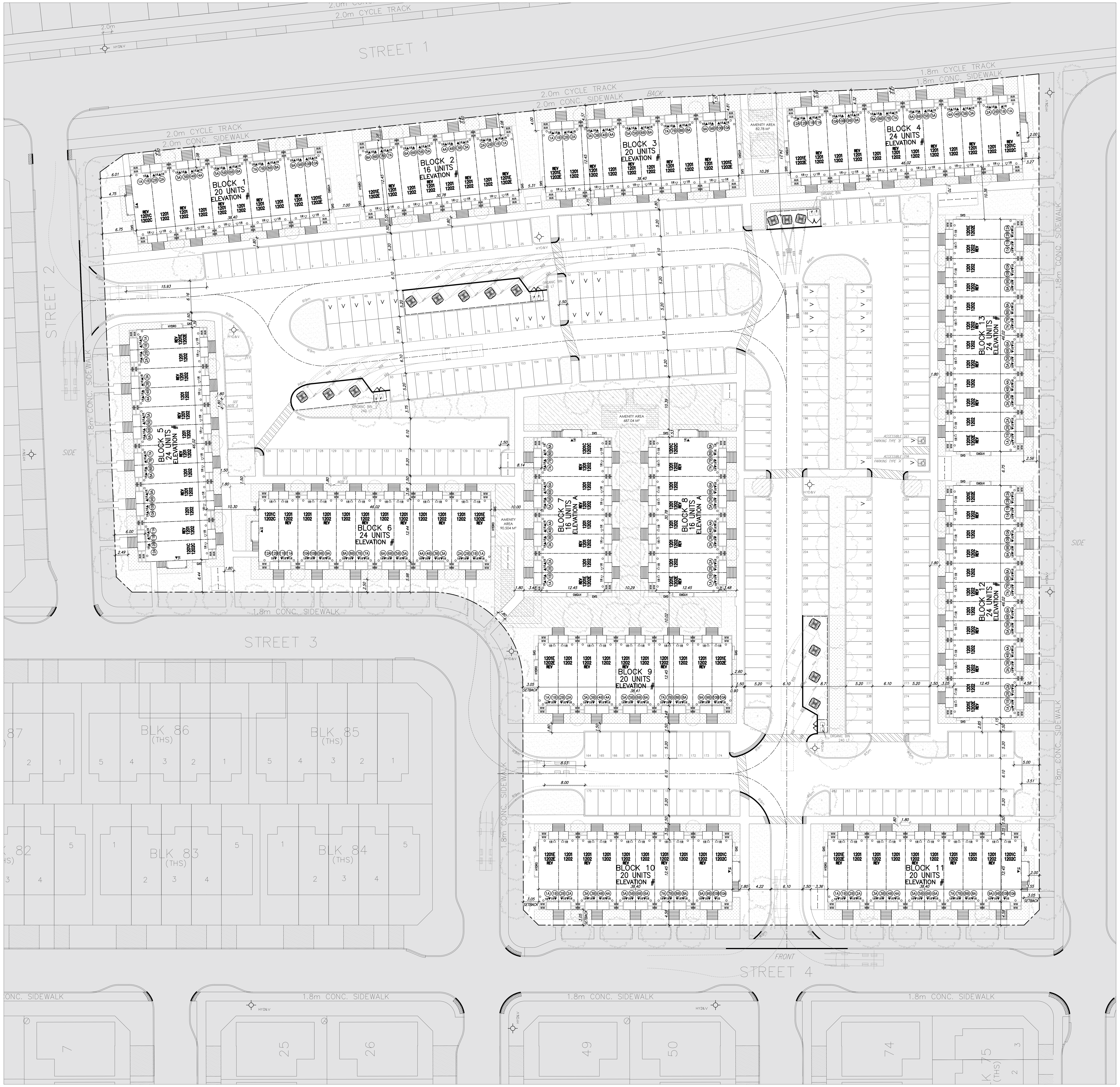
David Schaeffer Engineering Ltd.
120 Iber Road, Suite 103
Stittsville, ON K2S 1E9
613-836-0856
dsel.ca

APPENDIX A

General



SITE AREA	23,985.4 m² (2.4 ha)
PAVED AREA****	8,704 m² (36%)
LANDSCAPED AREA (MIN 30%)	8,878.9 m² (37%)
TOTAL BUILDING COVERAGE	6,402.5 m² (26.7%)
TOTAL GROSS FLOOR AREA	24,097.8 m²
DENSITY (UPH)	111.73 UPH
ZONE CATEGORY	R4Z[2968]

DWELLING BLOCK	DWELLING TYPE	COVERAGE AREA (m²)	UNITS
BLOCKS 4, 5, 6, 12, 13	24 UNITS STACKED DWELLING	572.75 m² (per Block)	120
BLOCKS 1, 3, 9, 10, 11	20 UNITS STACKED DWELLING	477.91 m² (per Block)	100
BLOCK 2, 7, 8	16 UNITS STACKED DWELLING	383.07 m² (per Block)	48
		TOTAL	268

AMENITY AREAS

	AREA	COMMENTS
PRIVATE AMENITY AREAS		
REAR DECK (m²)	398.37	Lower units (134 units)
SECOND FLOOR BALCONIES (m²)	541.07	Upper units (134 units)
TOTAL PRIVATE AREAS	939.44	
COMMUNAL AMENITY AREAS		
AMENITY AREA 1 (m²)	687.04	
AMENITY AREA 2 (m²)	82.78	
AMENITY AREA 3 (m²)	94.83	
TOTAL COMMUNAL AREAS (m²)	864.65	
TOTAL AMENITY AREAS (m²)	1804.09	

ZONE PROVISION - PLANNED UNIT DEVELOPMENT R4Z[2968]		**REQUIRED**	**PROPOSED**
162A(Z)	Min. Lot Area (m2)	1400 m²	23.985.47 m²
162A(Z)	Min. Lot Width (m)	18 m	102.26 m
162A(Z) R4Z[2968]	Min. Front Yard Setback (m)	3	3.05
162A(Z) R4Z[2968]	Min. Interior Side Yard Setback (m)	3	3.05
162B.6 R4Z[2968]	Min. Rear yard setback (m)	3	3.05
162A(Z)Y R4Z[2968]	Min. Corner Side yard set back (m)	3	3.05
162A(Z)	Max Building Height (m)	15	13.5
161	Landscaped Area (%)	30	37
131.1	Min. Width of Private Way / Parking Aisle (m)	6	6.1
131.4a	Min. Setback for Any Wall of a Residential Buildings Within a Planned Unit Development	1.2	3.05
131.2	Min. setback for any wall of a residential use building to a private way	1.8	2.60
137	**AMENITY AREA**		
137.6	Total min. amenity area (6m² per unit)	1608 m²	1804.09 m²
137.6	Min. Communal Amenity Area m² (Min. 50% area)	804 m²	864.65 m²
65	**PERMITTED PROJECTION INTO REQUIRED YARDS**		
65.5.i	Fire escapes, Open Stairways, Stoop (m)	>0.6m to lot line	0.6m
65.6.a(i)	Covered or Uncovered Balcony, Porch and Deck	2m no closer than 1 to a lot line	2m
	PARKING REQUIREMENTS	**REQUIRED**	**PROPOSED**
101 (Table R10) R4Z[2968]	Resident Parking - 1.0/ spaces/unit	268	268
102 (Table column III) R4Z[2968]	Visitor Parking - 0.1 spaces/unit	27 (0.1)	27 (0.1)
106.1	Min. Perpendicular Parking Space Size (m)	2.6 x 5.2	2.6 x 5.2
107 (Table 107.d)	Min. Requires Aisle Width	6.0	6.1
	BARRIER FREE PARKING		
Traffic and Parking Bylaw Section 111	Min. Barrier Free Parking **	2	2
111	**BICYCLE STORAGE**		
111B	Min. bicycle parking space dimension, horizontal (m)	Width: 0.6m Length: 1.8m	Width: 0.6m Length: 1.35m
111A(b)	Min. Bicycle parking space access aisle Width (m)	1.5	1.5
111.11	Min. Bicycle Parking 0.5 spaces/unit	134	135
110(a)(b)	**LANDSCAPE AREA SURROUNDING PARKING LOT**		
110.a	Abutting a Street (m)	3	3.51
110.b	Not Abutting a street (m)	3	N/A
110.1.b	Min. % of parking lot landscape	15%	22%
110	**REFUSE COLLECTION AREAS**		
110.3b	Min. Waste collection setback to lot line	3	>24m
110.3.c/d	Opaque Screen Min. Height (m)***	2	1.8m + landscape

** Per the 2014 Guide to the Integrated Accessibility Standards Regulation - Design of Public Spaces Standard, 4% of parking spaces provided for public use must be accessible. 2 of the provided 28 visitor spaces have been designed to be barrier-free, one Type A and one Type B size.

*** Section 110(3)(d) where an in-ground refuse container is provide, the screening requirement of Section (3)(c) above may be achieved with soft landscaping (Bylaw 2020-299)

**** Paved area includes 50% of the area required for bicycle parking spaces (67 spots)

GARBAGE:
REQUESTED BY ZONING:

GARBAGE: 0.231 CUBIC YARD /UNIT	0.231 X 268= 61.91 CUBIC YARD	= 11 (6 CU YD BINS)
RECYCLING 0.018 CUBIC YARD /UNIT	0.018 X 268 = 4.82 CUBIC YARDS	= 1 (6 CU YD BINS)
+ 0.062 CUBIC YARD /UNIT	0.062 X 268 = 16.62 CUBIC YARDS	= 3 (6 CU YD BINS)
ORGANIC 240L PER 50 UNITS	268/50 = 5.36 UNITS	= 6 (240L BIN)

SCALE 1:400 0 5 10 15 20 25 30

SITE PLAN NOTES
1. DO NOT SCALE DRAWINGS FOR PRINT.
2. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF Q4 ARCHITECTS AND CAIVAN . COPYRIGHT RESERVED.
3. WALKWAYS AND CURBS TO BE TIED INTO PUBLIC ROW WHERE APPLICABLE.
4. REFERENCE CITY OF OTTAWA T.W.S.I. DETAIL SC7.3
5. WHERE THE CLEAR WIDTH OF WALKWAY IS LESS THAN 1800 MM PROVIDE A PASSING AREA, 1800 MM WIDE BY 1800 MM LONG (MINIMUM) AT INTERVALS OF 30 METRES OR LESS AS PER CITY OF OTTAWA ACCESSIBILITY DESIGN STANDARDS 3.3.2- EXTERIOR PATHS OF TRAVEL - CLEAR WIDTH

Q4A ARCHITECTS

Q4 ARCHITECTS INC.
4110 YONGE STREET
Suite 602, Toronto ON.
M2P 2B7

T. 416.322.6334
F. 416.322.7294
E. info@q4architects.com

ONTARIO ASSOCIATION OF ARCHITECTS
CORA LIA TARACIUK
LICENCE
6623
2026-04-30

The contractor / builder must verify all dimensions on the job and report any discrepancy to the designer before proceeding with the work.

