



**51, 53, 55 & 75 Bradford Street &
20 Checkley Street
City of Barrie**

**Bunker's Creek
Regulatory Floodplain Analysis and
Floodplain Cut Fill Design**

August 2020

Submitted by:

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Project Number: 2196

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- Appendix C HEC-RAS Modelling
- Appendix D Floodplain Cut/Fill Calculations

SUBMISSION HISTORY

Submission	Date	In Support Of	Distributed To
1 st	February 2020	Official Plan Amendment and Zoning By-Law Amendment	City of Barrie, Barrie Lakeshore Developments
2 nd	August 2020	Official Plan Amendment and Zoning By-Law Amendment	City of Barrie, Barrie Lakeshore Developments

1.0 INTRODUCTION

SCS Consulting Group Ltd. has been retained by Barrie Lakeshore Developments to prepare this Bunker's Creek Regulatory Floodline Analysis report in support of the submission for Official Plan Amendment (OPA) and Zoning By-Law Amendment (ZBLA) from the City of Barrie for the proposed development of the property located at 51, 53, 55 and 75 Bradford Street and 20 Checkley Street in the City of Barrie.

1.1 Study Area

The subject site is generally bound by Bradford Street to the west, existing commercial development, residential development and Simcoe Street to the north, Lakeshore Drive to the east and Bunker's Creek to the south (refer to **Figure 2.1**).

The subject development is approximately 3.5 ha in size and is proposed to consist of high-rise mixed-use buildings providing opportunities for street related commercial uses, residential uses, hotel and amenity uses. The Site Plan is included in **Appendix A**.

The study area drains to Bunker's Creek, which outlets to Lake Simcoe immediately downstream (east) of Lakeshore Drive.

1.2 Purpose and Objectives of the Floodplain Analysis

This floodplain analysis has been prepared in support of the OPA and ZBLA approval process. The floodplain limits will inform the delineation of the proposed development limits.

1.3 Previous Documentation

Bunker's Creek

The Lake Simcoe and Region Conservation Authority (LSRCA) have previously prepared draft hydraulic (HEC-RAS) modelling for Bunker's Creek (2005) and this modelling is considered their Regulatory modelling. A copy of the 2005 HEC-RAS model was obtained from LSRCA and used as the basis of the floodplain analysis, as directed by LSRCA (refer to **Appendix C**).

The Regulatory storm event for Bunker's Creek is the 100 year storm event.

It is noted that this model utilizes a starting water elevation at Lake Simcoe of 219.5 m, which represents the high-water level of Lake Simcoe. It is also noted that this LSRCA model does not account for the significant reconstruction of Lakeshore Drive and the crossings of Bunker's Creek that were completed between the years 2014 and 2016 (based on IBI 2013 design).

Kidd's Creek

The LSRCA have draft HEC-RAS modelling for Kidd's Creek (2013) and this modelling is considered their Regulatory modelling. A copy of the 2013 model was obtained from LSRCA and used as the basis of the floodplain analysis, as directed by LSRCA (**Appendix C**).

The Regulatory storm event for Kidd's Creek is the Regional Storm (Hurricane Hazel) event.

2.0 FLOODPLAIN ANALYSIS

Detailed topographic mapping for the site and the Lakeshore Drive right-of way from approximately 255 m north of Simcoe Street to Dymet's Creek to the south was completed by Schaeffer Dzaldov Bennett Ltd. in late 2019 / early 2020 and further updated in July 2020 and was utilized as the base for the floodplain analysis and mapping (refer to **Appendix B**).

2.1 Kidd's Creek

The LSRCA's draft Kidd's Creek HEC-RAS model was combined into the LSRCA's draft Bunker's Creek model for ease of modelling. The Kidd's Creek geometry file "KF2LiHECRASUpdated_GR" has been imported into the Bunker's Creek geometry file as "River-1 REACH-2".

Based on discussions with LSRCA, the draft Kidd's Creek modelling was updated to:

- ➔ Revise the alignment of cross-section 211.5 to have the portion south of the Lakeshore Drive culvert crossing follow the centerline of Lakeshore Drive;
- ➔ Revise the alignment of cross-section 201.3 to follow the boulevard parallel to realigned cross-section 211.5;
- ➔ Shortened the length of cross-section 172.3 to not overlap with cross-section 201.3; and
- ➔ Revise the geometry of cross-sections 211.5 and 201.3 for the portions of the cross-sections that were included in the recent detailed topographic survey.

The new HEC-RAS plan name that incorporates the above revisions is called "SCS - Feb 2020 - Post LkShrDr Recnstr". A copy of the HEC-RAS model and output is included in **Appendix C**.

The results indicate that the Regional Storm flow downstream of Lakeshore Drive (at cross-section 211.5) is fully contained within the channel and therefore, there is no spill across Lakeshore Drive and/or to the south that would interact with the Regulatory floodline associated with the adjacent Bunker's Creek. Therefore, there was no need to balance the Regulatory floodlines of Bunker's and Kidd's Creeks at Lakeshore Drive, as initially contemplated and discussed with LSRCA.

2.2 Bunker's Creek

2.2.1 Pre Lakeshore Drive Reconstruction Regulatory Floodline

The LSRCA's draft Bunker's Creek HEC-RAS modelling (plan name "BunkEx_GR_2195") was updated to:

- ➔ Shift cross-section 264 downstream by 7 m to reflect the toe of the Bradford Street embankment, and rename to cross-section 257 for the stationing change;
- ➔ Update the geometry of cross-sections 66, 116, 166, 216, and 264 to reflect the recent detailed topographic survey for the portions of the cross-sections that the detailed survey covered;

- Adjust channel reach lengths for cross-sections 66 and 116 to be consistent with the left and right overbank reach lengths; and,
- Added in obstruction/levee to reflect existing high-rise buildings at 33 Ellen Street to the south of the site.

The new HEC-RAS plan name that incorporates the above revisions is called “SCS - Feb 2020 - Pre LkShrDr Recnstr”. A copy of the HEC-RAS model and output is included in **Appendix C**.

The resulting Regulatory (100 year) floodplain limits that would have reflected the Regulatory floodplain prior to the Lakeshore Drive reconstruction are illustrated on **Figure 2.1**.

