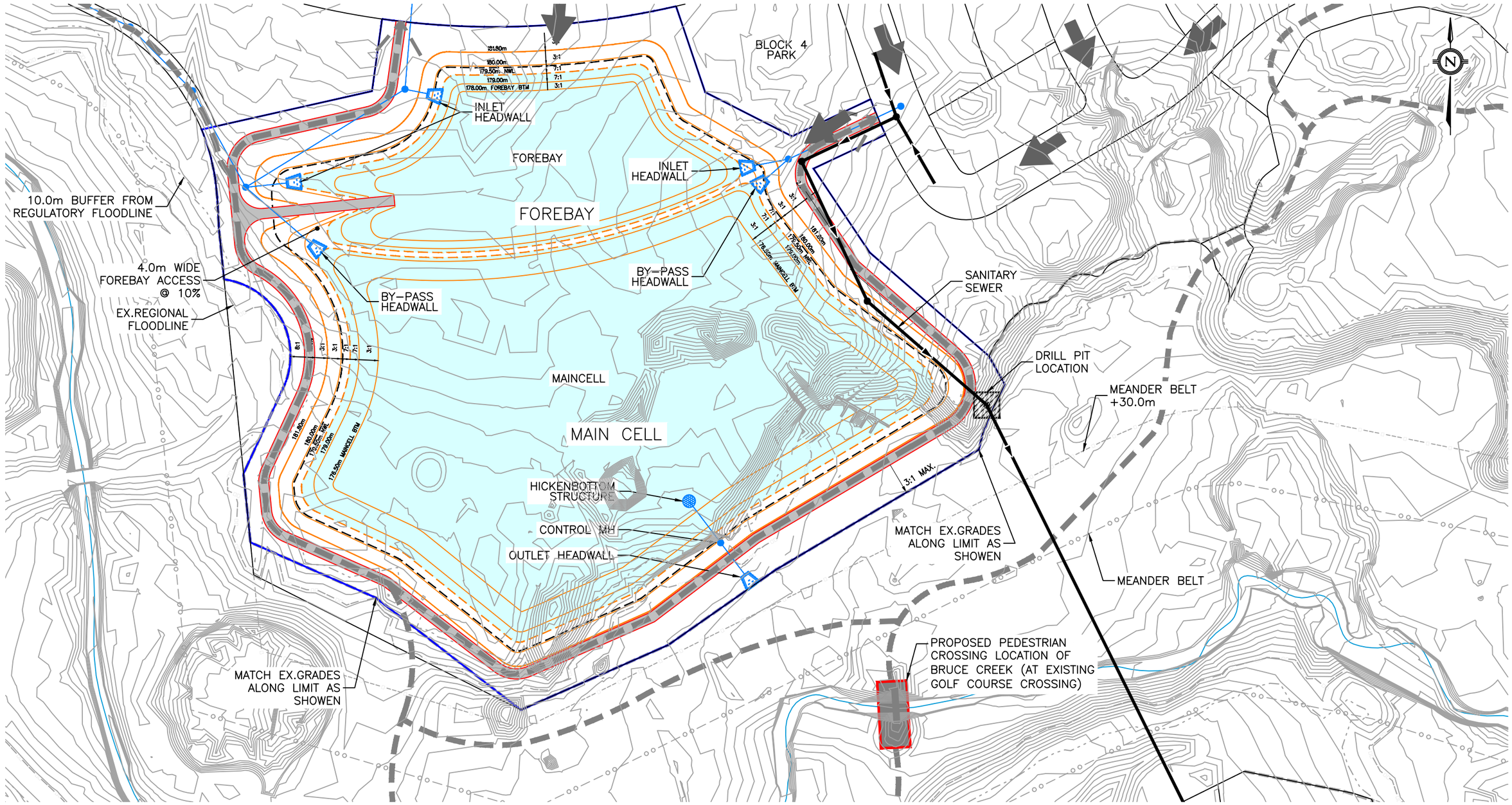
- Amended soils on backsplit lots;
- Increased top soil depths for all other lots;
- Rain barrels;
- Permeable pavers; and,
- Soak away pits or infiltration trenches within front yards parallel to the boulevard, with an overflow connection into the City storm sewer.

With respect to the public lands on the East Draft Plan the implementation of Group A LID's within the Park Blocks 5E and 7E or Pond Blocks 2E and 3E is not feasible. Even with a shallow third pipe system, the storm invert is just above the seasonally high groundwater table within Park Blocks 5E and 7E , thereby not satisfying the recommended 1.0 m separation criteria. For Park Block 6E, the only upstream area available to connect into an infiltration facility are the private roofs from lots fronting the park. As this park will already have two 9 m servicing corridors adjacent to the lots fronting the park, additional underground infrastructure such as an infiltration gallery is not recommended.

With respect to the public lands on the West Draft Plan the implementation of Group A LID's within the Park Block 15W or Pond Blocks 11W and 12W is not feasible. Even with a shallow third pipe system, the storm invert is close the seasonally high groundwater table within Park Block 15W, thereby not satisfying the 1.0 m separation criteria. For Park Block 13W, an infiltration gallery could be located within the park block and sized to deal with the target infiltration of 2 mm Imp-ha/event for all public lands within the West Draft Plan (approximately 240 m^3 per event) as adequate separation from the seasonally high groundwater table exists. However, Park Block 13W already has two 9 m servicing corridors adjacent to lots fronting the park. Installation of additional underground infrastructure such as an infiltration gallery is not recommended to ensure the proposed facility fit design for this park block can be achieved.

Based on this feasibility assessment, the "public treats public" approach is unable to satisfy the infiltration target for the public lands. As a result, the site wide water balance infiltration targets for the Subject Lands are not met through the implementation of the City's draft LID Guideline.

Therefore, this application will continue to implement an LID strategy similar to that presented in the 2017 MESP/FSR with minor changes. These changes include the elimination of the proposed perforated RLC pipe within the ROW to be replaced by LID's within private lots (such as rain barrels, permeable pavers, soak away pits or infiltration galleries within the front lots). **Figure 5.5** illustrates a revised Post Development Water Balance Mitigation Plan. Preliminary sizing calculations for the LID's within private lots are included in **Appendix E**. Updates to the site wide water balance and feature based water balance calculations from the MESP/FSR are not provided since the private lot LID's replace the perforated RLC pipes and are designed to service the same drainage areas. The overall LID strategy will be refined and finalized at detailed design with regard for the City of Markham's LID Guideline document and will attempt follow the document to the extent possible recognizing the site constraints.



Stantec
BEACON ENVIRONMENTAL
BURNSIDE

0 15 30 45 80 25
1:600

Legend

- POND BLOCK LIMIT
- SANITARY SEWER
- STORM SEWER
- PROPOSED SUBDRAIN
- EXISTING ELEVATION (EX.182.65)
- PERMANENT POOL
- ACCESS ROAD
- MAJOR OVERLAND FLOW DIRECTION
- CONCEPTUAL TRAIL
- LIMIT OF GRADING (MATCH EXISTING GROUND)

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FIGURE 5.1

SWM POND P1
GRADING PLAN

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 5.1 to 5.4 - SWM Pond Grading.dwg - Revised by <Luk, James>, Thu, Apr 05, 2018 , 1:03 PM

4.0m WIDE ACCESS ROAD

4.0m WIDE FOREBAY ACCESS @ 10%

2.00%

DRYING AREA

182.00m

183.50m

FOREBAY

FOREBAY BOTTOM

180.00m

181.00m

181.50m NWL

MAIN CELL

MAINCELL BOTTOM

178.50m

183.50m

EXISTING STORM SEWER TO BE REMOVED/DECOMMISSIONED

EX. 182.32

EX. 182.26

EX.181.24

EX.181.60

MATCH EX.GRADES ALONG LIMIT AS SHOWN

EX.183.55

EX.183.11

EX.183.24

EX. 182.79

EXISTING HEADWALL

3:1

7:1

N

Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 10 20 30 40 50

1:5000

Legend

- SUBJECT PROPERTY
- POND BLOCK LIMIT
- STORM SEWER
- EXISTING STORM SEWER (TO REMAIN)
- EXISTING FDC SEWER
- EX.182.65 EXISTING ELEVATION
- PERMANENT POOL
- ACCESS ROAD
- MAJOR OVERLAND FLOW DIRECTION
- PROPOSED SUBDRAIN
- CONCEPTUAL TRAIL
- LIMIT OF GRADING (MATCH EXISTING GROUND)

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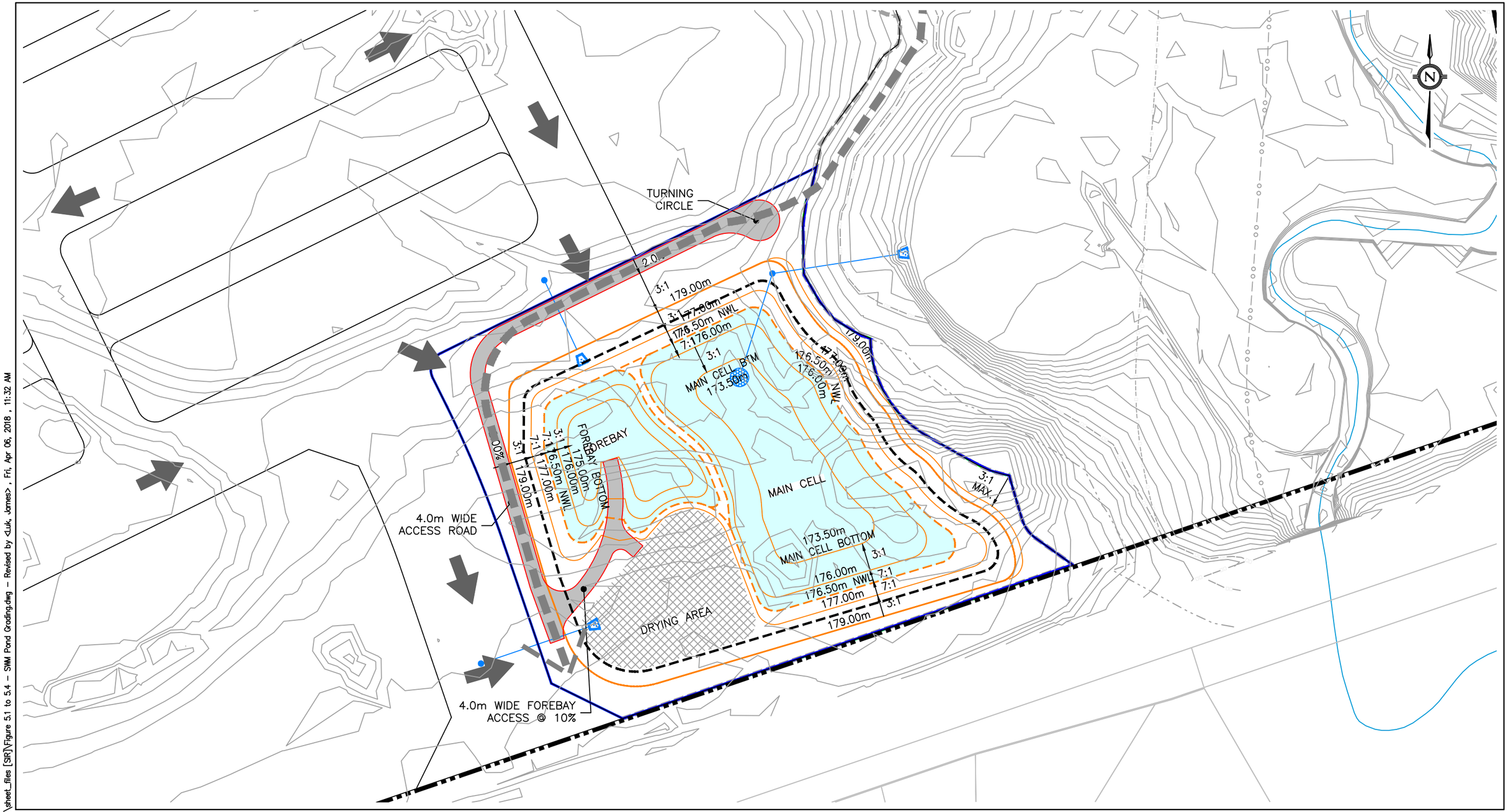
FIGURE 5.2