LEGEND

- STACKED TOWNS
- ENTRANCE DOOR
- REAR DECK DOOR
- PORCH
- PROJECTION (STAIRS)
- PAVERS
- HEAVY DUTY CONCRETE PAVING
- LIGHT DUTY ASPHALT PAVING
- CROSSWALK
- CURB (0.2m)
- DEPRESSED CURB
- TACTILE WALKING SURFACE INDICATOR
- BLOCK BOUNDARY
- WASTE ENCLOSURE FENCE
- WOOD PRIVACY FENCE
- HYD&V HYDRANT
- FR FIRE ROUTE SIGNAGE
- CMB COMMUNITY MAILBOX
- NO PARKING
- BARRIER FREE PARKING
- BARRIER FREE PARKING SIGNAGE
- V VISITOR PARKING
- BIKE RACKS
- EARTH BIN (6.5 yd³)
- MS1 HYDRO TRANSFORMER
- LIGHT POLE
- LIGHT WALL MOUNTED
- LARGE DECIDUOUS TREE*
- MEDIUM DECIDUOUS TREE*
- SMALL DECIDUOUS TREE*
- THREE FORM SHRUB*
- PLANT BED*
- SOFT LANDSCAPE *
- B BELL PEDESTAL
- C ROGERS VAULT

ATTACHED DRAFT MPLAN, FROM THE SURVEYED PLAN MARCH 23,2026, XREF INTO DRAWING

*TREES AND SHRUB LOCATIONS TO BE CONFIRMED ON LANDSCAPE PLAN

15			
14			
13			
12			
11			
10			
9			
8			
7			
6			
5			
4			
3			
2			
1	SP1 - CITY SUBMISSION	2026.04.30	JM

Issued / Revision Chart

Project Title

CONSERVANCY PH6 STACKED TOWNS

Location 3288 Borrisokane Rd OTTAWA, ON.

Legal Name Part of Lot 14 Concession 4 (Rideau Front) Part 4 Plan 4R-34850 Subject to Easement as in OC2446018 PIN 04595-4105

Client CAIVAN

Project No.

Scale **1:400**

Drawn By **CT**

Checked By **CT**

OVERALL SITE PLAN

SP1

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APPENDIX B

Water Supply

Barrhaven Conservancy Development Corporation - Water Distribution System Analysis - Phase 5

Final Report

Stantec

Prepared for:
David Schaeffer Engineering Ltd.

Date:
April 28, 2026

Prepared by:
Stantec Consulting Ltd.

Project/File:
163401817

Stantec Consulting Ltd.

Revision Record

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
0	Draft	AB	26-04-17	AMG	26-04-20	AP	26-04-22
1	Final	AB	26-04-27	AMG	26-04-27	AP	26-04-28

Disclaimer

The conclusions in the Report titled Barrhaven Conservancy Development Corporation - Water Distribution System Analysis - Phase 5 are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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Prepared by: ______________________________

Andrew Buckley, P.Eng.

Reviewed by: ______________________________

Alexandre Mineault-Guitard, ing., P.Eng.

Approved by: ______________________________

Ana Paerez, P.Eng.

Table of Contents

List of Tables

List of Figures

List of Appendices

1 Introduction

To support David Schaeffer Engineering Ltd. (DSEL) with the next phases of design for the Barrhaven Conservancy Development Corporation (BCDC) Lands, Stantec Consulting Ltd. (Stantec) was retained to complete a water distribution system analysis for Phase 5 of the development lands.

The study area, referred to as the Barrhaven Conservancy Development Lands, is within the City of Ottawa's (City) southwestern suburban neighbourhood of Barrhaven. The lands are situated between Strandherd Dr to the north, the Jock River to the south, Fraser-Clark Drain to the east, and bisected by Borrisokane Rd through the western portion, which forms the divide between the initial BCDC Development Lands phases (Phases 2 to 4, and Jock River 1 to 3; previously referred to as "Conservancy East Development Lands"), and the future BCDC Development Lands phases (Phase 5, Phase 6, and Ultimate, as shown in **Figure 1-1**; previously referred to as "Conservancy West Development Lands"). Phases 5 and 6 were previously referred to as "Phase 5" in the previous technical memo (Stantec Consulting Ltd., October 2025).

Detailed design for BCDC Development Lands, east of Borrisokane Rd (up to the Jock River Phase 3), have been completed, and the future phases of the BCDC Development Lands are expected to proceed once all phases east of Borrisokane Rd have been built out. The distribution network for the BCDC Development Lands, up to Jock River Phase 3, was analyzed under a previous assignment (Stantec Consulting Ltd., 2025). It is envisioned that these phases will be serviced from two (2) connections to the City's network, one at Chapman Mills Dr and the other at Danson Gardens Grv. and Darjeeling Ave.

Phasing and construction of the BCDC Development Lands west of Borrisokane Rd will be completed in sequence. Strategic phasing will be implemented such that the new development can be adequately serviced from two (2) connections to the City's network before a third connection is added across the Jock River to Flagstaff Drive to service the remainder of the development lands.

The goal of this analysis is to support detailed design of Phase 5, by confirming associated watermain sizing and redundancy needs, as development progresses. For this assignment, Stantec's scope of work includes the following tasks:

1) Extrapolating water boundary conditions based on the additional water demands, using previously received information from the City of Ottawa, as part of the detailed design for BCDC Development Lands, east of Borrisokane Rd (up to the Jock River Phase 3);
2) Updating the most current stand-alone hydraulic model of the distribution system within the BCDC Development Lands to incorporate Phases 5 and 6 of the BCDC Development Lands west of Borrisokane Rd, and updating the boundary conditions;
3) Setting up and running model simulations for average day (AVDY), peak hour (PKHR), maximum day (MXDY) plus fire flow (FF) and reliability analyses (AVDY+FF) to assess the performance of the water system within the development lands to meet design criteria;
4) Documenting the approach used, findings and recommendations from the analysis.

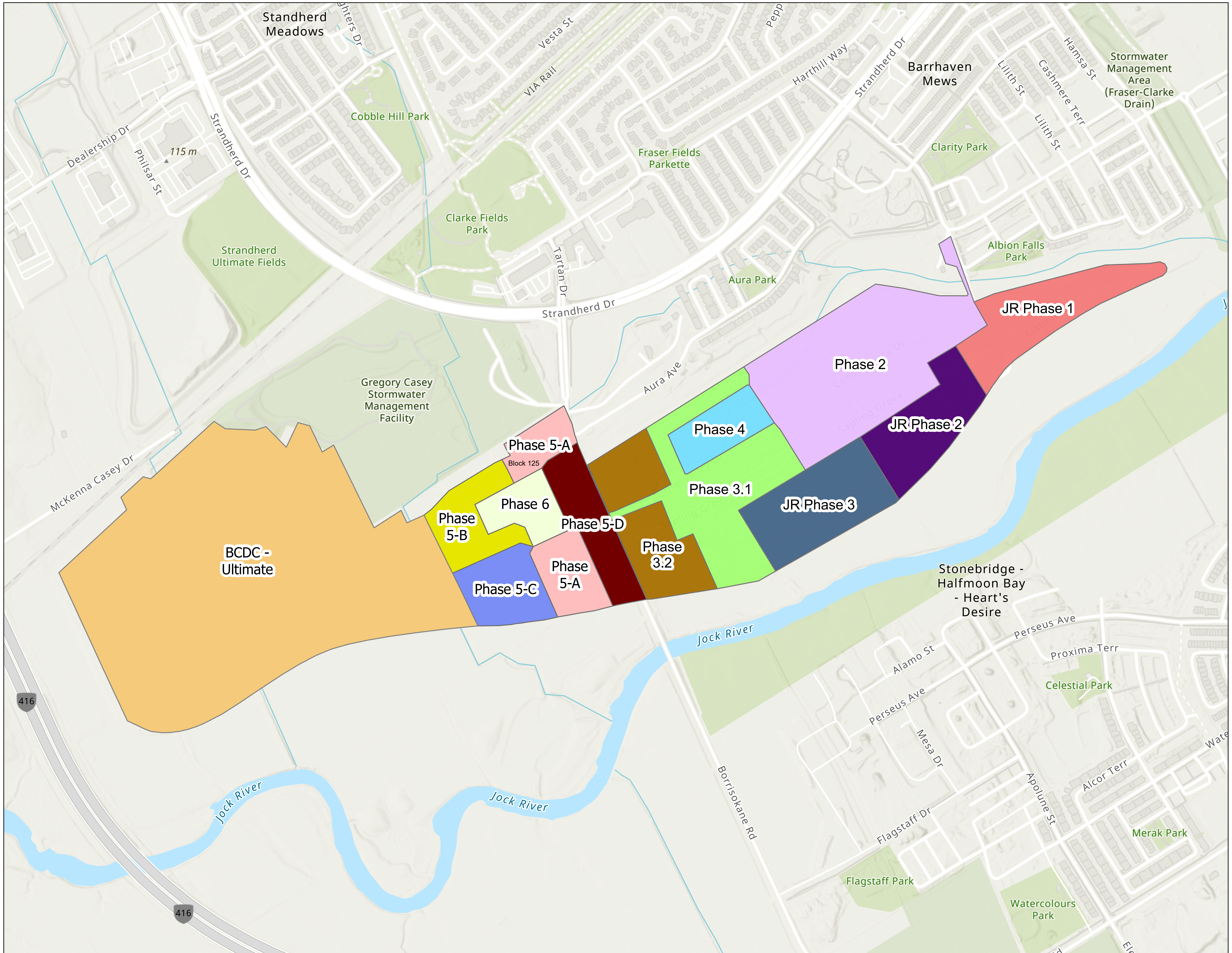


Figure No.
1-1

Title
Phasing for Barrhaven Conservancy Lands Development Project

Client/Project
David Schaeffer Engineering Ltd
Barrhaven Conservancy West Lands

Project Location
Ottawa, Ontario, Canada

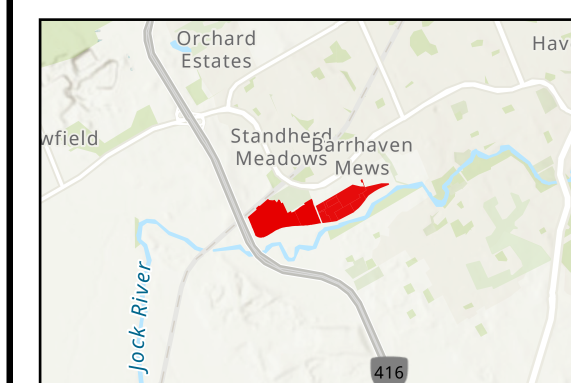
N

0 100 200 Meters
(At original document size of 11x17)
1:9,000

Legend

Phase

- Phase 2
- Phase 3.1
- Phase 3.2
- Phase 4
- JR Phase 1
- JR Phase 2
- JR Phase 3
- Phase 5-A
- Phase 5-B
- Phase 5-C
- Phase 5-D
- Phase 6
- BCDC - Ultimate



Notes
1. Coordinate System: MTM 3Degree
2. Background: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Stantec

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1.1 Phasing of BCDC Development Lands

The focus of the current study is on BCDC Phase 5 which will consist of multiple sub-phases (5A to 5D) as shown in **Figure 1-1.** It is understood that the site plan within Phase 6 will proceed before Phase 5. However, a hydraulic analysis in support of detailed design of Phase 6 will be provided under separate cover.