2.2.2 Post Lakeshore Drive Reconstruction Regulatory Floodline

Based on discussions and meetings with LSRCA and the City of Barrie, the LSRCA’s draft Bunker’s Creek HEC-RAS model needed to be updated to reflect the Lakeshore Drive reconstruction, as this LSRCA model was not used in the modelling that was completed to support the Lakeshore Drive reconstruction works (i.e. other HEC-RAS modelling was completed, but not adopted by LSRCA as the Regulatory model).

Therefore, the “Pre Lakeshore Drive Reconstruction” Bunker’s Creek modelling described above in **Section 2.2.1** was further updated to reflect the current configuration of Lakeshore Drive and the Bunker’s Creek crossings based on the recently completed topographic survey by Schaeffer Dzaldov Bennett surveyors.

The “Pre Lakeshore Drive Reconstruction” Bunker’s Creek modelling (plan name “SCS - Feb 2020 - Pre LkShrDr Reconstr”) was further updated to:

- Delete cross-sections 53.5, 37, 34, and 16.5 from the Bunker’s creek reach, and add new cross sections 9.5 and 21.5, as required to model the updated crossings;
- Update the deck coding and culvert configuration of the Lakeshore Drive and bike trail crossings (at bridges 41.5 and 5.5, respectively) to reflect the recent detailed topographic survey; and
- Shift cross-section 61 downstream by 8 m to reflect the topography of the Lakeshore Drive boulevard at the approach to the bridge, this section was renamed to section 54 to reflect the stationing change.

As discussed with LSRCA and noted in the first submission comment letter dated June 8, 2020, there was not containment of the Regulatory flood elevations on cross-sections 289, 257, and 216 in the first submission of this report. As discussed with LSRCA, these sections have been extended south and updated utilizing LSRCA DEM elevations provided by LSRCA. The resulting updated model shows containment of the Regulatory flood elevation at these cross-sections. Refer to **Appendix C**.

It is noted that the Lakeshore Drive road deck was coded on the upstream and downstream side as the highest of the: centreline of asphalt, centre median, median planters, or the culvert parapet wall. The new HEC-RAS plan name that incorporates the above revisions is called

“SCS - Feb 2020 - Post LkShrDr Recnstr”. A copy of the HEC-RAS model and output is included in **Appendix C**.

The resulting Regulatory (100 year) floodplain limits that reflect the current conditions (post Lakeshore Drive reconstruction) are illustrated on **Figure 2.1**. As shown, the existing Regulatory flood elevations through the site based on current (post Lakeshore Drive reconstruction) conditions are up to 0.25 m higher than the Regulatory floodplain elevations that existed prior to the Lakeshore Drive reconstruction.

3.0 PROPOSED FLOODPLAIN MODIFICATIONS

Modifications are proposed to the Regulatory floodplain to regularize the development limit along the north edge of the creek and a floodplain cut/fill analysis has been prepared to support the proposed modifications. For the purpose of the floodplain cut/fill analysis, the design was prepared using the “Post Lakeshore Drive Reconstruction” results, which is referred to as the existing floodplain in **Section 2.2.2** of this report.

3.1 Proposed Floodplain Fill

As shown on **Figure 3.1**, the proposed development will fill in the existing floodplain.

It is proposed to provide compensating cut on a net volume approach, which is justifiable given that the reach adjacent to the site is in an existing backwater condition caused by the undersized crossing at Lakeshore Drive. The proposed development will fill in the existing floodplain resulting in an unmitigated loss of approximately **1,100 m³** of floodplain storage, and the calculation is presented in **Appendix D**.

3.2 Proposed Floodplain Cut and Grading Design

Compensating cut is proposed to be provided in a park adjacent to Bunker's Creek. The park will provide trails and passive recreation, with grades above the high-water elevation of Lake Simcoe at 219.50 m.

The proposed floodplain cut grading begins by matching existing grades at the limit of the staked wetland, refer to **Figure 3.2** for details. In three localized areas, it is proposed to cut into the existing wetland, specifically at the southeast corner of Tower 4 and in the vicinity of the two proposed storm outfall channels to the existing pond. This concept was discussed and agreed upon with LSRCA at the pre-consultation meeting on September 10, 2019. Refer to the Environmental Impact Study (Beacon, August 2020) for details related to the restoration of the wetland areas proposed to be disturbed with the floodplain cut.

From the match line at the wetland, the grading slopes up at 0.5% to promote positive drainage to Bunker's Creek. The grading finishes with a 3:1 slope up to the retaining wall. Other slopes within the floodplain cut area are gradual between 0.5% and 5.0% maximum, as required for the inclusion of two storm outfall channels. The proposed grading is shown in **Appendix D**.

The proposed grading design creates approximately **1,400 m³** of floodplain storage, which is sufficient to offset the floodplain fill volume and provided a **net gain of approximately 300 m³** in floodplain storage. Proposed cut below the Lake Simcoe high water elevation of 219.50 m has not been counted toward the total floodplain cut volume. The floodplain cut volume calculation is presented in **Appendix D**.

3.3 Proposed Floodplain

A HEC-RAS scenario has been prepared with the proposed grading to assess impacts to the existing Regulatory floodplain. The results indicate that there will be no adverse effects on existing flood levels due to the proposed floodplain modifications. Regulatory flood elevations are all either maintained or decreased in the proposed grading scenario. Refer to scenario "SCS – Aug 2020 – Cut Fill" in **Appendix C**. The proposed development can be graded to provide a minimum of 0.3 m of freeboard from the Regulatory floodplain.

4.0 FUTURE FLOODPLAIN MODEL UPDATES

4.1 Bunker's Creek Culvert Replacement and Watercourse Improvements

The City of Barrie's Bunker's Creek Master Drainage Plan Update (Giffels, June 2004) and subsequent Drainage Master Plan (Tatham Engineering, March 2019) identified proposed improvements to the Bunker's Creek watercourse crossing at Bradford Street to increase the conveyance capacity of the road crossing and reduce the frequency of flooding and depth and velocity of overtopping during the Regulatory event such that safe access/egress will be provided across Bradford Street.