SWM POND P2 GRADING PLAN

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 5.1 to 5.4 – SWM Pond Grading.dwg – Revised by <Crescenzi, Adamo> , Fri, Apr 06, 2018 , 3:41 PM



Stantec
BEACON ENVIRONMENTAL
BURNSIDE

1:5000 0 10 20 30 40 50

Legend

- POND BLOCK LIMIT
- STORM SEWER
- PROPOSED SUBDRAIN
- EXISTING ELEVATION (EX.182.65)
- PERMANENT POOL
- ACCESS ROAD
- MAJOR OVERLAND FLOW DIRECTION
- CONCEPTUAL TRAIL
- LIMIT OF GRADING (MATCH EXISTING GROUND)

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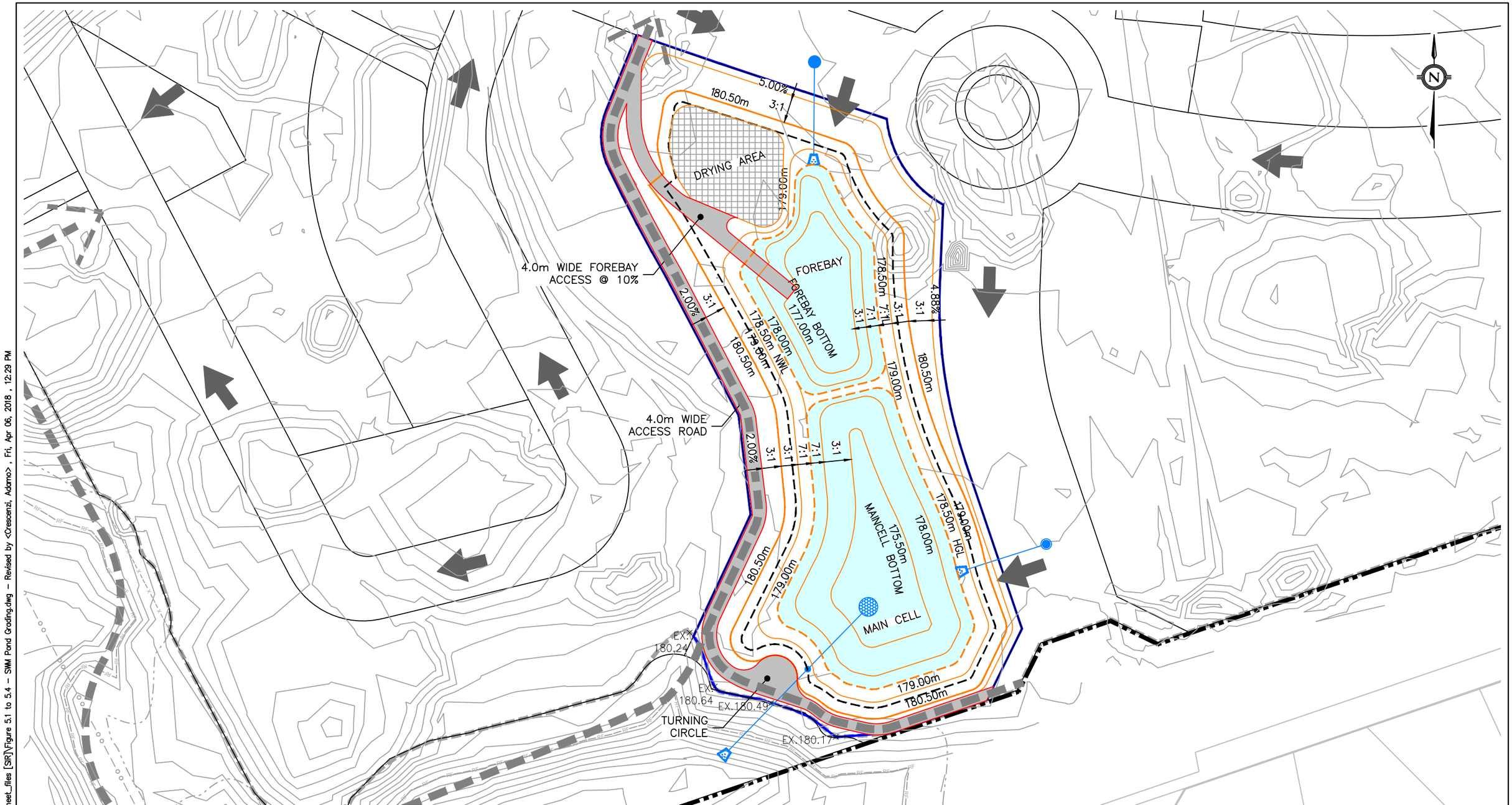
FIGURE 5.3

SWM POND P3
GRADING PLAN

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 5.1 to 5.4 – SWM Pond Grading.dwg – Revised by <Luk, James> , Fri, Apr 06, 2018 , 11:32 AM



Stantec
BEACON ENVIRONMENTAL
BURNSIDE

0 10 20 30 40 50
1:5000

Legend

- SUBJECT PROPERTY
- POND BLOCK LIMIT
- STORM SEWER
- PROPOSED SUBDRAIN
- EXISTING ELEVATION (EX.182.65)
- PERMANENT POOL
- ACCESS ROAD
- MAJOR OVERLAND FLOW DIRECTION
- CONCEPTUAL TRAIL
- LIMIT OF GRADING (MATCH EXISTING GROUND)
- OGS FOR QUALITY TREATMENT

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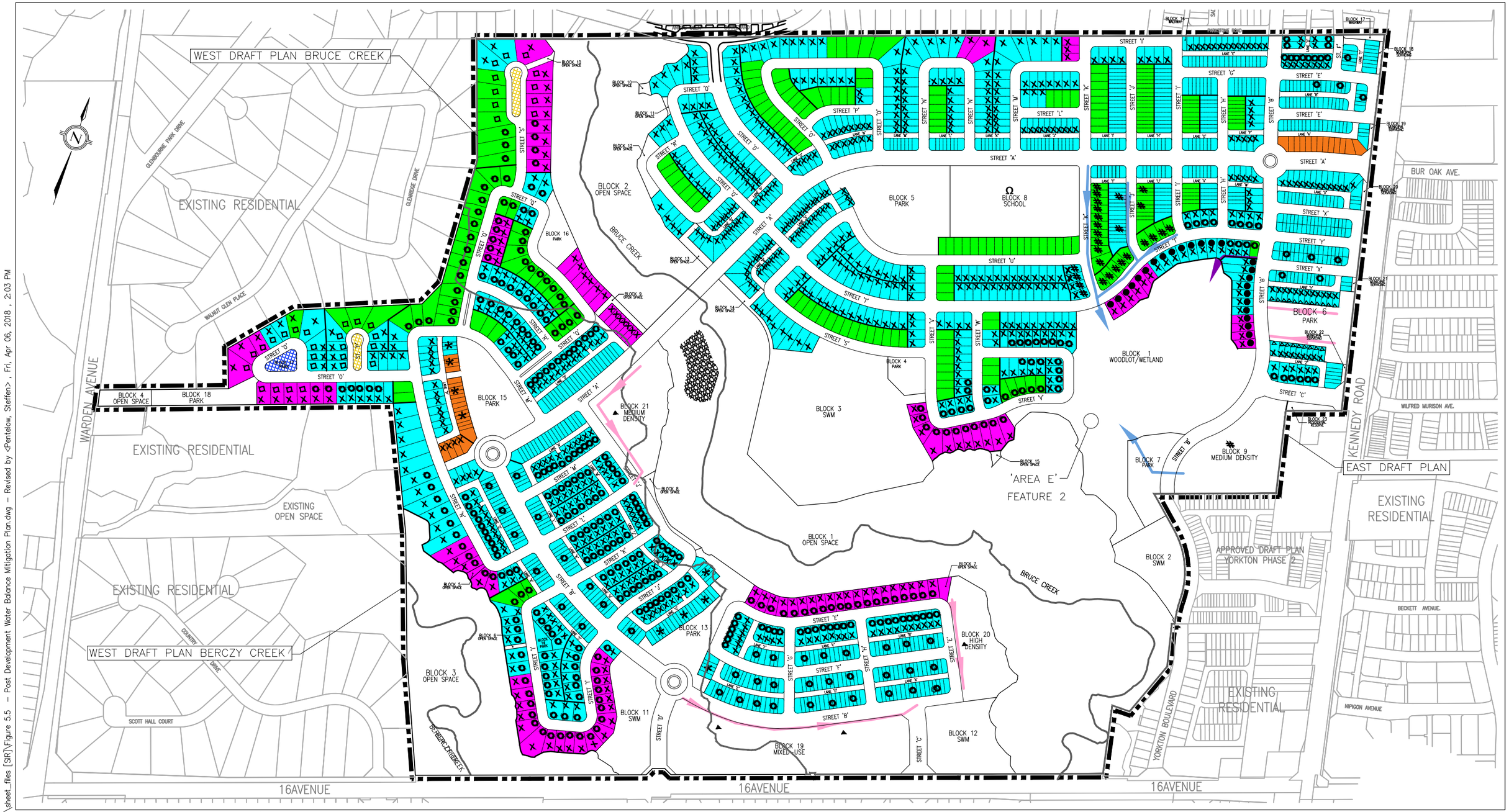
FIGURE 5.4

SWM POND P4
GRADING PLAN

April 2018



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 60 120 180 240 300

1:6000

Legend

- SUBJECT PROPERTY
- PROPOSED SOLID RLC
- PROPOSED RLC TO WOODLOT/ WETLAND FEATURE
- PROPOSED INFILTRATION GALLERY
- WETLAND STONE RESERVOIR FOR FDRLC OUTLET
- DRAINAGE DIVIDE BRUCE CREEK AND BERCZY CREEK

- BACK SPLIT
- FRONT DRAIN
- FRONT WALK
- WALKOUT
- ENCLAVE BIORETENTION
- INFILTRATION FACILITY
- * HALF ROOF TO SURFACE
- Ω FULL ROOF TO 'AREA E'

- HALF ROOF TO 'AREA E'
- HALF ROOF TO ON LOT LID (INFILTRATION GALLERY, RAIN BARREL, PERMEABLE PAVERS, SOAKAWAY PIT)
- HALF ROOF TO ENCLAVE BIORETENTION
- HALF ROOF TO INFILTRATION GALLERY
- FULL ROOF TO INFILTRATION GALLERY
- X HALF ROOF TO AMENDED SOILS
- FULL ROOF TO WOODLOT/WETLAND FEATURE

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FIGURE 5.5

POST DEVELOPMENT WATER BALANCE MITIGATION PLAN

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure 5.5 - Post Development Water Balance Mitigation Plan.dwg - Revised by <Pentelow, Steffen> , Fri, Apr 06, 2018 , 2:03 PM

6.0 TRAILS

A comprehensive trail network is proposed within the Subject Property. This trail system will link the existing external trail system along 16th Avenue, through the proposed development including Bruce Creek and Berczy Creek Valley systems to the Warden Avenue MUP and Angus Glen Boulevard. The proposed sidewalk and trail network plan for pedestrian and cyclist routing is shown on **Figure 6.1**. The proposed trail system uses the maintenance access roads within the SWM Pond blocks. To minimize overall disturbance within the valley systems, the proposed trail has been sited over top of the existing golf course cart paths including through the more sensitive natural features (i.e. woodlots) where possible. In addition, the trail is proposed primarily along the perimeter areas of the valley system and within areas where grading of the valley corridor is being completed for other purposes. The only locations that the proposed trail nears the creek bed or banks is at the existing pedestrian crossing locations.