Please note that "BCDC Phases 5 and 6" were previously referred to as Phase 5 in Stantec's 2025 Barrhaven Conservancy Phase 5 Study, and as Phase 4 in the 2022 Barrhaven Conservancy East Study.

The previous phasing plan for the BCDC Development Lands included a total of nine (9) phases. The design and construction status for each phase is summarized in **Table 1-1**. The unit configuration has been continuously updated in each hydraulic analysis as development progresses. **Figure 1-1** illustrates the most current draft plan for the BCDC Development Lands as provided by DSEL in March 2026, and shows the assumed phasing for this analysis.

Table 1-1: Phasing Summary for BCDC Development Lands

Phasing	Design/Construction Status
BCDC Phase 2 (PH 2)	Under Construction
BCDC Phase 3.1 (PH 3-1)	Under Construction
BCDC Phase 3.2 (PH 3-2)	Designed
BCDC Phase 4 (PH 4 / Site Plan)	Under Construction
BCDC Jock River Phase 1 (JR 1)	Under Construction
BCDC Jock River Phase 2 (JR 2)	Designed and Approved
BCDC Jock River Phase 3 (JR 3)	Designed and Approved
BCDC Phase 6 (PH 6)	Detail Design Upcoming
BCDC Phase 5-A (PH 5-A)	Detail Design
BCDC Phase 5-B (PH 5-B)	Detail Design
BCDC Phase 5-C (PH 5-C)	Detail Design
BCDC Phase 5-D (PH 5-D)	Detail Design
BCDC Ultimate	Conceptual Design Completed

1.2 Overview of Previous Studies

Below is a summary of previous Stantec's studies completed to assess the potable water network of the Conservancy Lands.

- 2021 Hydraulic Potable Water Assessment for the overall Barrhaven Conservancy Lands.
    - A hydraulic assessment to review and assess the limitations and opportunities associated with servicing the Conservancy Development Lands was completed.
    - This assessment assumed that the demands for the Barrhaven Conservancy Development Lands was not accounted for in the current capacity of the Zone 3SW pumps but can be accommodated by the SUC pumps.
    - Several servicing options were assessed, all presenting their own challenges with either limited land access, crossings of a body of water, and/or requiring a new watermain to be installed along recently or soon to be (re)constructed rights-of-way.
    - The City identified Alternative 2c as the preferred servicing alternative, with 2d also being a viable option.
        - 2c: Connect to future SUC watermains north of the Jock River at two locations;
        - 2d: Connect to future SUC watermain north of the Jock River, and connect to a second future watermain south of the Jock River (requiring crossing).
- 2022 Barrhaven Conservancy East (Phases 2, 3, 4 & Jock River) Water Distribution System Analysis
    - The Conservancy East Development Lands were assessed under two (2) scenarios (2 connections and 3 connections to the City's existing network). Both scenarios were serviced by the pressure zone SUC (future pressure zone reconfiguration).
        - Connection 1: existing 305 mm stub extending from Chapman Mills Dr;
        - Connection 2: T-junction on the existing 203 mm watermain at Danson Gardens Grv. and Darjeeling Ave; and
        - Connection 3: future 305 mm stub at the intersection of Flagstaff Drive and Borrisokane Rd (requires crossing the Jock River).
    - Two (2) watermain layout and sizing configurations were proposed; one for each connection scenarios to meet servicing criteria, including under reliability (watermain break) scenarios.
- 2023 Barrhaven Conservancy West Water Distribution System Analysis
    - The West Development Lands were assessed under the three (3) connections scenario, and under pressure zone SUC conditions (future pressure zone reconfiguration).

    - Under watermain break scenarios, some locations were slightly below the required fire flow (RFF) of 13,000 L/min. It was recommended to confirm, at the detailed design stage, the fire flow requirements across the site, as well as the required fire flow measures, to meet City criteria under all watermain break scenarios.

- 2025 Conservancy East Water Distribution System Analysis (Update)

    - The East Development Lands were evaluated under two connection scenarios and existing (pre-SUC) conditions. This approach was taken because the full build-out of the Conservancy East Development Lands is expected to occur before the pressure zone is reconfigured and before the Borrisokane Road watermain, crossing the Jock River, is constructed.

    - Under AVDY conditions, model results showed that the allowable maximum pressure of 80 psi was exceeded in some locations, and controls were recommended where required. Under PKHR conditions, the minimum pressures were in accordance with requirements. Under MXDY+FF conditions, the target fire flows were achieved for all phases.

    - Under a reliability analysis, where Connection 1 (Chapman Mills Dr) to the existing water system would not be operational, results showed that the fire flow requirements would not be achievable throughout the network under AVDY+FF conditions. However, adequate resiliency will be provided upon construction of the third connection through the Jock River.

- 2025 Barrhaven Conservancy West Phase 5 Initial Water Distribution System Analysis

    - Phase 5 was evaluated under the two connection scenarios, for existing (pre-SUC) and post-SUC conditions.

        - For existing (pre-SUC) conditions, under AVDY conditions, model results exceeded the allowable maximum pressure of 80 psi, and pressure reducing controls were recommended where required.
        - For existing (pre-SUC) and post-SUC conditions, under PKHR conditions, the minimum pressures were in accordance with the City's requirements.
        - Under MXDY+FF conditions, model results showed that the system would be able to provide the RFF of 13,000 L/min throughout Phase 5, except near a dead-end watermain. However, adequate hydrant placement, would satisfy the required fire flow. It was noted that the RFF should be confirmed during the detailed design stage of BCDC Phase 5.

    - Under a reliability analysis, where Connection 1 (Chapman Mills Dr) to the existing water system would not be operational, results showed that the fire flow requirements (13,000 L/min) would not be achievable throughout the network under AVDY+FF conditions, for both existing and post-SUC conditions. However, adequate redundancy would be provided to the development lands upon construction of the third connection through the Jock River. Until the construction of a third connection, mitigation measures were recommended.

2 Hydraulic Assessment

2.1 Serviceability

2.1.1 System Pressures

As per the City's Water Design Guidelines, the desired range of pressure under average day (AVDY), maximum day (MXDY) and peak hour (PKHR) demands is 345 to 552 kPa (50 to 80 psi) and no less than 276 kPa (40 psi) at ground elevation (i.e., at street level). The maximum pressure at any point in the water distribution system should not exceed 552 kPa (80 psi). Pressure reducing measures are required to service areas where pressures greater than 552 kPa (80 psi) are anticipated. Under emergency fire conditions, the system must be able to supply appropriate fire flow while maintaining a residual pressure of 138 kPa (20 psi).

2.1.2 Fire Flows

It is important to note that the overall watermain network recommendations are governed by fire flow requirements. As part of the 2022 Study (Stantec), a maximum required fire flow (RFF) of 216.67 L/s (13,000 L/min) was identified. This RFF was linked to the governing unit design at the time, which consisted of rear-lane townhome blocks. The 2023 Study (Stantec) considered this RFF for the assessment of what was referred to as the Conservancy West Development Lands. However, fire flow requirements were subsequently updated to be calculated in accordance with the City's Guidelines, through calculations using the Fire Underwriter Survey (FUS) and the Ontario Building Code (OBC) Office of the Fire Marshal (OFM) methods.

For Phase 6, RFF was calculated using OBC/OFM method, as this will be a private site block. For Phase 5, the RFF was calculated using FUS method. Calculations are listed in **Appendix A**.

Within Phase 5, lotting strategies (refer to **Figure 2-1**) were implemented to freeze the construction of some blocks to provide fire separation distances in accordance with the provisions listed in the City of Ottawa's Technical Bulletin ISDTB-2014-02, to cap the RFF at 10,000 L/min. These provisions include:

1. The building footprint is less than 600 m^2.
2. The rear unit exposure is at least 10 m.
3. The total number of residential units in a block is less than or equal to 6.

Table 2-1 summarizes the worst-case scenarios for fire flow calculations based on the most current information for the initial phases of the BCDC Development Lands (Stantec, 2025), and for Phases 5 and 6. The RFF for the Ultimate Phase of the BCDC is assumed to be 13,000 L/min. It is recommended that fire flow requirements for the Ultimate Phase of the BCDC be confirmed at the detailed design stage.