The proposed culvert improvement proposed requires watercourse improvements up and downstream of Bradford Street to accommodate the wider span structure of the crossing. Downstream of Bradford Street, the low flow channel has limited capacity (less than the 2 year storm event). The low flow channel is proposed to be widened to approximately 15.3 m and redesigned using natural channel design principles. The proposed widening works will improve the hydraulics of the drainage system and reduce the extent and frequency of flooding.

The City of Barrie has recently retained a consultant to undertake the design of the Bunker's Creek culvert and watercourse improvements. The detailed design of the culvert and watercourse improvements will be incorporated into the HEC-RAS model. We will continue to work with the City, LSRCA and private landowners as these studies progress.

Respectfully Submitted:

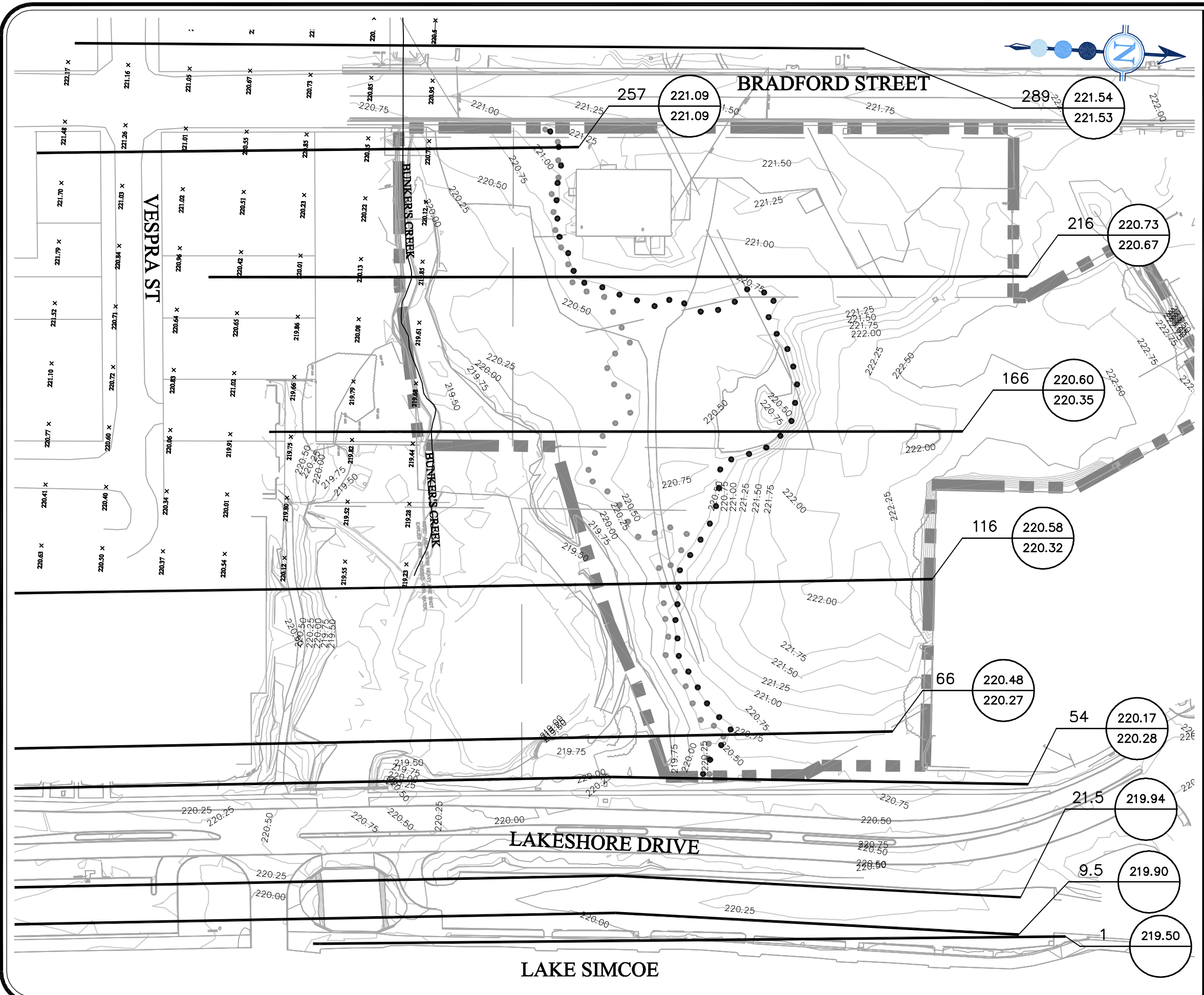
SCS Consulting Group Ltd.




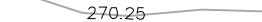








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LEGEND:

-  PROPERTY BOUNDARY
-  EXISTING CONTOUR AND ELEVATION
-  EXISTING REGULATORY FLOODLINE (PRIOR TO LAKESHORE DRIVE RECONSTRUCTION)
-  EXISTING REGULATORY FLOODLINE (POST LAKESHORE DRIVE RECONSTRUCTION)
-  EXISTING REGULATORY FLOOD ELEVATION (POST LAKESHORE DRIVE RECONSTRUCTION)
-  HEC-RAS SECTION ID
-  HEC-RAS SECTION LEADER
-  EXISTING REGULATORY FLOOD ELEVATION (PRIOR TO LAKESHORE DRIVE RECONSTRUCTION)
-  HEC - RAS CROSS-SECTION
-  ELEVATION FROM LSRCA DEM (JUNE 2020)