Three trail crossings of Bruce Creek are proposed, all of which are proposed at the existing golf course cart crossing locations. The structural integrity of the existing crossing structures will be reviewed to determine if the structures meet City standards. If required, these structures will be replaced. The new design and construction would be subject to approval by MNRF, TRCA and City of Markham. In particular, alteration to Redside Dace habitat may require permitting under the provincial *Endangered Species Act*.

Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 60 120 180 240 300

1:6000

Legend

- Existing Sidewalks
- Approved Sidewalks (not yet constructed)
- Proposed Sidewalks
- Existing Trails / Walkways
- Proposed Trails / Walkways
- Existing Bike Lanes
- Approved / Planned Bike Lanes (not yet constructed)
- Proposed Bike Lanes
- Existing Shared Bike Route
- Proposed Shared Bike Route
- Existing Traffic Lights
- Proposed Traffic Lights
- Proposed Bus Stop
- Proposed Crossing at Existing Bridge
- Proposed Crossing at Existing Service Culvert
- Potential Future Crossing
- Proposed Stairway Connection

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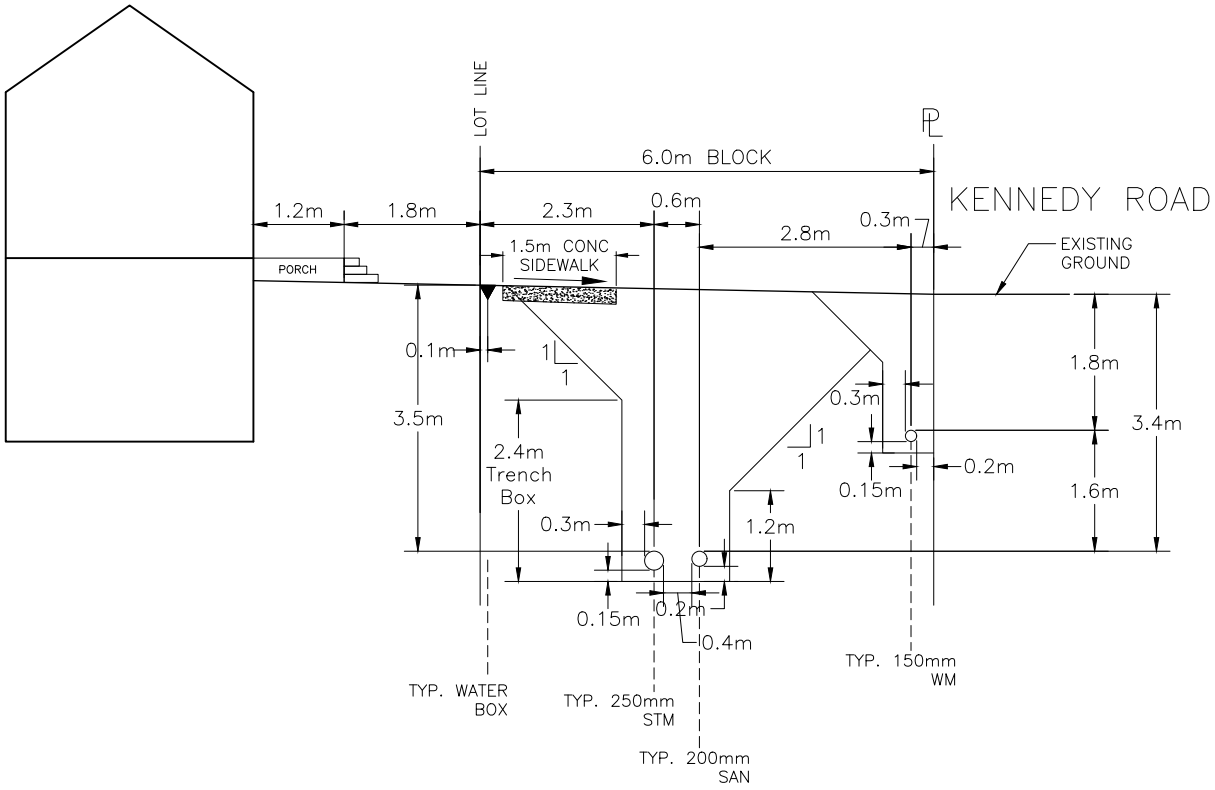
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE 6.1

PROPOSED SIDEWALK AND TRAIL NETWORK

April 2018

Appendix A SERVICING BLOCKS AND SERVICING CORRIDORS FIGURES



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 1 2 3 4 5

1:100

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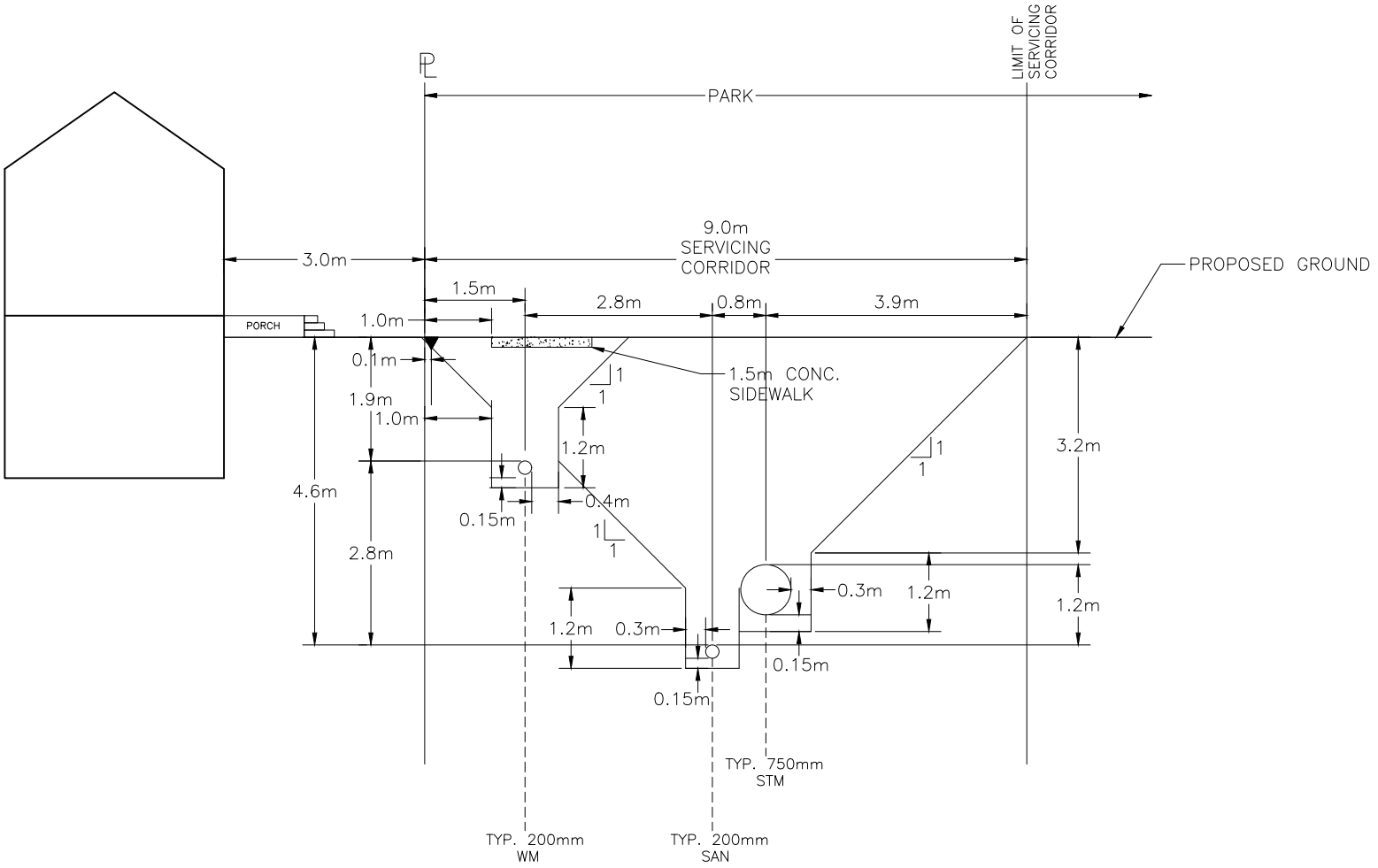
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE A□

□□□□ SERVICING BLOC□

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure A1 – 6m Servicing Block.dwg – Revised by <Luk, James> , Thu, Apr 05, 2018 , 1:21 PM



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 1 2 3 4 5

1:100

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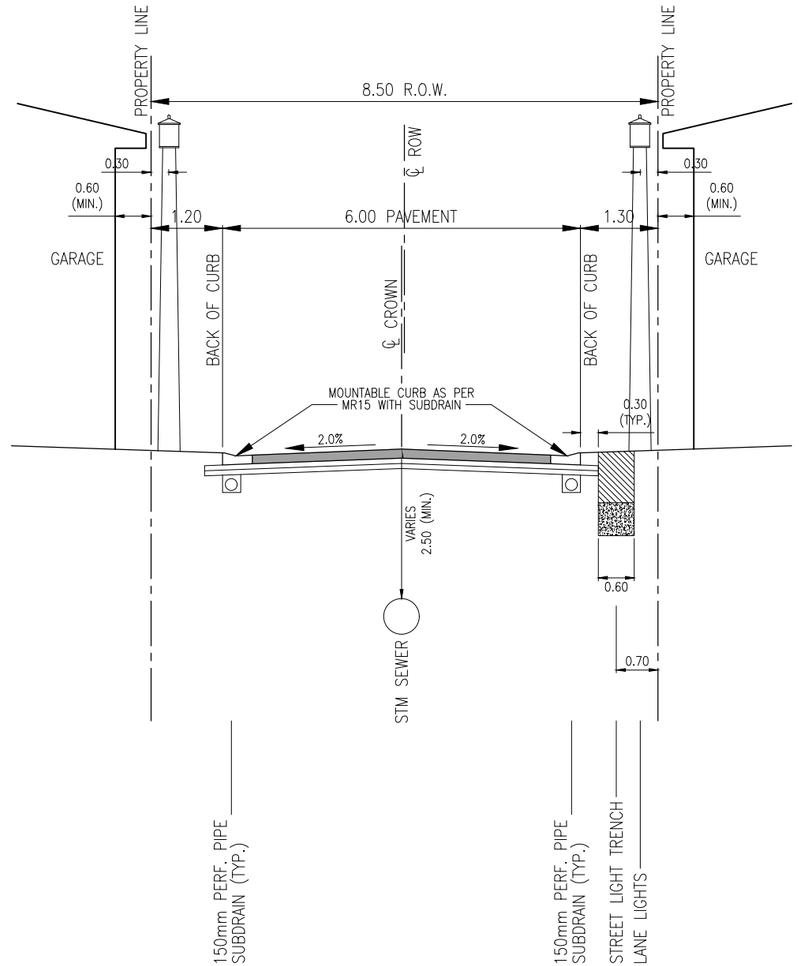
FIGURE A□