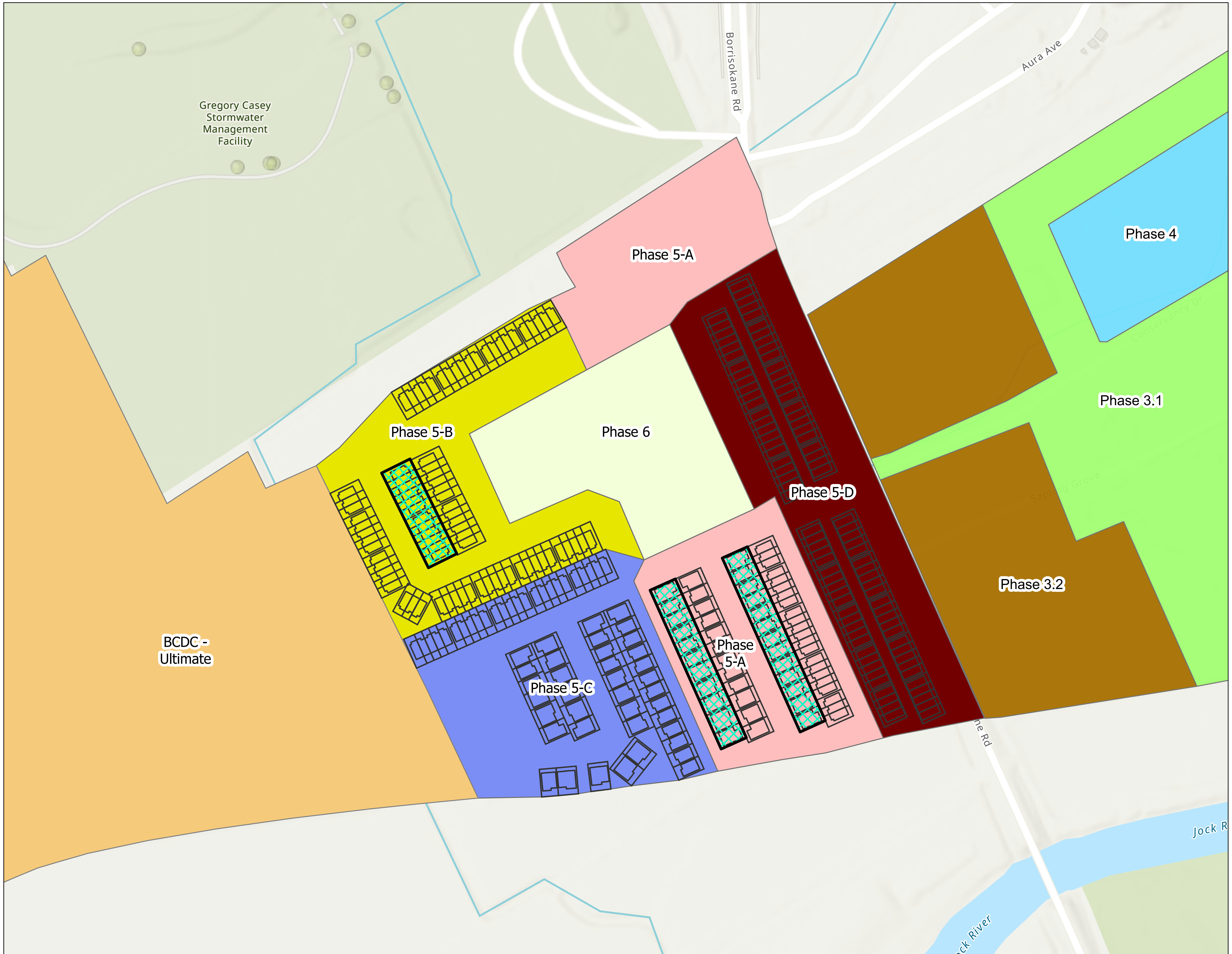


Figure No.
2-1

Title
Lotting Strategies for Fire Separation

Client/Project
David Schaeffer Engineering Ltd
Barrhaven Conservancy West Lands

Project Location
Ottawa, Ontario, Canada

N

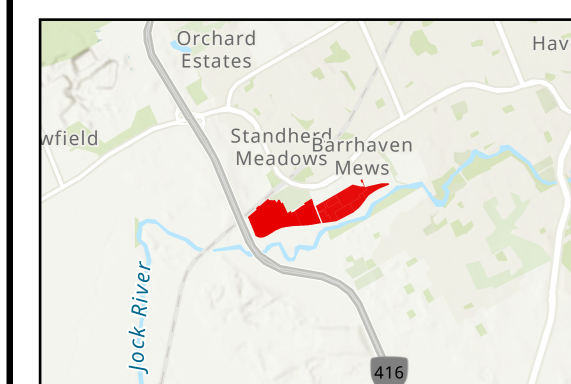
0 50 100 Meters
(At original document size of 11x17)
1:3,000

Legend

- Frozen Lots

Phase

- Phase 3.1
- Phase 3.2
- Phase 4
- Phase 5-A
- Phase 5-B
- Phase 5-C
- Phase 5-D
- Phase 6
- BCDC - Ultimate



Notes
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Stantec

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Table 2-1: Fire Flow Requirements

Phase		Fire Flow (L/min)
PH2		13,000 (1)
PH 3	**PH 3-1**	15,000 (1)
	PH 3-2	14,000 (1)
PH 4		6,300 (1)
JR 1		13,000 (1)
JR 2		13,000 (1)
JR3		13,000 (1)
PH 6		6,300 (2)
PH 5-A (Interim)		10,000 (3)
PH 5-A (Ultimate)		14,000 (4)
PH 5-B (Interim)		10,000 (3)
PH 5-B (Ultimate)		13,000 (4)
PH 5-C (Ultimate)		13,000 (4)
PH 5-D (Ultimate)		16,000 (4)
BCDC Ultimate Phase		13,000 (1)

Notes:
1- Identified and carried over from 2025 Study (Stantec).
2- Calculated using OBC/OFM.
3- Interim RFF, in accordance with the City's Technical Bulletin ISDTB-2014-02.
4- Calculated using FUS.

2.2 Growth and Demand Projections

The residential population was estimated based on household sizes and population densities (or persons per unit, PPU) specified in the City's Water Design Guidelines, namely 3.4, and 2.7 PPU for Single Family Homes (SFH), and Townhomes (TH), respectively. Based on the latest plans, the initial phases of BCDC Development Lands, up to and including Jock River Phase 3, comprise 1,263 total units (527 SFH and 736 TH), with a total residential population of 3,779. This information was carried over from previous studies, which constitute the most recent information for the BCDC Development Lands. Upon construction of all units within Phase 5 and 6 of the BCDC Development Lands, these phases will comprise 672 units (74 SFH, 598 TH), with a total residential population of 1,865. **Table 2-2** summarizes the unit counts and estimated population throughout different phases of the development based on the unit type, and the following assumptions.

Table 2-2: Unit Counts, Populations, and Demand Projections Based on the Most Current Concept Plans

Phase	Sub-phase	Unit Types	Units	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Phase 2 (PH 2)		Singles	204	694	2.25	5.62	12.36
		Towns	99	267	0.87	2.17	4.76
		Phase 2 Sub-total	***303***	***961***	***3.11***	***7.79***	***17.13***
Phase 3 (PH 3)	PH 3.1	Singles	0	0	0.00	0.00	0.00
		Towns	182	491	1.59	3.98	8.76
		Phase 3 .1 Sub-total	***182***	***491***	***1.59***	***3.98***	***8.76***
	PH 3.2	Singles	0	0	0.00	0.00	0.00
		Towns	200	551	1.75	4.38	9.63
		Phase 3.2 Sub-total	***200***	***540***	***1.75***	***4.38***	***9.63***
		Phase 3 Sub-total	***382***	***1,031***	***3.34***	***8.36***	***18.38***
Phase 4 (PH 4)		Singles	0	0	0.00	0.00	0.00
		Towns	196	529	1.72	4.29	9.43
		Phase 4 Sub-total	***196***	***529***	***1.72***	***4.29***	***9.43***
Jock River (JR)	JR1	Singles	105	357	1.16	2.89	6.36
		Towns	0	0	0.00	0.00	0.00
		Jock River 1 Sub-total	***105***	***357***	***1.16***	***2.89***	***6.36***
	JR2	Singles	91	309	1.00	2.51	5.51
		Towns	0	0	0.00	0.00	0.00
		Jock River 2 Sub-total	***91***	***309***	***1.00***	***2.51***	***5.51***
	JR3	Singles	127	432	1.40	3.50	7.70
		Towns	59	159	0.52	1.29	2.84
		Jock River 3 Sub-total	***186***	***591***	***1.92***	***4.79***	***10.54***
		Jock River Phases Sub-total	***382***	***1,258***	***4.08***	***10.19***	***22.41***
Phase 6		Singles	0	0	0.00	0.00	0.00
		Towns	0	0	0.00	0.00	0.00
		Condo	268	724	2.35	5.86	12.90
		Phase 6 Sub-total	***268***	***724***	***2.35***	**5.86**	**12.90**
Phase 5	PH 5-A	Singles	49	167	0.54	1.35	2.97
		Towns	22	59	0.19	0.48	1.06
		Block 125 ‘Future Development’	106	285	0.92	2.31	5.08
		Phase 5-A Sub-total	***153***	***511***	***1.66***	***4.14***	***9.11***
Phase 5	PH 5-B	Singles	0	0	0.00	0.00	0.00
		Towns	81	219	0.71	1.77	3.90
		Phase 5-B Sub-total	***81***	***219***	***0.71***	**1.77**	**3.90**
Phase 5	PH 5-C	Singles	25	85	0.28	0.69	1.52
		Towns	25	68	0.22	0.55	1.20
		Phase 5-C Sub-total	***50***	***153***	***0.49***	**1.24**	**2.72**
Phase 5	PH 5-D	Singles	0	0	0.00	0.00	0.00
		Towns	96	259	0.84	2.10	4.62
		Phase 5-D Sub-total	***96***	***259***	***0.84***	**2.10**	**4.62**
		Phase 5 & 6 Sub-total	***672***	***1865***	***6.04***	***15.11***	***33.24***
		Barrhaven Conservancy Development Sub-Total	***1,935***	***5,644***	***18.29***	**45.73**	**100.60**

Phase 5-A

- Construction of 24 SFH is “frozen” until construction of the additional watermain connection crossing the Jock River is completed. This is necessary to ensure fire protection separation in accordance with the City’s Technical Bulletin ISDTB-2014-02 in order to cap the RFF at 10,000 L/min.
- Block 125 (refer to **Figure 1-1**) is comprised of 106 units, which was calculated by multiplying a density of 110 units/ha, by 0.96 ha (per DSEL email, April 2026).

Phase 5-B

- Construction of two 6-unit TH is “frozen” until construction of the additional watermain connection crossing the Jock River is completed. This is necessary to ensure fire protection separation in accordance with the City’s Technical Bulletin ISDTB-2014-02 in order to cap the RFF at 10,000 L/min.

As part of Stantec’s 2022 Study for the BCDC lands, the City requested that the criteria outlined in the City’s Water Design Guidelines and Technical Bulletin ISTB-2021-03 were followed to establish water demands. This was considered a conservative approach, as the criteria in the City’s Water Design Guidelines are more restrictive in comparison to the ones outlined in the 2013 City’s Water Master Plan (WMP).

As such, the demand rates and peaking factors from the Water Design Guidelines and Technical Bulletin ISTB-2021-03 were applied to the population projections presented in **Table 2-2** based on unit type. For residential land-use, SFH, TH units were assigned an average day (AVDY) consumption rate of 280 L/cap/d. To determine maximum day (MXDY) demands, the AVDY demands were multiplied by a residential peaking factor of 2.5. Peak hour (PKHR) demands were established by multiplying MXDY demands by a residential peaking factor of 2.2. Estimated AVDY, MXDY and PKHR demand projections are summarized in **Table 2-2**.

2.3 Hydraulic Model Update

Innovyze's InfoWater Pro (v. 2024) was used to update the stand-alone hydraulic model of the water distribution system within the proposed development area for this analysis. The model was updated to reflect the most current draft plan including the proposed watermain layout (based on proposed road alignment) and projected water demands for the BCDC Development Lands. Watermains included in the model were assigned Hazen-Williams coefficients ("C-Factors") in accordance with the City's Water Design Guidelines, based on diameter.