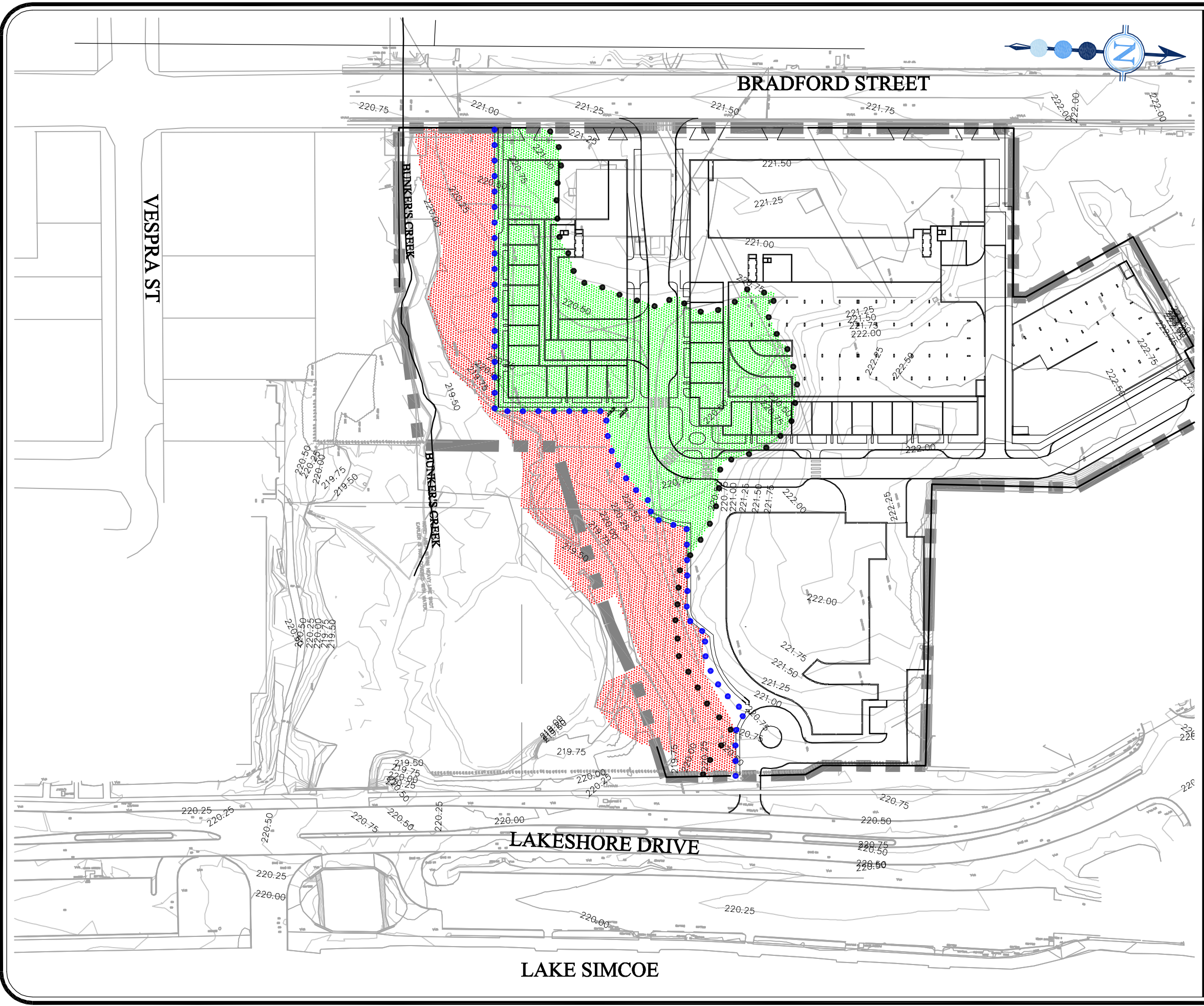
30 CENTURIAN DRIVE, SUITE 100
 MARKHAM, ONTARIO L3R 8B8
 TEL: (905) 475-1900
 FAX: (905) 475-8335

BARRIE LAKESHORE DEVELOPMENTS


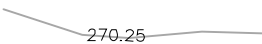


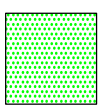
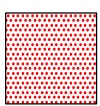
51, 53, 55 & 75 BRADFORD STREET AND 20 CHECKLEY STREET- BARRIE

BUNKER'S CREEK REGULATORY FLOODLINES

DESIGNED BY: B.O.	CHECKED BY: S.E.K.
SCALE: 1:1250	DATE: AUGUST 2020
PROJECT No: 2196	FIGURE No: 2.1



LEGEND:

-  PROPERTY BOUNDARY
-  EXISTING CONTOUR AND ELEVATION
-  EXISTING REGULATORY FLOODLINE (POST LAKESHORE DRIVE RECONSTRUCTION)
-  PROPOSED REGULATORY FLOODLINE
-  AREA OF FILL
-  AREA OF CUT