□□□□ SERVICING CORRIDOR

April 2018

File: v:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure A2 – 9m Servicing Corridor.dwg – Revised by <Crescenzi, Adamo> , Fri, Apr 06, 2018 , 12:35 PM

Appendix B MODIFIED RIGHT-OF-WAY SECTIONS



8.5m LANES

NOTES:

1. TYPICAL MINIMUM DEPTH OF UTILITY CROSSINGS SHALL BE 1.0M (TO CLEAR SUBDRAINS).
2. FOR SANITARY AND STORM SEWERS IN COMMON TRENCH, THE MINIMUM HORIZONTAL CLEARANCE BETWEEN THE PIPES SHALL BE 1.0m
3. THIS STANDARD IS A MODIFIED VERSION OF TOWN STANDARD MR10A

Stantec
BEACON ENVIRONMENTAL
BURNSIDE

1:100 0 1 2 3 4 5

Legend

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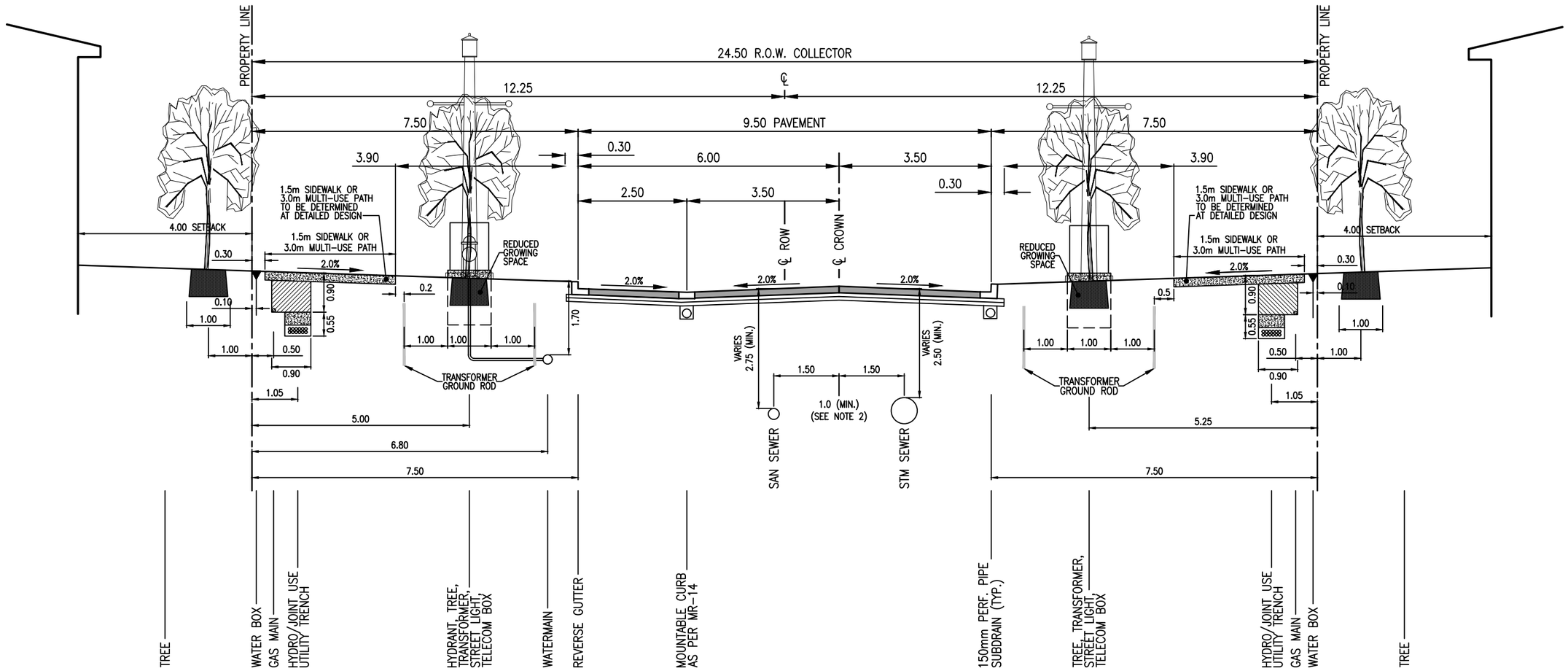
FIGURE B1

8.5m AND 10m LANES WITHOUT UTILITIES MR10A MODIFIED

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure B1 – 8.5m MR10A Modified ROW.dwg – Revised by <Crescenzi, Adamo> , Wed, Apr 04, 2018 , 5:14 PM



NOTES:

1. TYPICAL MINIMUM DEPTH OF UTILITY CROSSINGS SHALL BE 1.0M (TO CLEAR SUBDRAINS).
2. FOR SANITARY AND STORM SEWERS IN COMMON TRENCH, THE MINIMUM HORIZONTAL CLEARANCE BETWEEN THE PIPES SHALL BE 1.0M.
3. FOR THE CURB TRANSITION ON PARKING BAY, SEE MR18.
4. THIS STANDARD IS A MODIFIED VERSION OF TOWN STANDARD MR7.

24.5m STREET

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BEACON ENVIRONMENTAL
BURNSIDE

1:100 0 1 2 3 4 5

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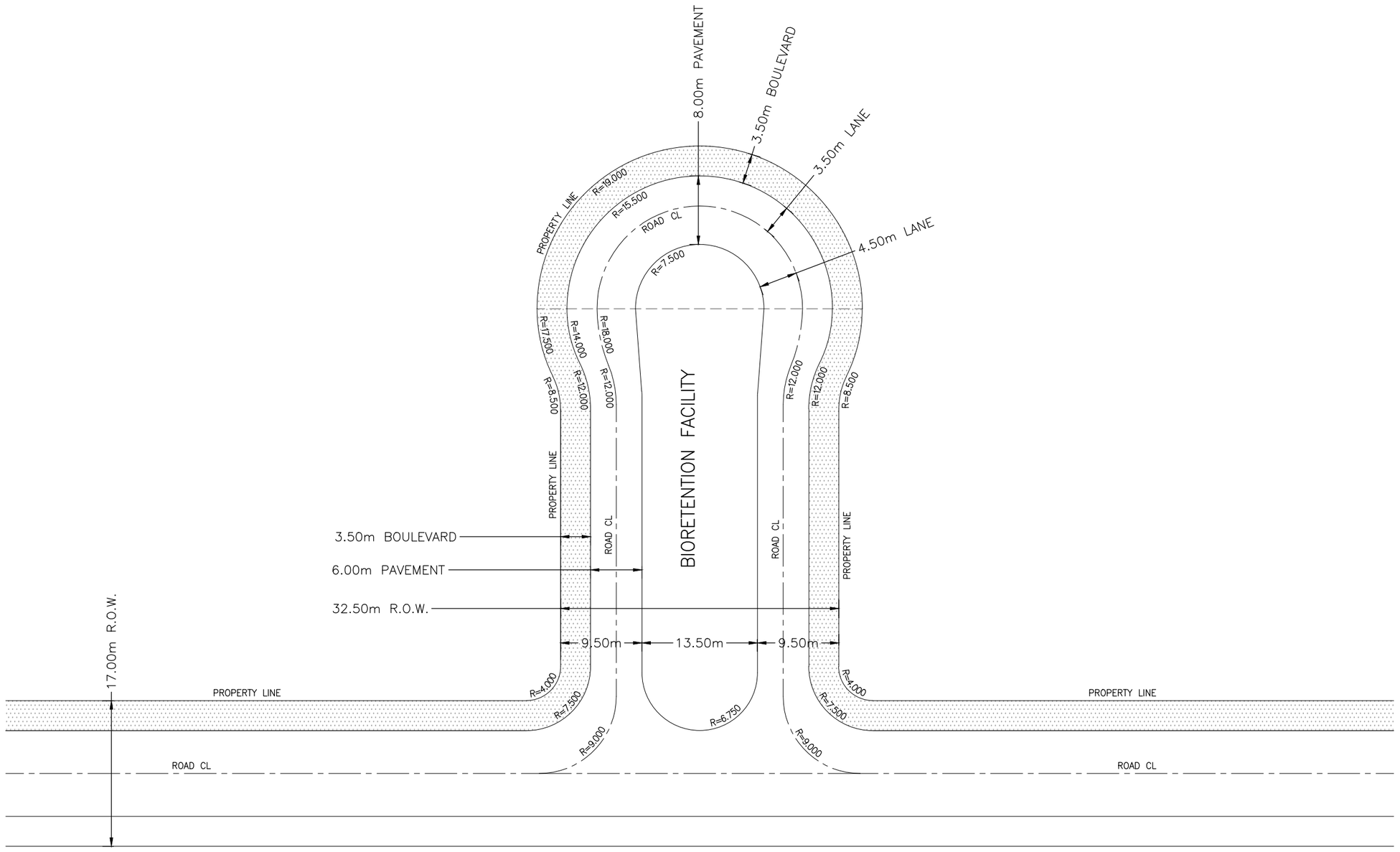
FIGURE B2

24.5 MODIFIED ROW SYMMETRICAL

April 2018

File: v:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure B2 - 24.5m Modified ROW.dwg - Revised by <Luk, James> , Thu, Apr 05, 2018 , 1:36 PM