2.3.1 Boundary Conditions

Boundary conditions were provided by the City as part of the 2025 Study (Stantec) in support of the BCDC development up to the Jock River Phase 3 for two (2) watermain connections under the existing pressure zone configuration and for three (3) watermain connections under the post-SUC pressure zone configuration. Given that this analysis includes the BCDC Phases 5 and 6 demands, updated boundary conditions were extrapolated from the ones provided by the City to reflect additional flow coming into the study area.

This analysis considers that Phases 6, 5-A and 5-B will be initially serviced from two (2) watermain connections to the City's network, while Phases 5-C and 5-D will proceed upon construction of the third watermain connection crossing the Jock River. As such, Phases 6, 5-A and 5-B are considered to be serviced under existing pressure conditions, while Phases 5-C and 5-D will be assessed under post-SUC conditions.

The boundary conditions used for this analysis are provided in **Appendix B**, and have been represented in the hydraulic model as fixed head reservoirs. Hydraulic Grade Line (HGL) values were applied to the fixed head reservoirs for the respective demand scenarios. Updated boundary conditions shall be obtained from the City to confirm the assumptions made herein or to revise the analysis as required.

2.3.2 Watermain Sizing and Layout

The network is proposed to consist of 152 mm, 203 mm, and 305 mm diameter watermains, with the 305 mm watermains functioning as the hydraulic backbone throughout the development lands. The 305 mm diameter watermains run west from connections 1 and 2, and continue westward past Borrisokane Rd, to the western limit of the proposed BCDC Phase 5. **Figure 2-2** shows the proposed watermain sizing throughout the BCDC Development Lands and notably the assumed watermain network within Phases 5 and 6.

Of note, the internal watermain connectivity and sizing within the private site plan block will be assessed and provided under separate cover. Furthermore, the 305 mm diameter watermain along Borrisokane Rd, extending over the Jock River to Connection 3 (Flagstaff Drive), was considered only for Phases 5-C and 5-D. Lastly, the maximum number of units permitted along a dead-end watermain is 49 on a permanent basis, or 75 on a temporary basis (looping to be provided within 2 years), to avoid the creation of a vulnerable service area. Based on the current draft plan, Phase 5-C will be serviced by a dead-end watermain until future development occurs west of the study area. As identified in **Table 2-2** , Phase 5-C includes a total of 50 units, which exceeds this criterion. Consequently, one (1) SFH will need to be frozen if Phase 5-C is not looped through future development (i.e., BCDC Ultimate Phase) within 2 years.

2.4 Hydrant Coverage Analysis

Table 1 in Appendix I of City of Ottawa Technical Bulletin ISTB-2018-02 specifies the maximum available hydrant flow rates based on hydrant classification and distance from the subject building. A Class AA hydrant located within 75 m of a building can provide a maximum flow of 5,700 L/min, while a Class AA hydrant located between 75 m and 150 m can provide up to 3,800 L/min. Based on these criteria and the proposed hydrant layout (refer to **Figure 2-2**), the available hydrant coverage was reviewed and confirmed to be adequate to satisfy the governing required fire flow for each development phase. It should be noted that assessment for Phase 6 will be completed under separate cover.

Table 2-3 summarizes the available hydrant coverage flow for each phase and compares it to the corresponding governing required fire flow, showing adequate hydrant coverage in all phases.

Table 2-3: Hydrant Coverage Analysis

<table>
<tr><th rowspan="3">Phase</th><th rowspan="3">Required Ultimate Fire Flow (L/min)</th><th colspan="4">Fire Hydrant</th><th rowspan="3">Combined Hydrant Flow Coverage (L/min)</th></tr>
<tr><th colspan="2">Within 75 m</th><th colspan="2">Between 75 m and 150 m</th></tr>
<tr><th>Quantity</th><th>Contribution to RFF (L/min)</th><th>Quantity</th><th>Contribution to RFF (L/min)</th></tr>
<tr><td>5-A</td><td>14,000</td><td>1</td><td rowspan="4">Up to 5,700</td><td>3</td><td rowspan="4">Up to 3,800</td><td>Up to 17,100</td></tr>
<tr><td>5-B</td><td>13,000</td><td>2</td><td>3</td><td>Up to 22,800</td></tr>
<tr><td>5-C</td><td>13,000</td><td>1</td><td>2</td><td>Up to 13,300</td></tr>
<tr><td>5-D</td><td>16,000</td><td>2</td><td>2</td><td>Up to 19,000</td></tr>
</table>

Figure No.

2-2

Title

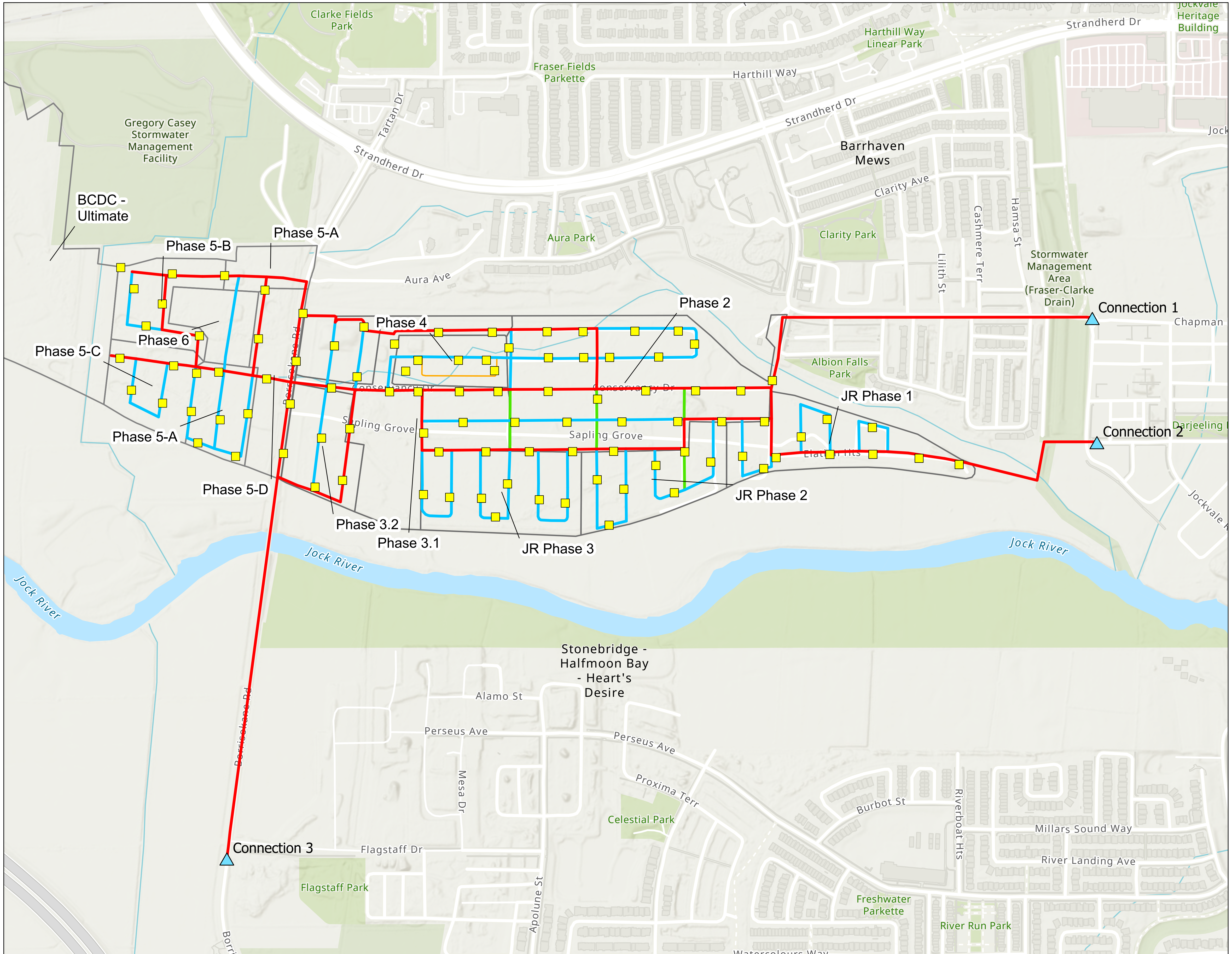
Watermain Sizing and Layout

Client/Project

David Schaeffer Engineering Ltd
Barrhaven Conservancy West Lands

Project Location

Ottawa, Ontario, Canada



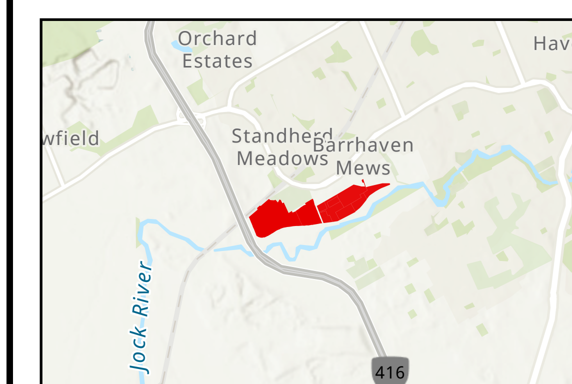
N

0 100 200 Meters
(At original document size of 11x17)
1:8,000

Legend

Diameter (mm)

- 100
- 150
- 200
- 300
- Phase Boundary
- Proposed Hydrants



Notes

1. Coordinate System: MTM 3Degree
2. Background: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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3 Hydraulic Modelling Results

Hydraulic modelling was completed for the BCDC Development Lands Phases 5-A, 5-B, and 6 interim development conditions, under the existing servicing conditions (Zone 3SW) to assess how the network would respond with additional water demands, and only two (2) connections to the City's network. Modelling was also completed for BCDC Phases 5-C and 5-D interim development conditions, under post SUC conditions, and three (3) connections to the City's network.

The following sub-sections present the modelling results under AVDY, PKHR, and MXDY+FF demands, as well as under emergency conditions in the event of a watermain break at key locations. Detailed modelling results for all scenarios are also provided in **Appendix C**.

3.1 Existing Conditions

3.1.1 Phase 5-A & 6

3.1.1.1 Average Day and Peak Hour Demands

Under AVDY demands with two connections to the water distribution system, the maximum modelled head for the BCDC Development Lands (up to and including Phase 5-A and 6) under existing conditions is 155.4 m. Given the difference in ground elevation across the site, the available maximum pressures range from 87.9 to 89.5 psi. These maximum pressures exceed the City's maximum pressure objective of 80 psi. As per the OBC, in areas that may be occupied, the static pressure at any fixture shall not exceed 80 psi. Where pressures do exceed 80 psi, pressure control measures, such as pressure reducing valves (PRVs), shall be considered. However, given that the development area will ultimately be serviced under SUC conditions, which will be operate at lower HGL of approximately 10 m (14 psi), the maximum pressures are considered acceptable under ultimate (SUC) servicing conditions.