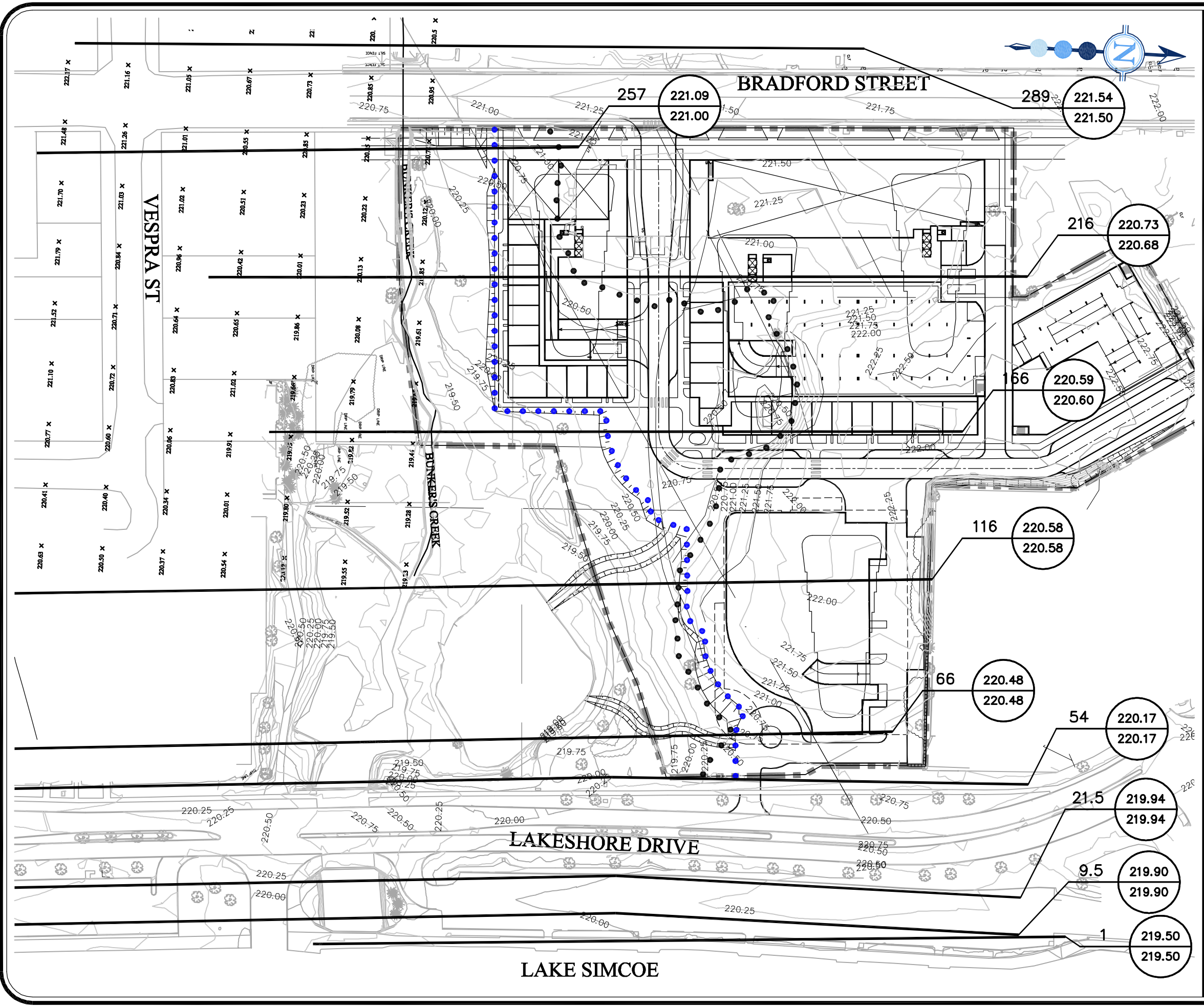
30 CENTURIAN DRIVE, SUITE 100
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BARRIE LAKESHORE DEVELOPMENTS


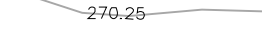



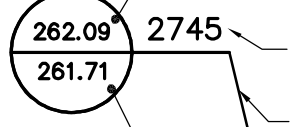



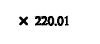
51, 53, 55 & 75 BRADFORD STREET AND 20 CHECKLEY STREET- BARRIE

BUNKER'S CREEK PROPOSED CUT AND FILL AREAS

DESIGNED BY: B.O.	CHECKED BY: S.E.K.
SCALE: 1:1250	DATE: AUGUST 2020
PROJECT No: 2196	FIGURE No: 3.1



LEGEND:

-  PROPERTY BOUNDARY
-  EXISTING CONTOUR AND ELEVATION
-  PROPOSED REGULATORY FLOODLINE
-  EXISTING REGULATORY FLOODLINE (POST LAKESHORE DRIVE RECONSTRUCTION)
-  EXISTING REGULATORY FLOOD ELEVATION (POST LAKESHORE DRIVE RECONSTRUCTION)
-  HEC-RAS SECTION ID
-  HEC-RAS SECTION LEADER
-  PROPOSED REGULATORY FLOOD ELEVATION
-  HEC - RAS CROSS-SECTION
-  ELEVATION FROM LSRCA DEM (JUNE 2020)

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BARRIE LAKESHORE DEVELOPMENTS