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

1:500 0 5 10 15 20 25

Legend

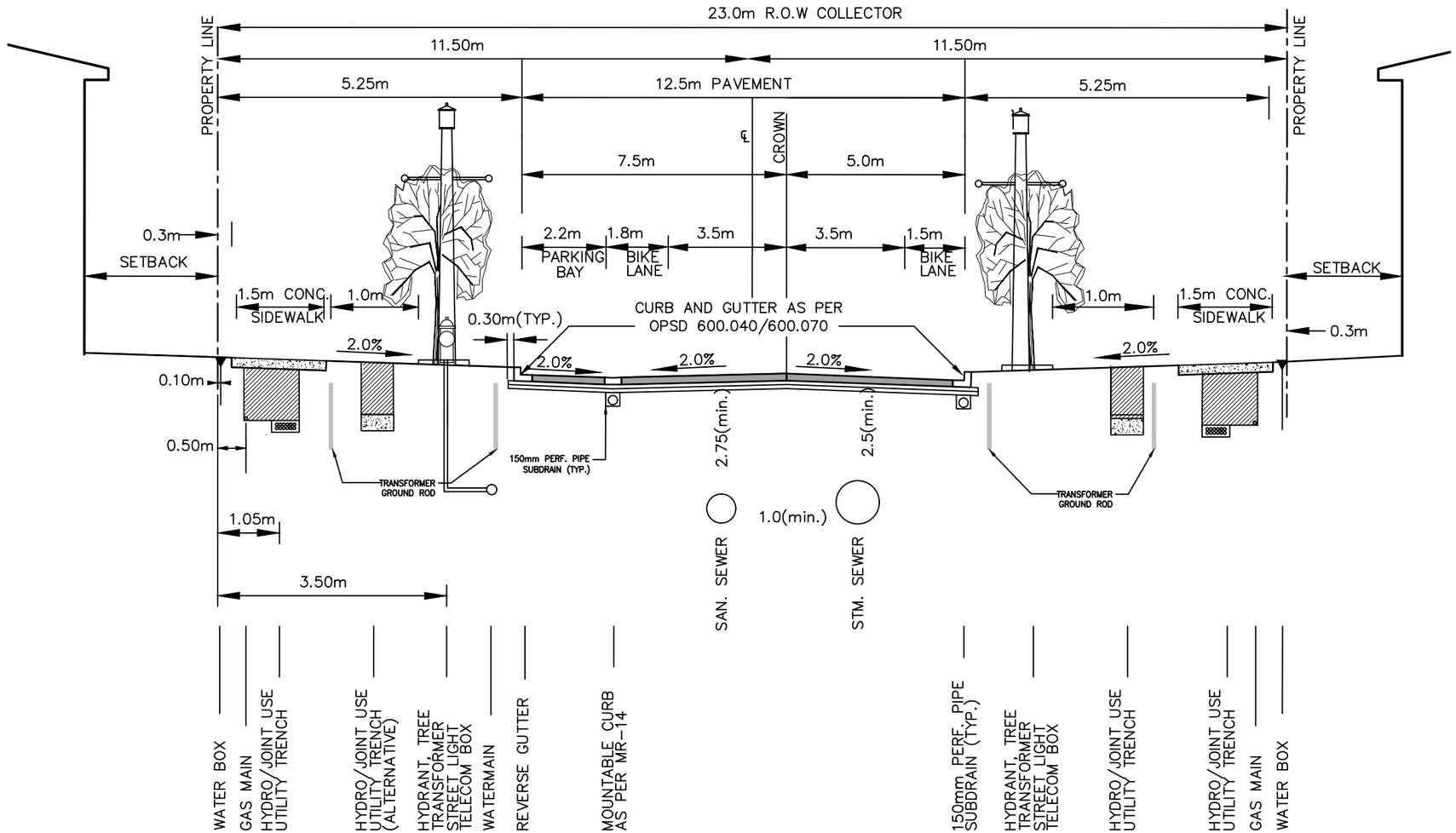
SUPPLEMENTAL INFORMATION REPORT (SIR)
4134 16TH AVENUE
RESIDENTIAL DEVELOPMENT

FIGURE B3

RESIDENTIAL ENCLAVE CUL-DE-SAC (TYPICAL MODIFIED)

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure B3 – Enclave ROW Detail.dwg – Revised by <Crescenzi, Adamo> , Fri, Apr 06, 2018 , 1:44 PM



NOTES:

1. TYPICAL MINIMUM DEPTH OF UTILITY CROSSINGS SHALL BE 1.0M (TO CLEAR SUBDRAINS).
2. FOR SANITARY AND STORM SEWERS IN COMMON TRENCH, THE MINIMUM HORIZONTAL CLEARANCE BETWEEN THE PIPES SHALL BE 1.0M.
3. FOR THE CURB TRANSITION ON PARKING BAY, SEE MR18.
4. THIS STANDARD IS A MODIFIED VERSION OF TOWN STANDARD MR6.

23.0m STREET

PARKING PERMITTED BOTH SIDES IN OFF PEAK PERIODS
N.T.S.

Stantec
BEACON ENVIRONMENTAL
BURNSIDE

1:100 0 1 2 3 4 5

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FIGURE B4

23.0m MODIFIED RESIDENTIAL COLLECTOR ROAD

April 2018

File: V:\01606\Active\160622264\Drawing\sheet_files [SIR]\Figure B4 - 23.0m Modified ROW.dwg - Revised by <Crescenzi, Adamo> , Wed, Apr 04, 2018 , 5:15 PM

Appendix C SWM POND VOLUME CALCULATIONS

Stantec

Project Description: 4134 16th Avenue
Job Number: 160622264
Creation Date: 6-Apr-18

SWM Pond 1 Storage Calculations

Input

Base of Pond =	176.50	
N.W.L. =	179.50	masl
Increment for Volume =	0.1	m
Required Permanent Pool Volume =	**22896**	m^3
Permanent Pool Volume Provided =	**78891**	m^3
100 Year Required Volume =	**77832**	m^3
100-year Elevation =	**181.51**	m
100-year Freeboard =	**0.29**	m

Elevation/Storage Information

	Elevation (m)	Stage (m)	Area 1 (m^2)	Total Area (m^2)	Avg. Area (m^2)	Incremental Storage (m^3)	Cumulative Storage (m^3)	Cumulative Storage above Permanent Pool (m^3)
Pond Base	176.50	0.00	19,679	19,679		0		
	177.00	0.50	20,572	20,572	20,125	10,063	**10,063**	**0**
	177.50	1.00	21,487	21,487	21,029	10,515	**20,577**	**0**
	178.00	1.50	27,963	27,963	24,725	12,362	**32,940**	**0**
	178.50	2.00	29,515	29,515	28,739	14,369	**47,309**	**0**
	179.00	2.50	31,194	31,194	30,354	15,177	**62,486**	**0**
NWL	179.50	3.00	34,426	34,426	32,810	16,405	**78,891**	**0**
	180.00	3.50	37,751	37,751	36,088	18,044	**96,935**	**18,044**
	180.50	4.00	39,027	39,027	38,389	19,195	**116,130**	**37,239**
	181.00	4.50	40,321	40,321	39,674	19,837	**135,967**	**57,076**
	181.50	5.00	41,636	41,636	40,979	20,489	**156,456**	**77,565**
Pond Top	181.80	5.30	42,433	42,433	42,034	12,610	**169,067**	**90,175**

Stantec

Project Description: 4134 16th Avenue
Job Number: 160622264
Creation Date: 6-Apr-18

SWM Pond 2 Storage Calculations

Input

Base of Pond =	178.50	
N.W.L. =	181.50	masl
Increment for Volume =	0.1	m
Required Permanent Pool Volume =	**2149**	m^3
Permanent Pool Volume Provided =	**4923**	m^3
100 Year Required Volume (2017 MESP) =	**6776**	m^3
100-year Elevation =	**182.84**	m
100-year Freeboard =	**0.66**	m

Elevation/Storage Information

	Elevation (m)	Stage (m)	Area 1 (m^2)	Total Area (m^2)	Avg. Area (m^2)	Incremental Storage (m^3)	Cumulative Storage (m^3)	Cumulative Storage above Permanent Pool (m^3)
Pond Base	178.50	0.00	575	575		0		
	179.00	0.50	765	765	670	335	**335**	**0**
	179.50	1.00	984	984	874	437	**772**	**0**
	180.00	1.50	1,555	1,555	1,269	635	**1,407**	**0**
	180.50	2.00	1,993	1,993	1,774	887	**2,294**	**0**
	181.00	2.50	2,483	2,483	2,238	1,119	**3,413**	**0**
NWL	181.50	3.00	3,557	3,557	3,020	1,510	**4,923**	**0**
	182.00	3.50	5,062	5,062	4,309	2,155	**7,078**	**2,155**
	182.50	4.00	5,555	5,555	5,308	2,654	**9,732**	**4,809**
	183.00	4.50	6,072	6,072	5,814	2,907	**12,639**	**7,715**
Pond Top	183.50	5.00	6,622	6,622	6,347	3,174	**15,812**	**10,889**

Stantec

Project Description: 4134 16th Avenue
Job Number: 160622264
Creation Date: 6-Apr-18

SWM Pond 3 Storage Calculations

Input

Base of Pond =	173.50	
N.W.L. =	176.50	masl
Increment for Volume =	0.1	m
Required Permanent Pool Volume =	**4097**	m^3
Permanent Pool Volume Provided =	**7723**	m^3
Year Required Volume (2017 MESP) =	**13002**	m^3
100-year Elevation =	**178.37**	m
100-year Freeboard =	**0.63**	m

Elevation/Storage Information

	Elevation (m)	Stage (m)	Area 1 (m^2)	Total Area (m^2)	Avg. Area (m^2)	Incremental Storage (m^3)	Cumulative Storage (m^3)	Cumulative Storage above Permanent Pool (m^3)
Pond Base	173.50	0.00	1,168	1,168		0		
	174.00	0.50	1,421	1,421	1,294	647	**647**	**0**
	174.50	1.00	1,700	1,700	1,561	780	**1,427**	**0**
	175.00	1.50	2,535	2,535	2,118	1,059	**2,486**	**0**
	175.50	2.00	3,076	3,076	2,805	1,403	**3,889**	**0**
	176.00	2.50	3,672	3,672	3,374	1,687	**5,576**	**0**
NWL	176.50	3.00	4,917	4,917	4,294	2,147	**7,723**	**0**
	177.00	3.50	6,030	6,030	5,473	2,737	**10,460**	**2,737**
	177.50	4.00	6,909	6,909	6,470	3,235	**13,694**	**5,972**
	178.00	4.50	8,407	8,407	7,658	3,829	**17,523**	**9,801**
	178.50	5.00	9,075	9,075	8,741	4,371	**21,894**	**14,171**
Pond Top	179.00	5.50	9,786	9,786	9,430	4,715	**26,609**	**18,886**

Stantec

Project Description: 4134 16th Avenue
Job Number: 160622264
Creation Date: 6-Apr-18

SWM Pond 4 Storage Calculations

Input

Base of Pond =	175.50	
N.W.L. =	178.50	masl
Increment for Volume =	0.1	m
Required Permanent Pool Volume =	**4718**	m^3
Permanent Pool Volume Provided =	**6318**	m^3
Year Required Volume (2017 MESP) =	**10571**	m^3
100-year Elevation =	**180.16**	m
100-year Freeboard =	**0.34**	m

Elevation/Storage Information

	Elevation (m)	Stage (m)	Area 1 (m^2)	Total Area (m^2)	Avg. Area (m^2)	Incremental Storage (m^3)	Cumulative Storage (m^3)	Cumulative Storage above Permanent Pool (m^3)
Pond Base	175.50	0.00	796	796		0		
	176.00	0.50	1,016	1,016	906	453	**453**	**0**
	176.50	1.00	1,254	1,254	1,135	567	**1,020**	**0**
	177.00	1.50	2,098	2,098	1,676	838	**1,858**	**0**
	177.50	2.00	2,575	2,575	2,336	1,168	**3,026**	**0**
	178.00	2.50	3,120	3,120	2,848	1,424	**4,450**	**0**
NWL	178.50	3.00	4,350	4,350	3,735	1,867	**6,318**	**0**
	179.00	3.50	5,582	5,582	4,966	2,483	**8,801**	**2,483**
	179.50	4.00	6,295	6,295	5,938	2,969	**11,770**	**5,452**
	180.00	4.50	7,734	7,734	7,014	3,507	**15,277**	**8,959**
Pond Top	180.50	5.00	8,024	12098.36	9,916	4,958	**20,235**	**13,917**

Appendix D SWM POND CLEANOUT CALCULATIONS AND DRYING AREA CALCULATIONS

Project Description: 4134 16th Avenue
Job Number: 160622264
Creation Date: 6-Apr-18

SWM Pond Cleanout Method Comparison

Pond ID	April 2018 Draft Plan Block Size (without Drying Area)	TSS Loading Rate	50% Forebay Volume			75% Removal Efficiency			Standard MOE Permanent Pool Size		
			Cleanout Volume	Frequency	Drying Area (assume 0.87m jersey barrier)	Cleanout Volume	Frequency	Drying Area (assume 0.87m jersey barrier)	Cleanout Volume	Frequency	Drying Area (assume 0.87m jersey barrier)
	(ha)	(m^3/yr)	(m^3)	(yrs)	(m^2)	(m^3)	(yrs)	(m^2)	(m^3)	(yrs)	(m^2)
1	5.76	312	4,986	16	5,731	63,219	202	72,665	7,800	25	8,966
2	1.03	34	454	13	522	3,443	102	3,957	820	24	943
3	1.36	65	666	10	766	4,873	75	5,601	1,350	21	1,552
4	1.25	66	725	11	833	3,099	47	3,562	3,219	25	3,700

Recommended SWM Pond Cleanout Strategy

Pond ID	April 2018 Draft Plan Block Size (without Drying Area)	TSS Loading Rate	50% Forebay Volume		
			Cleanout Volume	Frequency	Drying Area (assume 0.87m jersey barrier)
	(ha)	(m^3/yr)	(m^3)	(yrs)	(m^2)
1	5.76	312	4,986	16	N/A*
2	1.03	34	454	13	522
3	1.36	65	666	10	766
4	1.25	66	725	11	833

*Bypass pipes provided

WET POND 1 SEDIMENT REMOVAL FREQUENCY CALCUALTIONS

Theory

Clean Out Frequency of SWM pond based on the minimum time calculated
for the methods 1 and 2.

method 1:

Time required for sediment accumulation to reduce forebay volume by 50%.

method 2:

Time required for sediment accumulation to cause the TSS removal efficiency to be reduced by 5% (from 80% to 75%).