Under PKHR demands with two (2) connections to the City's water distribution system, minimum modelled pressures for BCDC Phase 5-A and 6 conditions range between 65.2psi and 67.2 psi under existing conditions. These minimum pressures fall within the desired pressure range of 50 to 80 psi outlined by the City's Guidelines.

Table 3-1: System Pressure under Existing AVDY and PKHR Conditions (PH 5-A & PH 6)

Parameter	Existing Condition / Zone 3SW (psi)
Maximum Pressure (under AVDY)	89.5
Minimum Pressure (under PKHR)	65.2

3.1.1.2 Maximum Day Plus Fire Flow

With two (2) connections to the water distribution system, available fire flows throughout the proposed BCDC Development (up to and including Phases 5-A and 6) were assessed based on the fire flow requirements outlined in **Section 2.1.2** (refer to **Table 2-1**). The results under MXDY+FF showed that the system will be able to provide the interim RFF of 10,000 L/min throughout the BCDC Development Lands Phases 5-A and 6.

To conclude, these results show that the proposed watermain sizing and layout meet serviceability requirements, with two (2) connections under existing conditions, to service the assumed Phases 5-A, and 6 of the BCDC Development Lands, excluding the frozen units as outlined in **Figure 2-1**.

3.1.1.3 Reliability

Three (3) watermain failure scenarios were analysed, as listed below and illustrated in **Figure 3-1**, to assess whether adequate redundancy is provided within the proposed distribution network to meet fire flow targets under average day conditions.

1. Break of the 300 mm pipe servicing the north-end of Phase 5-A & 6 from Borrisokane Rd.
2. Break of the 300 mm pipe servicing the middle of Phase 5-A & 6 from Borrisokane Rd.
3. Break of the 300mm pipe (along Chapman Mill Dr) servicing the BCDC development from Connection 1.

Under failure scenarios 1, 2 and 3, modelling results suggest that the interim RFF of 10,000 L/min will be met throughout Phases 5-A & 6. Please see **Appendix C** for complete results.

3.1.2 Phase 5-B

3.1.2.1 Average Day and Peak Hour Demands

Under AVDY demands with two (2) connections to the water distribution system, the maximum modelled head for BCDC Development Lands (up to and including Phase 5-B) under existing conditions is 155.2 m. Given the difference in ground elevation across the site, the available maximum pressures range from 87.7 to 89.2 psi. These maximum pressures exceed the City’s maximum pressure objective of 80 psi. However, given that the development area will ultimately be serviced under SUC conditions, which will be operate at lower HGL of approximately 10 m (14 psi), the maximum pressures are considered acceptable under ultimate (SUC) servicing conditions.

Under PKHR demands, minimum modelled pressures for BCDC Phase 5-B conditions range between 64.8 psi and 67.2 psi under existing conditions. These minimum pressures fall within the desired pressure range of 50 to 80 psi outlined by the City’s Guidelines.

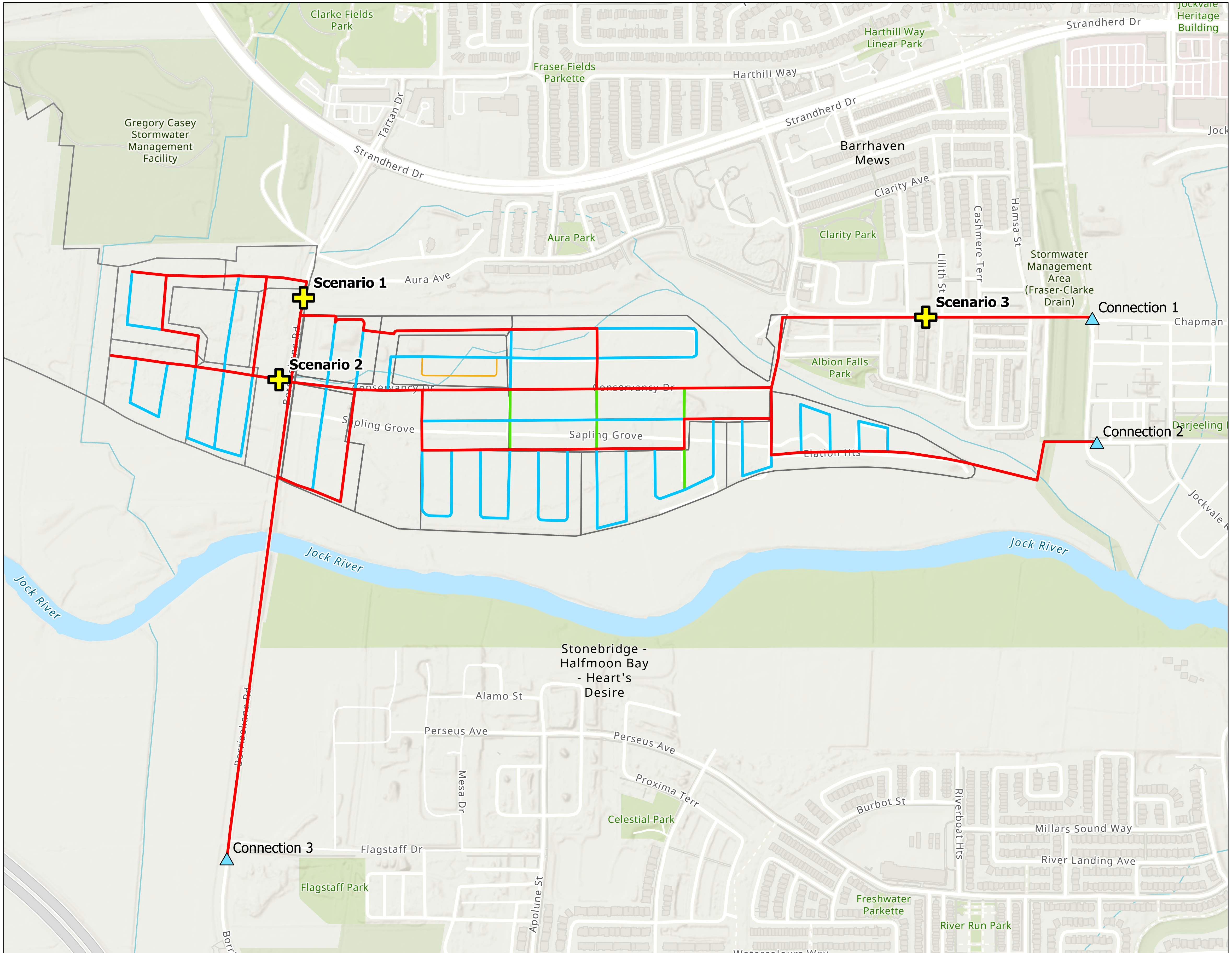


Figure No.
3-1

Title
Reliability Analysis

Client/Project
David Schaeffer Engineering Ltd
Barrhaven Conservancy West Lands

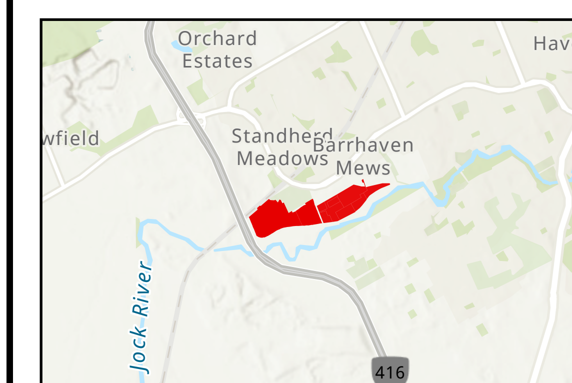
Project Location
Ottawa, Ontario, Canada

N

0 100 200 Meters
(At original document size of 11x17)
1:8,000

Legend
- Watermain Failure Scenario/Location
- Connection Location

Diameter (mm)
- 100
- 150
- 200
- 300
- Phase Boundary



Notes
1. Coordinate System: MTM 3Degree
2. Background: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Table 3-2: System Pressure under Existing AVDY and PKHR Conditions (PH 5-B)

Parameter	Existing Condition / Zone 3SW (psi)
Maximum Pressure (under AVDY)	89.2
Minimum Pressure (under PKHR)	64.8

3.1.2.2 Maximum Day Plus Fire Flow

With two (2) connections to the water distribution system, available fire flows throughout the proposed BCDC Phase 5-B development scenario were assessed based on the fire flow requirements outlined in **Section 2.1.2** (refer to **Table 2-1**). The results under MXDY+FF showed that the system will be able to provide the interim RFF of 10,000 L/min throughout the BCDC Development Lands (up to Phase 5-B).

To conclude, these results show that the proposed watermain sizing and layout meet serviceability requirements, with two (2) connections under existing conditions, to service the assumed Phase B of the BCDC Development Lands, excluding the frozen units as outlined in **Figure 2-1**.

3.1.2.3 Reliability

Under failure scenario 1, 2 and 3, as described in **Section 3.1.1.3**, the interim RFF of 10,000 L/min will be met throughout Phase 5-B. The network's redundancy is thus considered acceptable.

3.2 Post-SUC Conditions

3.2.1 Phase 5-C

3.2.1.1 Average Day and Peak Hour Demands

Under AVDY demands with three (3) connections to the water distribution system, the maximum modelled head for the BCDC Development (up to and including Phase 5-C) under post-SUC conditions is 146.4 m. Given the difference in ground elevation across the site, the available maximum pressures range from 75.2 psi to 76.7psi. These maximum pressures meet the City's maximum pressure objective of 80 psi.

Under PKHR demands with three (3) watermain connections to the water distribution system, minimum modelled pressures for Phase 5-C under post-SUC conditions range between 66.4 psi to 68.3 psi. These minimum pressures fall within the desired pressure range of 50 to 80 psi outlined by the City's Guidelines.

Table 3-3: System Pressure under Post-SUC AVDY and PKHR Conditions (PH 5-C)

Parameter	Post SUC Conditions (psi)
Maximum Pressure (under AVDY)	76.7
Minimum Pressure (under PKHR)	66.4

3.2.1.2 Maximum Day Plus Fire Flow

With three (3) connections to the water distribution system, available fire flows throughout the proposed development scenario were assessed based on the fire flow requirements outlined in **Section 2.1.2** (refer to **Table 2-1**). The results under MXDY+FF showed that the system will be able to provide the required fire flows throughout the BCDC Development Lands, up to and including Phase 5-C.

To conclude, these results show that the proposed watermain sizing and layout meet serviceability requirements, with three (3) connections under post-SUC conditions, to service the BCDC Development Lands up to and including Phase 5-C.