51, 53, 55 & 75 BRADFORD STREET AND 20 CHECKLEY STREET- BARRIE

BUNKER'S CREEK PROPOSED REGULATORY FLOODLINE

DESIGNED BY: B.O.	CHECKED BY: S.E.K.
SCALE: 1:1250	DATE: AUGUST 2020
PROJECT No: 2196	FIGURE No: 3.2

APPENDIX A

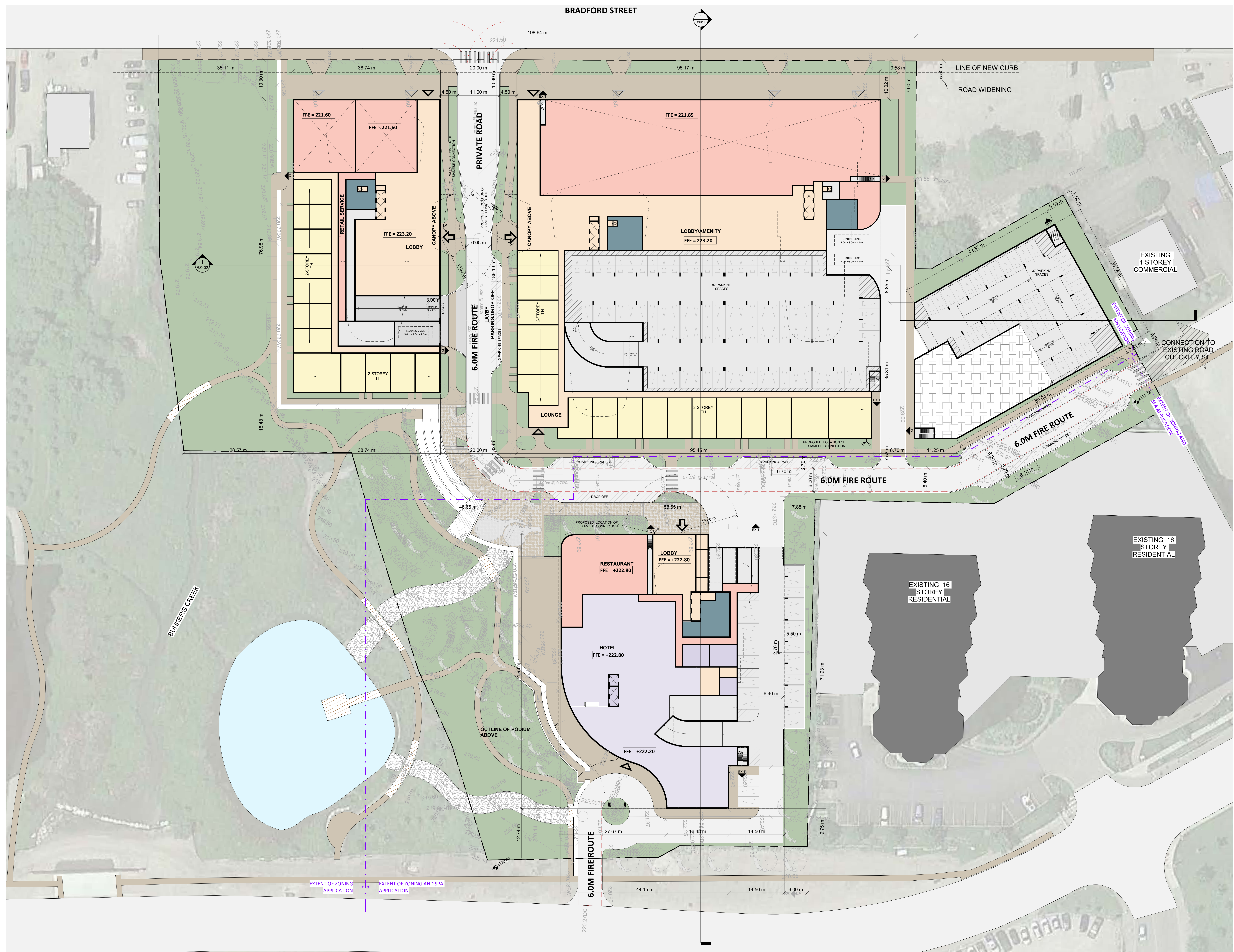
SITE PLAN

LEGEND

- PRIMARY RESIDENTIAL / HOTEL ENTRANCE
- SECONDARY RESIDENTIAL / HOTEL ENTRANCE
- RETAIL ENTRANCE
- EXIT
- FIRE HYDRANT
- SIAMESE CONNECTION
- CONVEX MIRROR
- TRANSFORMER WITH CLEARANCES
- FIRE ROUTE SIGN
- SPOT ELEVATION
- GAS HYDRO METER