Input Data

Drainage Area	146.82	Ha
Level of Imperviousness [1]	59.00%	
[1] Imperviousness is the weighted average of all land uses based on area.		
Actual Starting Permanent Pool Storage	78891	m^3
Actual Starting Forebay Permanent Pool Storage	9971	m^3

Calculations

Method 1:

From table 6.3 MOE Guideline, 2003, the Total Suspeneded Solids (TSS) loading based on an imperviousness of 59.00% is:

Total TSS Loading = 2.1 m^3/ha/year

Total TSS Loading from Drainage Area = 312.26 m^3/year

Assuming all TSS deposition is in the sediment forebay:

50% of forebay volume = 4985.5 m^3

312.26 m^3/year

Method 1 Clean Out Frequency= **16** years

Method 2:

Actual Permanent Pool Storage per ha =	537	m^3/ha
Extended Detention allowance=	+40	m^3/ha
	577	m^3/ha

From figures 4.2-4.5 of the MOE guideline, 1994, (Note that figures used were not present in MOE guideline 2003) The Total Suspended Solids Removal effieciency based on a impervious area of 59.00% is

TSS removal efficeincy at	577	m^3/ha=		82.36

The resulting permanent pool volume at a removal efficiency of 75 % is

Permanent pool volume @ 75%=	106.74	m^3/ha
Drainage Area =	146.82	ha
	15672	m^3

Sediment accumulation to invoke a clean out (difference between actual and 75% removal efficiency volume)

Actual Permanent Pool Volume	78891	m^3
Permanent Pool Volume @ 75 % efficiency	-15672	m^3
	63219	m^3

Resultant Clean Out Frequency

Sediment Accumulation to invoke Clean out	63219	m^3
Total TSS Loading from Drainage Area =	312.26	m^3/year
	202	years

Method 2 Clean out Frequency= **202** years

Conclusion

Clean out frequency is determined by the minimum result from method 1 and method 2

Method 1 Clean out Frequency= **16** years

Method 2 Clean out Frequency= **202** years

Therefore the Clean out frequency is **16** years

Sizing Sediment Decant area

The sediment decant area is to be sized for the 16 year Sediment accumulation volume

Total TSS Loading from Drainage Area[1] = 312.26 m^3/year

[1] From Table 6.3 of the MOE Guideline (2003) TSS Loading of 1.6 m^3/ha/year, and a total of 50.47 ha of drainage area

16 year sediment accumulation volume = 4985.5 m^3

WET POND 2 SEDIMENT REMOVAL FREQUENCY CALCUALTIONS

Theory

Clean Out Frequency of SWM pond based on the minimum time calculated for the methods 1 and 2.

method 1:

Time required for sediment accumulation to reduce forebay volume by 50%.

method 2:

Time required for sediment accumulation to cause the TSS removal efficiency to be reduced by 5% (from 80% to 75%).

Input Data

Drainage Area	11.84	Ha
Level of Imperviousness [1]	70.00%	
[1] Imperviousness is the weighted average of all land uses based on area.		
Actual Starting Permanent Pool Storage	4923	m^3
Actual Starting Forebay Permanent Pool Storage	908	m^3

Calculations

Method 1:

From table 6.3 MOE Guideline, 2003, the Total Suspeneded Solids (TSS) loading based on an imperviousness of 70.00% is:

Total TSS Loading = 2.8 m^3/ha/year

Total TSS Loading from Drainage Area = 33.64 m^3/year

Assuming all TSS deposition is in the sediment forebay:

50% of forebay volume = 454 m^3

33.64 m^3/year

Method 1 Clean Out Frequency= **13** years

Method 2:

Actual Permanent Pool Storage per ha =	416	m^3/ha
Extended Detention allowance=	+40	m^3/ha
	456	m^3/ha

From figures 4.2-4.5 of the MOE guideline, 1994, (Note that figures used were not present in MOE guideline 2003) The Total Suspended Solids Removal effieciency based on a impervious area of 70.00% is

TSS removal efficeincy at	456	m^3/ha=		81.00

The resulting permanent pool volume at a removal efficiency of 75 % is

Permanent pool volume @ 75%=	125.00	m^3/ha
Drainage Area =	11.84	ha
	1480	m^3

Sediment accumulation to invoke a clean out (difference between actual and 75% removal efficiency volume)

Actual Permanent Pool Volume	4923	m^3
Permanent Pool Volume @ 75 % efficiency	-1480	m^3
	3443	m^3

Resultant Clean Out Frequency

Sediment Accumulation to invoke Clean out	3443	m^3
Total TSS Loading from Drainage Area =	33.64	m^3/year
	102	years
Method 2 Clean out Frequency=	**102**	years

Conclusion

Clean out frequency is determined by the minimum result from method 1 and method 2

Method 1 Clean out Frequency=	**13**	years
Method 2 Clean out Frequency=	**102**	years
Therefore the Clean out frequency is	**13**	years

Sizing Sediment Decant area

The sediment decant area is to be sized for the 16 year Sediment accumulation volume

Total TSS Loading from Drainage Area[1] = 33.64 m^3/year

[1] From Table 6.3 of the MOE Guideline (2003) TSS Loading of 1.6 m^3/ha/year, and a total of 50.47 ha of drainage area

13 year sediment accumulation volume = 454.0 m^3

WET POND 3 SEDIMENT REMOVAL FREQUENCY CALCUALTIONS

Theory

Clean Out Frequency of SWM pond based on the minimum time calculated for the methods 1 and 2.

method 1:

Time required for sediment accumulation to reduce forebay volume by 50%.

method 2:

Time required for sediment accumulation to cause the TSS removal efficiency to be reduced by 5% (from 80% to 75%).

Input Data

Drainage Area	22.8	Ha
Level of Imperviousness [1]	70.00%	
[1] Imperviousness is the weighted average of all land uses based on area.		
Actual Starting Permanent Pool Storage	7723	m^3
Actual Starting Forebay Permanent Pool Storage	1331	m^3

Calculations

Method 1:

From table 6.3 MOE Guideline, 2003, the Total Suspeneded Solids (TSS) loading based on an imperviousness of 70.00% is:

Total TSS Loading = 2.8 m^3/ha/year

Total TSS Loading from Drainage Area = 64.79 m^3/year

Assuming all TSS deposition is in the sediment forebay:

50% of forebay volume = 665.5 m^3

64.79 m^3/year

Method 1 Clean Out Frequency= **10** years

Method 2:

Actual Permanent Pool Storage per ha =	339	m^3/ha
Extended Detention allowance=	+40	m^3/ha
	379	m^3/ha

From figures 4.2-4.5 of the MOE guideline, 1994, (Note that figures used were not present in MOE guideline 2003) The Total Suspended Solids Removal effieciency based on a impervious area of 70.00% is

TSS removal efficeincy at	379	m^3/ha=		81.00

The resulting permanent pool volume at a removal efficiency of 75 % is

Permanent pool volume @ 75%=	125.00	m^3/ha
Drainage Area =	22.8	ha
	2850	m^3

Sediment accumulation to invoke a clean out (difference between actual and 75% removal efficiency volume)

Actual Permanent Pool Volume	7723	m^3
Permanent Pool Volume @ 75 % efficiency	-2850	m^3
	4873	m^3

Resultant Clean Out Frequency

Sediment Accumulation to invoke Clean out	4873	m^3
Total TSS Loading from Drainage Area =	64.79	m^3/year
	75	years
Method 2 Clean out Frequency=	**75**	years

Conclusion

Clean out frequency is determined by the minimum result from method 1 and method 2

Method 1 Clean out Frequency=	**10**	years
Method 2 Clean out Frequency=	**75**	years
Therefore the Clean out frequency is	**10**	years

Sizing Sediment Decant area

The sediment decant area is to be sized for the 16 year Sediment accumulation volume

Total TSS Loading from Drainage Area[1] = 64.79 m^3/year

[1] From Table 6.3 of the MOE Guideline (2003) TSS Loading of 1.6 m^3/ha/year, and a total of 50.47 ha of drainage area

10 year sediment accumulation volume = 665.5 m^3

WET POND 4 SEDIMENT REMOVAL FREQUENCY CALCUALTIONS

Theory

Clean Out Frequency of SWM pond based on the minimum time calculated for the methods 1 and 2.

method 1:

Time required for sediment accumulation to reduce forebay volume by 50%.

method 2:

Time required for sediment accumulation to cause the TSS removal efficiency to be reduced by 5% (from 80% to 75%).

Input Data

Drainage Area	29.24	Ha
Level of Imperviousness [1]	61.00%	
[1] Imperviousness is the weighted average of all land uses based on area.		
Actual Starting Permanent Pool Storage	6318	m^3
Actual Starting Forebay Permanent Pool Storage	1449	m^3

Calculations

Method 1:

From table 6.3 MOE Guideline, 2003, the Total Suspeneded Solids (TSS) loading based on an imperviousness of 61.00% is:

Total TSS Loading = 2.3 m^3/ha/year

Total TSS Loading from Drainage Area = 65.98 m^3/year

Assuming all TSS deposition is in the sediment forebay:

50% of forebay volume = 724.5 m^3

65.98 m^3/year

Method 1 Clean Out Frequency= **11** years

Method 2:

Actual Permanent Pool Storage per ha =	216	m^3/ha
Extended Detention allowance=	+40	m^3/ha
	256	m^3/ha

From figures 4.2-4.5 of the MOE guideline, 1994, (Note that figures used were not present in MOE guideline 2003) The Total Suspended Solids Removal effieciency based on a impervious area of 61.00% is

TSS removal efficeincy at	256	m^3/ha=		82.09

The resulting permanent pool volume at a removal efficiency of 75 % is

Permanent pool volume @ 75%=	110.08	m^3/ha
Drainage Area =	29.24	ha
	3219	m^3

Sediment accumulation to invoke a clean out (difference between actual and 75% removal efficiency volume)

Actual Permanent Pool Volume	6318	m^3
Permanent Pool Volume @ 75 % efficiency	-3219	m^3
	3099	m^3

Resultant Clean Out Frequency

Sediment Accumulation to invoke Clean out	3099	m^3
Total TSS Loading from Drainage Area =	65.98	m^3/year
	47	years

Method 2 Clean out Frequency= **47** years

Conclusion

Clean out frequency is determined by the minimum result from method 1 and method 2

Method 1 Clean out Frequency= **11** years

Method 2 Clean out Frequency= **47** years

Therefore the Clean out frequency is **11** years

Sizing Sediment Decant area

The sediment decant area is to be sized for the 16 year Sediment accumulation volume

Total TSS Loading from Drainage Area[1] = 65.98 m^3/year

[1] From Table 6.3 of the MOE Guideline (2003) TSS Loading of 1.6 m^3/ha/year, and a total of 50.47 ha of drainage area