3.2.1.3 Reliability

Failure scenarios 1, 2 and 3, as described in **Section 3.1.1.3**, were assessed under Phase 5-C conditions. Results from each scenario are discussed below.

<u>Failure Scenario 1:</u> Modelling results suggest that available fire flow within the BCDC Development (up to and including Phase 5-C) range from 12,900 L/min (at nodes J172) to 14,000 L/min. Adequate hydrant placement, in accordance with Appendix I of ISDTB-2018-02, satisfies the RFF across all sub-phases. Modelling results are thus considered acceptable.

<u>Failure Scenario 2:</u> Modelling results suggest that a watermain break at location #2 would result in significant impact to the available fire flow within the BCDC Development (up to and including Phase 5-C). Under such conditions, the available fire flows range from 11,000 L/min (at nodes J14) to 14,000 L/min. The reduced fire flows are particularly evident in Phase 5-A and 5-C, as illustrated in **Figure 3-2**. Adequate hydrant placement, in accordance with Appendix I of ISDTB-2018-02, would satisfy the RFF across Phase 5-C. However, buildings with fire flow requirement greater than 10,000 L/min within Phase 5-A would not be able to be adequately protected. Two (2) solutions are available to mitigate these deficiencies:

1) Lotting strategies (refer to **Figure 3-2**) to freeze the construction of some blocks to provide fire separation distances in accordance with the provisions listed in the City of Ottawa's Technical Bulletin ISDTB-2014-02, to cap the RFF at 10,000 L/min for units within Phase 5-A; or

2) Construction of the 305 mm diameter watermain within Phase 5-D (refer to **Figure 3-2**) concurrent with the development of Phase 5-C.

<u>Failure Scenario 3:</u> Modelling results suggest that available fire flows within Phases 5 (up to Phase 5-C) and 6 of the BCDC Development range from 13,200 L/min (at nodes J14) to 14,000 L/min. The results demonstrate that the system would be able to provide the required fire flows throughout the BCDC Development Lands, up to and including Phase 5-C, under such watermain failure scenario.

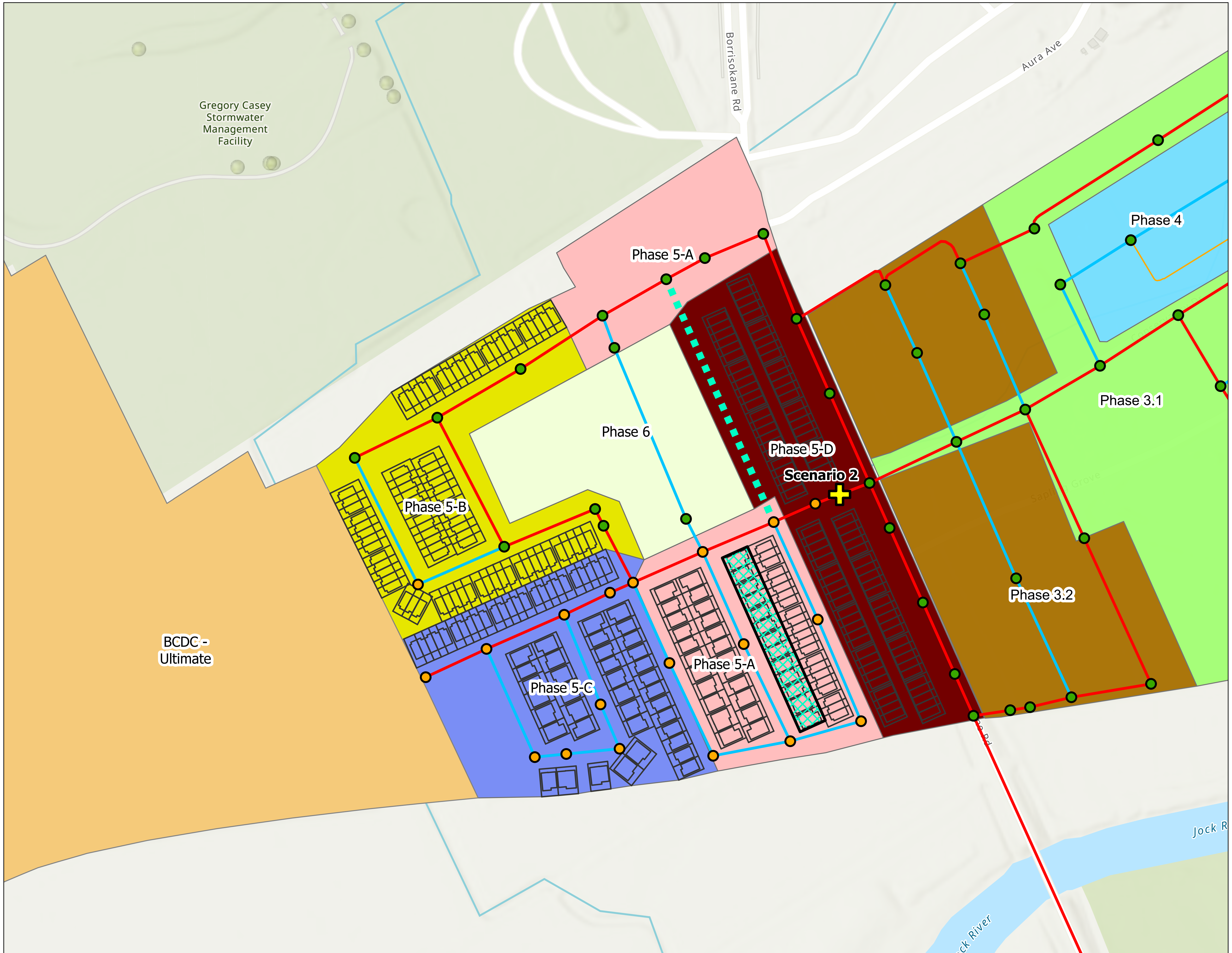


Figure No.
3-2

Title
Available Fire Flows under AVDY+FF Failure Scenario 2 & Phase 5-C Conditions

Client/Project
David Schaeffer Engineering Ltd
Barrhaven Conservancy West Lands

Project Location
Ottawa, Ontario, Canada

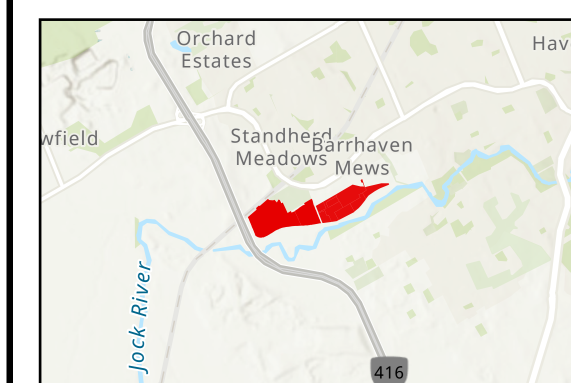
N

0 50 100 Meters
(At original document size of 11x17)
1:3,000

Legend
Watermain Failure Scenario/Location
Available Fire Flow (L/min)
- <= 10,000
- 10,000 - 14,000
- > 14,000

Diameter (mm)
- 100
- 150
- 200
- 300
- Phase 5-D Watermain (300 mm)
- Required Frozen Lots

Phase
- Phase 3.1
- Phase 3.2
- Phase 4
- Phase 5-A
- Phase 5-B
- Phase 5-C
- Phase 5-D
- Phase 6
- BCDC - Ultimate



Notes
1. Coordinate System: MTM 3Degree
2. Background: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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3.2.2 Phase 5-D

3.2.2.1 Average Day and Peak Hour Demands

Under AVDY demands with three (3) connections to the water distribution system, the maximum modelled head for the BCDC Development (up to and including Phase 5-D) under post-SUC conditions is 146.3 m. Given the difference in ground elevation across the site, the available maximum pressures range from 75.1 psi to 76.6 psi. These maximum pressures meet the City's maximum pressure objective of 80 psi.

Under PKHR demands with three (3) to the water distribution system, minimum modelled pressures for Phase 5-D under post-SUC conditions range between 65.8 psi to 67.8 psi. These minimum pressures fall within the desired pressure range of 50 to 80 psi outlined by the City's Guidelines.

Table 3-4: System Pressure under Post-SUC AVDY and PKHR Conditions (PH 5-D)

Parameter	Post SUC Conditions (psi)
Maximum Pressure (under AVDY)	76.6
Minimum Pressure (under PKHR)	65.8

3.2.2.2 Maximum Day Plus Fire Flow

With three (3) connections to the water distribution system, available fire flows throughout the proposed development scenario were assessed based on the fire flow requirements outlined in **Section 2.1.2** (refer to **Table 2-1**). The results under MXDY+FF showed that the network can satisfy the respective RFF across all sub-phases.

To conclude, these results show that the proposed watermain sizing and layout meet serviceability requirements, with three (3) connections under post-SUC conditions, to service the BCDC Development Lands up to and including Phase 5-D and Phase 6.

3.2.2.3 Reliability

Failure scenarios 1, 2 and 3, as described in **Section 3.1.1.3**, were assessed under Phase 5-D conditions. Results from each scenario are discussed below.

<u>Failure Scenario 1:</u> Modelling results suggest that available fire flow within the BCDC Development (up to and including Phase 5-D) range from 13,900 L/min (at nodes J14) to 16,000 L/min. The results demonstrate that the system would be able to provide the required fire flows throughout the BCDC Development Lands, up to and including Phase 5-D, under such watermain failure scenario.

<u>Failure Scenario 2:</u> Modelling results suggest that available fire flows within the BCDC Development (up to and including Phase 5-D) range from 12,500 L/min (at nodes J14) to 16,000 L/min. Adequate hydrant placement, in accordance with Appendix I of ISDTB-2018-02, satisfies the RFF across all sub-phases. Modelling results are thus considered acceptable.

Failure Scenario 3: Modelling results suggest that available fire flows within Phases 5 and 6 of the BCDC Development range from 12,300 L/min (at nodes J14) to 16,000 L/min. Adequate hydrant placement, in accordance with Appendix I of ISDTB-2018-02, satisfies the RFF within across all sub-phases. Modelling results are thus considered acceptable.