PARKING STANDARDS

2.70 m
5.50 m
TYPICAL
TYPE A
TYPE B
3.40 m
3.10 m
0.75 m
0.50 m
PARALLEL



1 RZ-GROUND FLOOR PLAN
RZ102 1 : 300

DATE	DESCRIPTION	BY
2019-09-09	ISSUED FOR PERMITTING	OP

PROJECT: **BARRIE WATERFRONT**
51, 53, 55 & 57 BRADFORD STREET AND 20 CHECKLEY STREET, BARRIE, ON

DRAWING: **GROUND FLOOR PLAN (FULL BUILDOUT)**

PROJECT NO: 19-10550
PROJECT DATE: 2019-09-09
DRAWN BY: OP
CHECKED BY: RMM
SCALE: As Indicated

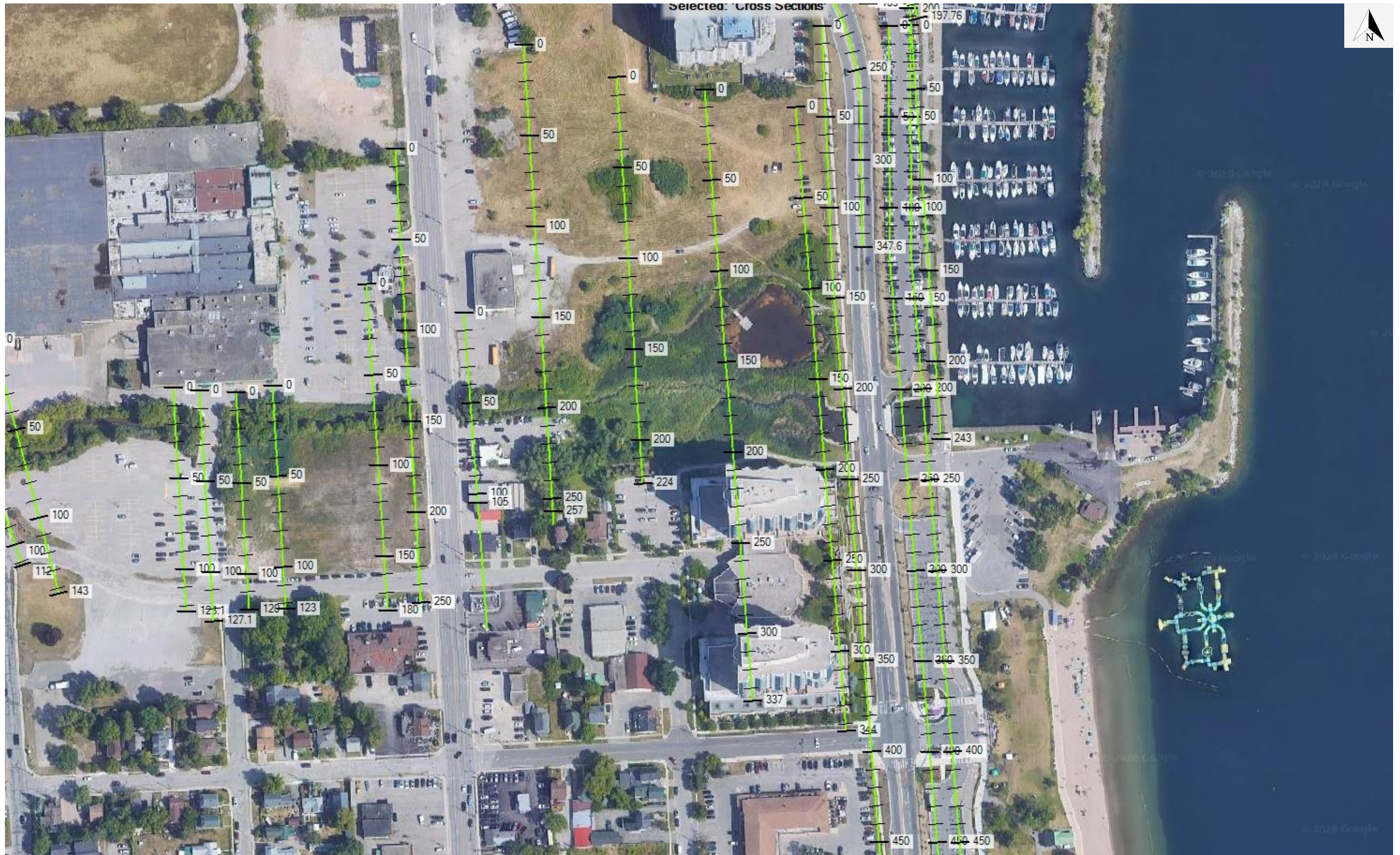
DRAWING NO: **RZ102**

2020-07-16 7:40:43 PM

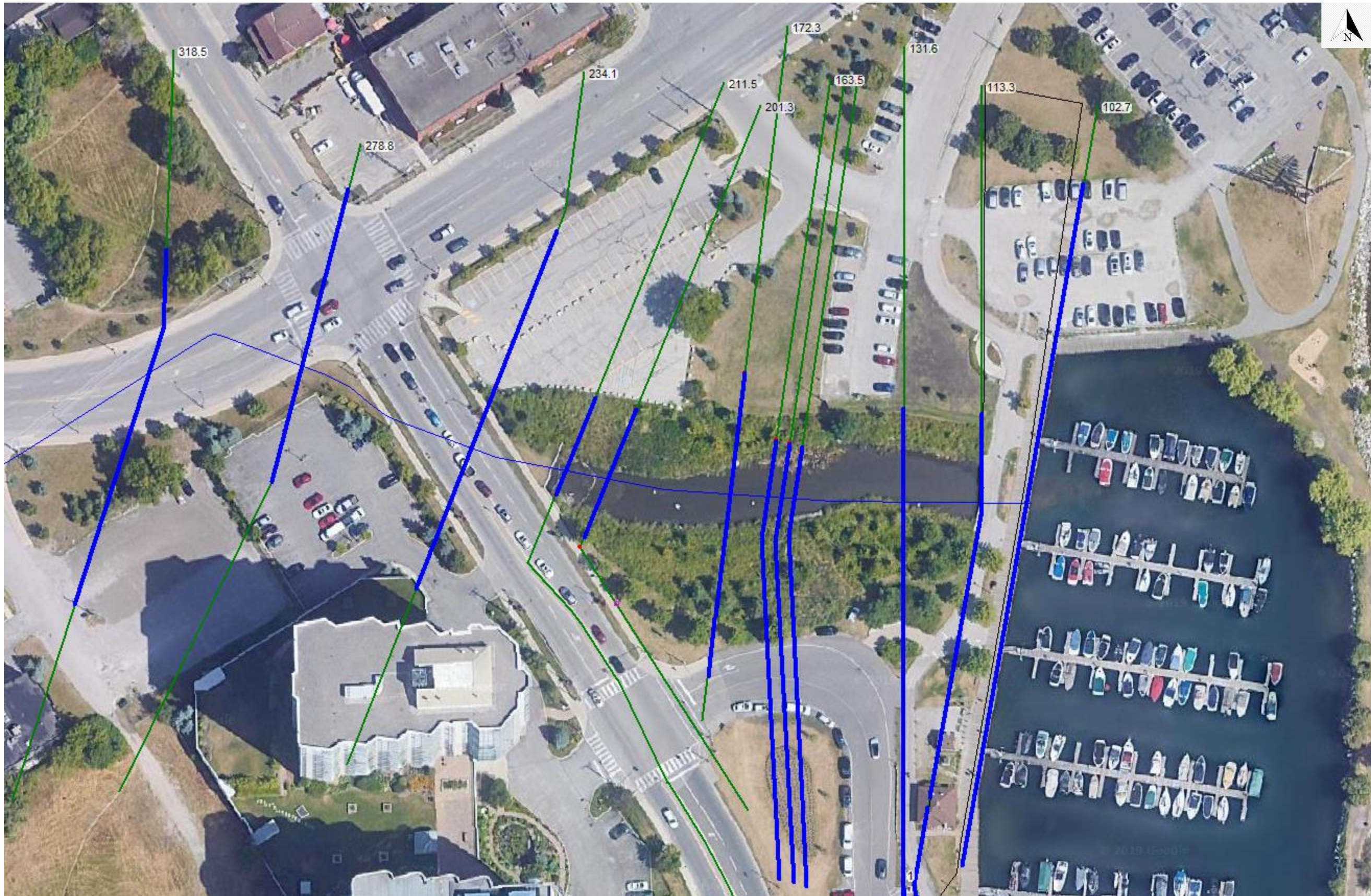
APPENDIX B

TOPOGRAPHIC SURVEY

APPENDIX C
HEC-RAS MODEL



BUNKER'S CREEK CROSS SECTION LAYOUT (PLAN SCS – AUGUST 2020 – POST LKSHRDR RECONSTR)