11 year sediment accumulation volume = 724.5 m^3

Appendix E LID SIZING CALCULATIONS FOR PRIVATE LOTS

APPENDIX E.1
CITY STRATEGY - IN LOT LID CALCS

Project Description: York Downs MESP
Job Number: 160622264
Creation Date: 10-Apr-18

For private lots following City of Markham Draft LID Guidelines 2018

Target depth = **2** **mm / Imp ha / event**

Perforated RLC Trench Sizing Calculation - IN LOT

Note the drainage area is estimated to be building envelope area per lot

source: ***Low Impact Development Stormwater Management Planning and Design Guide*** **, p 4-58**

input
output

$d_{r\,max} = I \times t_s / V_r$

$d_{r\,max}$ =	744	maximum stone reservoir depth (mm)
I =	12.4	infiltration rate assumed for calculations (mm/hr) *minimum evaluated in situ testing for native soils = 50 mm/hr
Vr =	0.4	Void space ratio for aggregate used (typically 0.40 for 50 mm clear stone)
t_s =	24	Time to drain (design for 48 hr drain time recommended)

Example Calculation:

Af = WQV / (dr * Vr)

Where:

A_f =	6	Footprint surface area (m2)
Average Building Envelope Area =	0.035	(ha)
Drainage Area =	0.035	(ha)
WQD=	2.00	Water Quality Depth (mm)
WQV =	0.704	Water quality volume (m^3)
d_r =	0.30	Stone reservoir depth (m)
V_r =	0.4	Void space ratio for aggregate used (typically 0.4 for 50 mm clear stone)
Frontage	21.3	(m)
Width of Stone Required	0.3	(m)

Note:The ratio of impervious drainage area to footprint surface area of the practice should be between 5:1 and 20:1 to limit the rate of accumulation of fine sediments and thereby prevent clogging.

	Infiltration Rate	Void Ratio	Recommended Drain Time	Max. Stone Depth	Building Envelope Area	Drainage Area	Water Quality Depth	Water Quality Volume	Trench Volume	Actual Stone Depth	Actual Drain Time	Footprint Area	Lot Frontage	**Infiltration Trench Width**	Redundancy Factor (from City of Markham LID Manual - DRAFT, 2018)	Infiltration Trench Width adjusted for redundancy
	i	Vr	t_s	$d_{r\,max}$		Size for Entire roof	WQD	WQV		d_r	t (TRCA Eqn)	A_f (TRCA Eqn)		**w**		
(Lot ID)	(mm/hr)		(hr)	(mm)	(ha)	(ha)	(mm)	(m^3)	(m^3)	(mm)	(hr)	(m^2)	(m)	**(m)**		(m)
A	12.4	0.4	24	744	0.035	0.035	**2**	0.70	1.76	300	10	6	21.3	**0.3**	1.5	0.4
L	12.4	0.4	24	744	0.009	0.009	**2**	0.18	0.45	300	10	1	6.1	**0.2**	1.5	0.4
B	12.4	0.4	24	744	0.024	0.024	**2**	0.47	1.18	300	10	4	15.2	**0.3**	1.5	0.4
C	12.4	0.4	24	744	0.019	0.019	**2**	0.38	0.95	300	10	3	13.1	**0.2**	1.5	0.4

Project Description: York Downs MESP
Job Number: 160622264
Creation Date: 10-Apr-18

For private lots following City of Markham Draft LID Guidelines 2018

Target depth = **2** **mm / Imp ha / event**

Rain Barrell - IN LOT

Note the drainage area is estimated to be building envelope area per lot

Typical Rain Barrell Volume =	55	gal	
	208	L	
	0.2	m^3	

input
output

Example Calculation:

Typical Roof Area =	0.035	ha
	350	m2
Capture Rainfall =	2	mm
Capture Volume =	0.7	m^3
Number of Rain Barrells Required =	4	
Redundancy Factor =	2.50	per City of Markham Draft LID Guidelines 2108
Total Number of Rainbarrells =	10	

	Building Envelope Area	Drainage Area	Water Quality Depth	Water Quality Volume	**Rain Barrells Required**	Redundancy Factor (from City of Markham LID Manual - DRAFT, 2018)	Total Rain Barrells Required	Comments
		Size for Entire roof	WQD	WQV				
(Lot ID)	(ha)	(ha)	(mm)	(m^3)				
A	0.035	0.035	**2**	0.70	**4**	2.50	10	*NOT FEASIBLE*
L	0.009	0.009	**2**	0.18	**1**	2.50	3	*LIKELY NOT FEASIBLE*
B	0.009	0.009	**2**	0.18	**1**	2.50	3	
C	0.019	0.019	**2**	0.38	**2**	2.50	5	*NOT FEASIBLE*

Project Description: York Downs MESP
Job Number: 160622264
Creation Date: 10-Apr-18

For private lots following City of Markham Draft LID Guidelines 2018

Target depth = **2** **mm / Imp ha / event**

Permeable Paver Sizing Calculation - IN LOT

Note the drainage area is estimated to be building envelope area per lot

source: ***Low Impact Development Stormwater Management Planning and Design Guide*** **, p 4-58**

input
output

$d_{r\,max} = I \times t_s / V_r$

$d_{r\,max}$ =	744	maximum stone reservoir depth (mm)
I =	12.4	infiltration rate assumed for calculations (mm/hr) *minimum evaluated in situ testing for native soils = 50 mm/hr
Vr =	0.4	Void space ratio for aggregate used (typically 0.40 for 50 mm clear stone)
t_s =	24	Time to drain (design for 48 hr drain time recommended)

Example Calculation:

Af = WQV / (dr * Vr)

Where:

A_f =	6	Footprint surface area (m2)
Average Building Envelope Area =	0.035	(ha)
Drainage Area =	0.035	(ha)
WQD=	2.00	Water Quality Depth (mm)
WQV =	0.704	Water quality volume (m^3)
d_r =	0.30	Stone reservoir depth (m)
V_r =	0.4	Void space ratio for aggregate used (typically 0.4 for 50 mm clear stone)
Typical Driveway Area	54.0	(m)
	OK	

Note:The ratio of impervious drainage area to footprint surface area of the practice should be between 5:1 and 20:1 to limit the rate of accumulation of fine sediments and thereby prevent clogging.

	Infiltration Rate	Void Ratio	Recommended Drain Time	Max. Stone Depth	Building Envelope Area	Drainage Area	Water Quality Depth	Water Quality Volume	Trench Volume	Actual Stone Depth	Actual Drain Time	**Footprint Area**	Typical Driveway Area	Check if Driveway Area is greater than footprint Area	Redundancy Factor (from City of Markham LID Manual - DRAFT, 2018)	Perm Paver Area adjusted for redundancy	Check if Driveway Area is greater than footprint Area
	i	Vr	t_s	$d_{r\,max}$		Size for Entire roof	WQD	WQV		d_r	t (TRCA Eqn)	**A_f (TRCA Eqn)**					
(Lot ID)	(mm/hr)		(hr)	(mm)	(ha)	(ha)	(mm)	(m^3)	(m^3)	(mm)	(hr)	**(m^2)**	(m^2)			(m^2)	
A	12.4	0.4	24	744	0.035	0.035	**2**	0.70	1.76	300	10	**6**	54.0	OK	2.58	15.1	OK
L	12.4	0.4	24	744	0.009	0.009	**2**	0.18	0.45	300	10	**1**	35.0	OK	2.58	3.8	OK
B	12.4	0.4	24	744	0.009	0.009	**2**	0.18	0.45	300	10	**1**	36.0	OK	2.58	3.8	OK
C	12.4	0.4	24	744	0.019	0.019	**2**	0.38	0.95	300	10	**3**	36.0	OK	2.58	8.1	OK

Project Description: York Downs MESP
Job Number: 160622264
Creation Date: 10-Apr-18

For private blocks following City of Markham Draft LID Guidelines 2018

Target depth = 2 mm / Imp ha / event

Note the drainage area % of block area varies for each block as follows: Block 19 - 50 %, Block 20 & 21 -30%

Perforated RLC Trench Sizing Calculation - PRIVATE BLOCKS

source: ***Low Impact Development Stormwater Management Planning and Design Guide*** **, p 4-58**

input
output

$d_{r\,max} = I \times t_s / V_r$

$d_{r\,max}$ =	744	maximum stone reservoir depth (mm)
I =	12.4	infiltration rate assumed for calculations (mm/hr) *minimum evaluated in situ testing for native soils = 50 mm/hr
Vr =	0.4	Void space ratio for aggregate used (typically 0.40 for 50 mm clear stone)
t_s =	24	Time to drain (design for 48 hr drain time recommended)

Example Calculation:

Af = WQV / (dr * Vr)
Where:

A_f =	144	Footprint surface area (m2)
Average Building Envelope Area =	3.430	(ha)
Drainage Area =	1.715	(ha)
WQD=	2.00	Water Quality Depth (mm)
WQV =	34.3	Water quality volume (m^3)
d_r =	0.60	Stone reservoir depth (m)
V_r =	0.4	Void space ratio for aggregate used (typically 0.4 for 50 mm clear stone)
Length	396	(m)
Width of Stone Required	0.4	(m)

Note:The ratio of impervious drainage area to footprint surface area of the practice should be between 5:1 and 20:1 to limit the rate of accumulation of fine sediments and thereby prevent clogging.

	Infiltration Rate	Void Ratio	Recommended Drain Time	Max. Stone Depth	Block Area	Drainage Area	Water Quality Depth	Water Quality Volume	Trench Volume	Actual Stone Depth	Actual Drain Time	Footprint Area	Length of Trench	**Infiltration Trench Width**	Redundancy Factor (from City of Markham LID Manual - DRAFT, 2018)	Infiltration Trench Width adjusted for redundancy
	i	Vr	t_s	$d_{r\,max}$			WQD	WQV		d_r	t (TRCA Eqn)	A_f (TRCA Eqn)		**w**		
(Block ID)	(mm/hr)		(hr)	(mm)	(ha)	(ha)	(mm)	(m^3)	(m^3)	(mm)	(hr)	(m^2)	(m)	**(m)**		(m)
19W	12.4	0.4	24	744	3.430	1.72	**2**	34.30	85.75	600	19	143	396	**0.4**	1.5	0.5
20W	12.4	0.4	24	744	1.330	0.40	**2**	7.98	19.95	600	19	33	145	**0.2**	1.5	0.3
21W	12.4	0.4	24	744	1.640	0.49	**2**	9.84	24.60	600	19	41	285	**0.1**	1.5	0.2

APPENDIX E.2
SIR STRATEGY – IN LOT LID CALCS

Project Description: York Downs MESP
Job Number: 160622264
Creation Date: 10-Apr-18

Target depth = **25** **mm / Imp ha / event**

Note the drainage area % of block area varies for each block as follows: Block 19 - 50 %, Block 20 & 21 -30%

Perforated RLC Trench Sizing Calculation - PRIVATE BLOCKS

source: ***Low Impact Development Stormwater Management Planning and Design Guide*** **, p 4-58**

input
output

$d_{r\,max} = I \times t_s / V_r$

$d_{r\,max}$ =	744	maximum stone reservoir depth (mm)
I =	12.4	infiltration rate assumed for calculations (mm/hr) *minimum evaluated in situ testing for native soils = 50 mm/hr
Vr =	0.4	Void space ratio for aggregate used (typically 0.40 for 50 mm clear stone)
t_s =	24	Time to drain (design for 48 hr drain time recommended)

Example Calculation:

Af = WQV / (dr * Vr)

Where:

A_f =	1801	Footprint surface area (m2)
Average Building Envelope Area =	3.430	(ha)
Drainage Area =	1.715	(ha)
WQD=	25.00	Water Quality Depth (mm)
WQV =	428.75	Water quality volume (m^3)
d_r =	0.60	Stone reservoir depth (m)
V_r =	0.4	Void space ratio for aggregate used (typically 0.4 for 50 mm clear stone)
Length	396	(m)
Width of Stone Required	4.5	(m)

Note:The ratio of impervious drainage area to footprint surface area of the practice should be between 5:1 and 20:1 to limit the rate of accumulation of fine sediments and thereby prevent clogging.