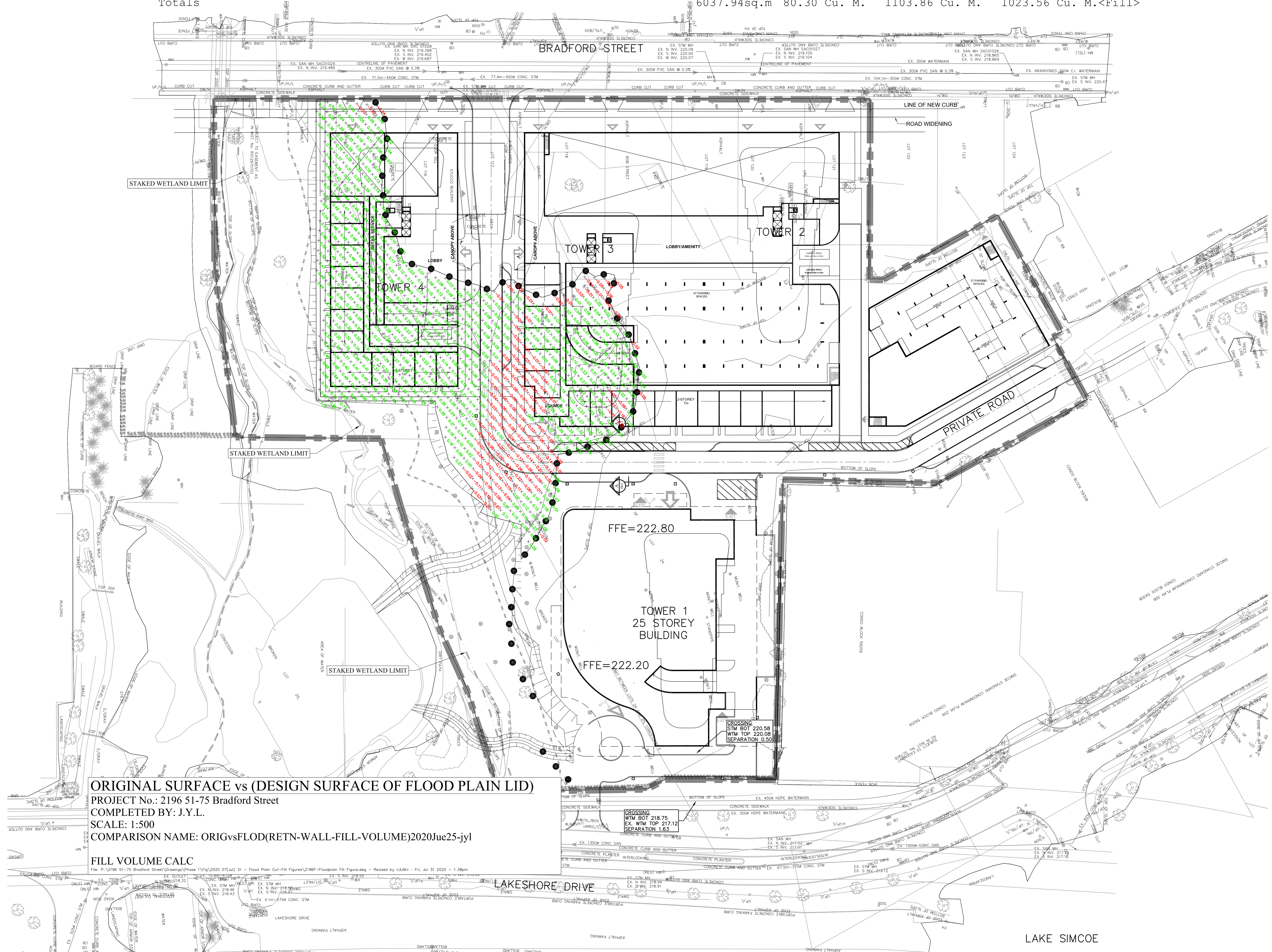


KIDD'S CREEK REGULATORY WATER SURFACE EXTENTS (FROM PLAN SCS - FEB2020 - PRE LKSHRDR RECWSTR)

APPENDIX D

FLOODPLAIN CUT FILL AND GRADING

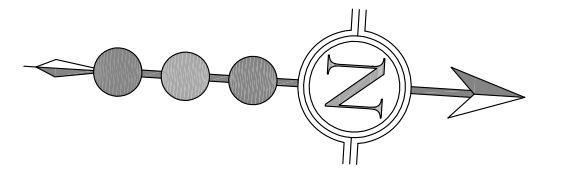
Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
ORIGvsFLOD (RETN-WALL-FILL-VOLUME) 2020Jun25-jyl	1.000	1.000	6037.94sq.m	80.30 Cu. M.	1103.86 Cu. M.	1023.56 Cu. M.<Fill>
Totals			6037.94sq.m	80.30 Cu. M.	1103.86 Cu. M.	1023.56 Cu. M.<Fill>



ORIGINAL SURFACE vs (DESIGN SURFACE OF FLOOD PLAIN LID)
 PROJECT No.: 2196 51-75 Bradford Street
 COMPLETED BY: J.Y.L.
 SCALE: 1:500
 COMPARISON NAME: ORIGvsFLOD(RETN-WALL-FILL-VOLUME)2020Jue25-jyl

FILL VOLUME CALC
 File: P:\2196 51-75 Bradford Street\Drawings\Phase 1\Fig\2020 07(M) 31 - Flood Plain Cut-Fill Figures\2196F-Floodplain Fill Figure.dwg - Revised by CLM: Pfl, Jul 31 2020 - 1:36pm

LAKE SIMCOE



STAKED WETLAND LIMIT

STAKED WETLAND LIMIT

STAKED WETLAND LIMIT

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
ORIGvsDSGN (FLOODPLAIN PARK) 2020Jun30-Jul	1.000	1.000	5545.42sq.m	1548.23 Cu. M.	149.26 Cu. M.	1398.97 Cu. M.<Cut>
Totals			5545.42sq.m	1548.23 Cu. M.	149.26 Cu. M.	1398.97 Cu. M.<Cut>

ORIGINAL SURFACE vs (DESIGN SURFACE OF FLOOD PLAIN PARK GRADING (DETAILED DESIGN))
 PROJECT No.: 2196 51-75 Bradford Street
 COMPLETED BY: J.Y.L.
 DATE: JULY 24, 2020
 SCALE: 1:300
 COMPARISON NAME: ORIGvsDSGN(FLOODPLAIN PARK)2020Jul24-jyl
 DESCRIPTION: ORIGINAL SURFACE (MAR 27, 2020) vs JULY 24, 2020 FLOODPLAIN PARK DESIGN SURFACE - FOR THE PURPOSE OF DETERMINING THE CUT VOLUME FOR THE CUT/FILL ANALYSIS OF THE VOLUME BETWEEN THE RET. WALL AND CREEK
 File: P:\2196 51-75 Bradford Street\Drawings\Phase 1\Fig.2020 07.01.31 - Flood Plain Cut-Fill Figures\2196-Floodplain Cut Figures.dwg - Revised by J.Y.L. Jul 31, 2020 - 1:42pm

CROSSING
 SAN BOT 218.42
 WTM TOP 217.12
 SEPARATION 1.30

CROSSING
 SAN BOT 218.36
 WTM TOP 217.96
 SEPARATION 0.40

CROSSING
 WTM BOT 218.75
 EX. WTM TOP 217.12
 SEPARATION 1.63

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