	Infiltration Rate	Void Ratio	Recommended Drain Time	Max. Stone Depth	Block Area	Drainage Area	Water Quality Depth	Water Quality Volume	Trench Volume	Actual Stone Depth	Actual Drain Time	Footprint Area	Length of Trench	**Infiltration Trench Width**	Redundancy Factor (from City of Markham LID Manual - DRAFT, 2018)	Infiltration Trench Width adjusted for redundancy
	i	Vr	t_s	$d_{r\,max}$			WQD	WQV		d_r	t (TRCA Eqn)	A_f (TRCA Eqn)		**w**		
(Block ID)	(mm/hr)		(hr)	(mm)	(ha)	(ha)	(mm)	(m^3)	(m^3)	(mm)	(hr)	(m^2)	(m)	**(m)**		(m)
19W	12.4	0.4	24	744	3.430	1.72	**25**	428.75	1071.88	600	19	1786	396	**4.5**	1.5	6.8
20W	12.4	0.4	24	744	1.330	0.40	**25**	99.75	249.38	600	19	416	145	**2.9**	1.5	4.3
21W	12.4	0.4	24	744	1.640	0.49	**25**	123.00	307.50	600	19	513	285	**1.8**	1.5	2.7

Project Description: York Downs MESP
Job Number: 160622264
Creation Date: 10-Apr-18

Target depth = **25** **mm / Imp ha / event**

Perforated RLC Trench Sizing Calculation - IN LOT

Note the drainage area is estimated to be half of the building envelope area per lot

source: ***Low Impact Development Stormwater Management Planning and Design Guide*** **, p 4-58**

input
output

$d_{r\,max} = I \times t_s / V_r$

$d_{r\,max}$ =	744	maximum stone reservoir depth (mm)
I =	12.4	infiltration rate assumed for calculations (mm/hr) *minimum evaluated in situ testing for native soils = 50 mm/hr
Vr =	0.4	Void space ratio for aggregate used (typically 0.40 for 50 mm clear stone)
t_s =	24	Time to drain (design for 48 hr drain time recommended)

Example Calculation:

Af = WQV / (dr * Vr)

Where:

A_f =	18	Footprint surface area (m2)
Average Building Envelope Area =	0.035	(ha)
Drainage Area =	0.018	(ha)
WQD=	25.00	Water Quality Depth (mm)
WQV =	4.4	Water quality volume (m^3)
d_r =	0.60	Stone reservoir depth (m)
V_r =	0.4	Void space ratio for aggregate used (typically 0.4 for 50 mm clear stone)
Frontage	21.3	(m)
Width of Stone Required	0.9	(m)

Note:The ratio of impervious drainage area to footprint surface area of the practice should be between 5:1 and 20:1 to limit the rate of accumulation of fine sediments and thereby prevent clogging.

	Infiltration Rate	Void Ratio	Recommended Drain Time	Max. Stone Depth	Building Envelope Area	Drainage Area	Water Quality Depth	Water Quality Volume	Trench Volume	Actual Stone Depth	Actual Drain Time	Footprint Area	Lot Frontage	**Infiltration Trench Width**	Redundancy Factor (from City of Markham LID Manual - DRAFT, 2018)	Infiltration Trench Width adjusted for redundancy
	i	Vr	t_s	$d_{r\,max}$		Size for half roof	WQD	WQV		d_r	t (TRCA Eqn)	A_f (TRCA Eqn)		**w**		
(Lot ID)	(mm/hr)		(hr)	(mm)	(ha)	(ha)	(mm)	(m^3)	(m^3)	(mm)	(hr)	(m^2)	(m)	**(m)**		(m)
A	12.4	0.4	24	744	0.035	0.018	**25**	4.40	11.00	600	19	18	21.3	**0.9**	1.5	1.29
L	12.4	0.4	24	744	0.009	0.004	**25**	1.11	2.78	600	19	5	6.1	**0.8**	1.5	1.14
B	12.4	0.4	24	744	0.024	0.012	**25**	2.94	7.34	600	19	12	15.2	**0.8**	1.5	1.20
C	12.4	0.4	24	744	0.019	0.009	**25**	2.36	5.91	600	19	10	13.1	**0.8**	1.5	1.13

Project Description: York Downs MESP
Job Number: 160622264
Creation Date: 10-Apr-18

Target depth = **25** **mm / Imp ha / event**

Rain Barrell - IN LOT

Note the drainage area is estimated to be half of building envelope area per lot

Typical Rain Barrell Volume =	55	gal
	208	L
	0.2	m^3

input
output

Example Calculation:

Typical Roof Area =	0.035	ha
	350	m2
Capture Rainfall =	2	mm
Capture Volume =	0.7	m^3

Number of Rain Barrells Required = 4

Redundancy Factor = 2.50 per City of Markham Draft LID Guidelines 2108

Total Number of Rainbarrells = 10

	Building Envelope Area	Drainage Area	Water Quality Depth	Water Quality Volume	**Rain Barrells Required**	Redundancy Factor (from City of Markham LID Manual - DRAFT, 2018)	Total Rain Barrells Required	Comments
		Size for Half roof	WQD	WQV				
(Lot ID)	(ha)	(ha)	(mm)	(m^3)				
A	0.035	0.018	**25**	4.40	**22**	2.50	55	*NOT FEASIBLE AS STANDALONE OPTION*
L	0.009	0.004	**25**	1.11	**6**	2.50	15	*NOT FEASIBLE AS STANDALONE OPTION*
B	0.009	0.004	**25**	1.11	**6**	2.50	15	*NOT FEASIBLE AS STANDALONE OPTION*
C	0.019	0.009	**25**	2.36	**12**	2.50	30	*NOT FEASIBLE AS STANDALONE OPTION*

Project Description: York Downs MESP
Job Number: 160622264
Creation Date: 10-Apr-18

Target depth = **25** **mm / Imp ha / event**

Permeable Paver Sizing Calculation - IN LOT

Note the drainage area is estimated to be half of the building envelope area per lot

source: ***Low Impact Development Stormwater Management Planning and Design Guide*** **, p 4-58**

input
output

$d_{r\,max} = I \times t_s / V_r$

$d_{r\,max}$ =	744	maximum stone reservoir depth (mm)
I =	12.4	infiltration rate assumed for calculations (mm/hr) *minimum evaluated in situ testing for native soils = 50 mm/hr
Vr =	0.4	Void space ratio for aggregate used (typically 0.40 for 50 mm clear stone)
t_s =	24	Time to drain (design for 48 hr drain time recommended)

Example Calculation:

Af = WQV / (dr * Vr)

Where:

A_f =	18	Footprint surface area (m2)
Average Building Envelope Area =	0.035	(ha)
Drainage Area =	0.018	(ha)
WQD=	25.00	Water Quality Depth (mm)
WQV =	4.4	Water quality volume (m^3)
d_r =	0.60	Stone reservoir depth (m)
V_r =	0.4	Void space ratio for aggregate used (typically 0.4 for 50 mm clear stone)
Typical Driveway Area	54.0	(m)
	OK	

Note:The ratio of impervious drainage area to footprint surface area of the practice should be between 5:1 and 20:1 to limit the rate of accumulation of fine sediments and thereby prevent clogging.

	Infiltration Rate	Void Ratio	Recommended Drain Time	Max. Stone Depth	Building Envelope Area	Drainage Area	Water Quality Depth	Water Quality Volume	Trench Volume	Actual Stone Depth	Actual Drain Time	**Footprint Area**	Typical Driveway Area	Check if Driveway Area is greater than footprint Area	Redundancy Factor (from City of Markham LID Manual - DRAFT, 2018)	Perm Paver Area adjusted for redundancy	Check if Driveway Area is greater than footprint Area
	i	Vr	t_s	$d_{r\,max}$		Half roof	WQD	WQV		d_r	t (TRCA Eqn)	**A_f (TRCA Eqn)**					
(Lot ID)	(mm/hr)		(hr)	(mm)	(ha)	(ha)	(mm)	(m^3)	(m^3)	(mm)	(hr)	**(m^2)**	(m^2)			(m^2)	
A	12.4	0.4	24	744	0.035	0.018	**25**	4.40	11.00	600	19	**18**	54.0	OK	2.58	47	OK
L	12.4	0.4	24	744	0.009	0.004	**25**	1.11	2.78	300	10	**9**	35.0	OK	2.58	24	OK
B	12.4	0.4	24	744	0.024	0.012	**25**	2.94	7.34	600	19	**12**	36.0	OK	2.58	32	OK
C	12.4	0.4	24	744	0.019	0.009	**25**	2.36	5.91	600	19	**10**	36.0	OK	2.58	25	OK

Project Description: York Downs MESP
Job Number: 160622264
Creation Date: 10-Apr-18

Target depth = **25** **mm / Imp ha / event**

Bioretention Enclave (Typical Size) - PUBLIC ROAD

source: Low Impact Development Stormwater Management Planning and Design Guide, p 4-87

input
output

$d_{c\,max} = i \times (t_s - d_p/i_j / V_r$

$d_{c\,max}$ =	544	maximum stone reservoir depth (mm)
i =	12.4	infiltration rate assumed for calculations (mm/hr) *minimum evaluated in situ testing for native soils = 50 mm/hr
Vr =	0.4	Void space ratio for aggregate used (typically 0.40 for 50 mm clear stone)
t_s =	24	Time to drain (design for 48 hr drain time recommended)
d_p =	80	Maximum surface ponding depth (mm)

Example Calculation:

Af = WQV / (dr * Vr)

Where:

A_f =	469	Footprint surface area (m2)
Drainage Area =	0.450	(ha)
WQD=	25.00	Water Quality Depth (mm)
WQV =	112.5	Water quality volume (m^3)
d_r =	0.60	Stone reservoir depth (m)
V_r =	0.4	Void space ratio for aggregate used (typically 0.4 for 50 mm clear stone)

Note:The ratio of impervious drainage area to footprint surface area of the practice should be between 5:1 and 20:1 to limit the rate of accumulation of fine sediments and thereby prevent clogging.

	Infiltration Rate	Void Ratio	Recommended Drain Time	Max. Stone Depth	Block Area	Drainage Area	Water Quality Depth	Water Quality Volume	Trench Volume	Actual Stone Depth	Actual Drain Time	**Footprint Area**	Ratio of Roof to Foot Print Area	Redundancy Factor (from City of Markham LID Manual - DRAFT, 2018)	Footprint Area adjusted for redundancy
	i	Vr	t_s	$d_{r\,max}$			WQD	WQV		d_r	t (TRCA Eqn)	**A_f (TRCA Eqn)**			
(Bioretention ID)	(mm/hr)		(hr)	(mm)	(ha)	(ha)	(mm)	(m^3)	(m^3)	(mm)	(hr)	**(m^2)**			(m^2)
1	12.4	0.4	24	544	0.450	0.45	**25**	112.50	281.25	600	19	**469**	**10**	1.5	703

Avail Surf Area = 730 m^2