4 Conclusions and Recommendations

A hydraulic analysis of the water distribution system was conducted to evaluate the serviceability of the proposed Phase 5 (divided in sub-phases 5-A through 5-D) within the BCDC Development Lands, under the assumption that Phase 6 will be completed beforehand. The goal of the analysis was to support detail design of Phase 5, by confirming associated watermain sizing and redundancy needs. Based on the hydraulic analysis, the following conclusions and recommendations are made:

- The estimated AVDY, MXDY and PKHR demand projections up to and including the proposed BCDC Phases 5 and 6 development scenarios are 18.29 L/s, 45.73 L/s, and 100.60 L/s, respectively.
- Phase 5 and 6 of the BCDC Development Lands comprise 672 units (74 SFH, 598 TH), with a total residential population of 1,865.
- Existing (pre-SUC) conditions:
    - The proposed watermain sizing and layout meet serviceability requirements with two (2) connections to service up to BCDC Phases 5-A, 5-B and Phase 6.
    - Lotting strategies (refer to **Figure 2-1**) were implemented within Phases 5-A and 5-B to freeze the construction of some blocks to provide fire separation distances in accordance with the provisions listed in the City of Ottawa’s Technical Bulletin ISDTB-2014-02, to cap the RFF at 10,000 L/min.
    - Under failure scenarios 1, 2 and 3, modelling results suggest that the interim RFF of 10,000 L/min will be met throughout Phases 5-A, 5B & 6.
- Post-SUC conditions:
    - The proposed watermain sizing and layout meet serviceability requirements for AVDY and PKHR demands with three (3) connections to service up to BCDC Phases 5-C and 5-D.
    - The maximum number of units permitted along a dead-end watermain is 49 on a permanent basis, or 75 on a temporary (2 years maximum) basis, to avoid the creation of a vulnerable service area. Based on the current draft plan, Phase 5-C will be serviced by a dead-end watermain until future development occurs west of the study area. As identified in **Table 2-2** , Phase 5-C includes a total of 50 units, which exceeds this criterion. Consequently, one (1) SFH will need to be frozen if Phase 5-C is not looped through future development (i.e. BCDC Ultimate Phase) within 2 years.
    - Adequate hydrant placement, in accordance with Appendix I of ISDTB-2018-02, will satisfy the required fire flow at all locations under MXDY+FF conditions. The alternative procedure was employed to optimize the sizing of the dead-end watermain.

  - Modelling results demonstrated that parts of the BCDC Development Lands, specifically within Phases 5-A and 5-C, would be vulnerable under a watermain break scenario at Location #2 (refer to **Figure 3-1**). Under such conditions, the available fire flow range from 11,000 L/min (at nodes J14) to 14,000 L/min. The reduced fire flows are especially evident within Phase 5-A and 5-C, as shown in **Figure 3-2**. Adequate hydrant placement, in accordance with Appendix I of ISDTB-2018-02, will satisfy the RFF across Phase 5-C. However, buildings with fire flow requirement greater than 10,000 L/min within Phase 5-A would not be adequately protected. Two (2) solutions are available to mitigate these deficiencies:

    1) Lotting strategies (refer to **Figure 3-2**) to freeze the construction of some blocks to provide fire separation distances in accordance with the provisions listed in the City of Ottawa's Technical Bulletin ISDTB-2014-02, to cap the RFF at 10,000 L/min for units within Phase 5-A; or

    2) Construction of the 305 mm diameter watermain within Phase 5-D (refer to **Figure 3-2**) concurrent with the development of Phase 5-C.

- Available hydrant coverage was reviewed, based on the City of Ottawa Technical Bulletin ISTB-2018-02, and confirmed to be adequate to satisfy the governing required fire flow for each project phase. It should be noted that assessment for Phase 6 will be completed during subsequent design phase.

- Updated boundary conditions shall be obtained from the City to confirm the assumptions made in this analysis and the resulting modelling results.

5 References

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Appendix A Fire Flow Calculations

Fire Flow Calculations as per the Ontario Building Code (OBC)

Stantec

OFM Fire Flow Calculation

Calculations based on *Fire Protection Water Supply Guideline for Part 3 in the Ontario Building Code* by the Office of the Fire Marshal (OFM 1999)

Stantec Project #:	**163401817**
Project Name:	**Barrhaven Conservancy Development Project**
Date:	**4/20/2026**
Fire Flow Calculation #:	**5**
Description:	**Residential**

Data inputted b Andrew Buckley P.Eng.
Data reviewed I Alexandre Mineault-G, P.Eng.

Notes: *Block #12 is assumed to comprise of a total of 24 stacked townhouse units. For calculations, the block was considered as 12 - 3 storeys units, with a basement (more than 50% below ground). It is also assumed that the block has an average floor area of 568 sq. ft. Wood Frame Construction, no sprinklers.*

Office of the Fire Marshal Determination of Required Fire Protection Water Supply

Step	Task	Notes		Multiplier Associated with Option		Value Used	
1	**General Building Details**						
1.1	**Enter Number of Storeys**	Number of Floors/Storeys in the Unit (incl. basement):			4	4	Storeys
1.2	**Choose Type of Housing (if TH, Enter Number of Units Per TH Block)**	Type of Housing	Single Family	0	Townhouse - indicate # of units	12	Units
			Townhouse - indicate # of units	12			
			Other (Comm, Ind, Apt etc.)	0			
1.3	**Choose Presence of Sprinklers**	Sprinklers?			None	None	N/A
1.4	**Choose Presence of Firewalls**	Firewall separations?			None	None	N/A
1.5	**Choose Presence of Stand-Pipe System**	Stand-pipe system?			None	None	N/A
2	**Determining Water Supply Coefficient K**						
2.1	**Choose Type of Construction**	**Type of Construction**					
		Type of Construction	Non-combustible construction + fire separations + fire-resistance ratings in accordance with Section 3.2.2 of OBC	Type I	Type III	N/A	N/A
			Non-combustible construction + fire separations + no fire-resistance rating	Type II			
			Combustible construction + fire separations + fire-resistance ratings in accordance with Section 3.2.2 of OBC	Type III			
			Combustible construction + fire separations + no fire-resistance rating	Type IV			
2.2	**Choose Classification**	**Building Classification**					
		Occupancy Classification (OBC)	A-2, B-1, B-2, B-3, C, D	18	C	A-2, B-1, B-2, B-3, C, D	N/A
			A-4, F-3	22			
			A-1, A-3	25			
			E, F-2	31			
			F-1	41			
2.3	**Water Supply Coefficient (K)**	Water Supply Coefficient K				18	N/A
3	**Determining Building Volume V**						
3.1	**Enter Ground Floor Area of One Unit**	**Floor Space Area**					
		Average Floor Area (A) :			569 Square Metres (m2)	569	Area in Square Meters (m^2)
3.2	**Building Height (h)**	**Building Height**					
		Bottom Elevation :			0.0 Meters (m)	12.4	Height in Meters (m)
		Top Elevation :			12.4 Meters (m)		
3.3	**Building Volume (V)**	Building Volume V = A * h				7,060	Volume in Meters Cube (m^3)
4	**Determining Spatial Coefficient S**						
4.1	**Choose Exposure Distances from Building to Property Line**	Exposure Distance from Building to Property Line in Meters (m)	**North Side**	0	0.50	0.50	Distance in Meters (m)
			Property Line to Street Centreline (Street Facing)	2.5			
			Total Exposure Distance	**2.5**			
			East Side	3.1	0.00		
			Property Line to Street Centreline (Street Facing)	11.8			
			Total Exposure Distance	**14.8**			
			South Side	0	0.00		
			Property Line to Street Centreline (Street Facing)	10.5			
			Total Exposure Distance	**10.5**			
			West Side	0	0.00		
			Property Line to Street Centreline (Street Facing)	31.5			
			Total Exposure Distance	**31.5**			
4.2	**Total Spatial Coefficient (S_{tol})**	Total Spatial Coefficient $S_{tot} = 1 + \Sigma S_x$				1.50	N/A
5	**Determining Required Minimum Supply of Water Q and Fire Flow**						
5.1	**Obtain Required Fire Volume, Flow & Duration**	**Minimum Supply of Water, rounded to nearest 1,000 L; $Q = K*V*S_{tot}$**				**191,000**	**L**
		Required Minimum Water Supply Flow Rate (L/min)				**6,300**	**L/min**
		Required Minimum Water Supply Flow Rate (L/s)				**105**	**L/s**
		Required Minimum Duration of Fire Flow (min)				**40**	**min**

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 163401817
Project Name: Barrhaven Conservancy Development Project
Date: 4/20/2026
Fire Flow Calculation #: 2
Description: Phase 5-A; Block #77

Data inputted by: Andrew Buckley, P.Eng.
Data reviewed by: Alexandre Mineault-G, P.Eng.

Notes: *Block #77 is assumed to comprise a total of 6 townhouse units. For FUS calculations, each unit was considered with a basement (more than 50% below ground) and an average floor area of 466 sq. ft. Wood Frame Construction, Limited Combustible Occupancy Content, and no sprinklers.*

Step	Task	Notes										Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction										1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas										YES	-
		466	466									931	-
3	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min										-	10,000
4	Determine Occupancy Charge	Limited Combustible										-15%	8,500
5	Determine Sprinkler Reduction	None										0%	0
		Non-Standard Water Supply or N/A										0%	
		Not Fully Supervised or N/A										0%	
		% Coverage of Sprinkler System										0%	
5A	Determine Bylaw Requirement	Community bylaw requiring all building that may be built within 30m of subject building to be fully sprinkler protected										NO	-
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?			-	-
		Front	20.1 to 30	61	2	> 100	Type V		NO			10%	5,950
		Right	0 to 3	14	2	21-41	Type V		NO			21%	
		Rear	3.1 to 10	35	2	61-80	Type V		NO			18%	
		Left	0 to 3	14	2	21-41	Type V		NO			21%	
7	Determine Final Required Fire Flow	**Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min**											**14,000**
		Total Required Fire Flow in L/s											**233**
		Required Duration of Fire Flow (hrs)											**3.00**
		Required Volume of Fire Flow (m^3)											**2,520**

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 163401817
Project Name: Barrhaven Conservancy Development Project
Date: 4/20/2026
Fire Flow Calculation #: 3
Description: Phase 5-B; Block #94

Data inputted by: Andrew Buckley, P.Eng.
Data reviewed by: Alexandre Mineault-G, P.Eng.

Notes: *Block #94 is assumed to comprise a total of 6 townhouse units. For FUS calculations, each unit was considered with a basement (more than 50% below ground) and an average floor area of 465 sq. ft. Wood Frame Construction, Limited Combustible Occupancy Content, and no sprinklers.*

Step	Task	Notes							Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction							1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas							YES	-
		465	465						931	-
3	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min							-	10,000
4	Determine Occupancy Charge	Limited Combustible							-15%	8,500
5	Determine Sprinkler Reduction	None							0%	0
		Non-Standard Water Supply or N/A							0%	
		Not Fully Supervised or N/A							0%	
		% Coverage of Sprinkler System							0%	
5A	Determine Bylaw Requirement	Community bylaw requiring all building that may be built within 30m of subject building to be fully sprinkler protected							NO	-
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	Firewall / Sprinklered ?	-	-
		Front	20.1 to 30	79	2	> 100	Type V	NO	10%	4,675
		Right	20.1 to 30	30	2	61-80	Type V	NO	6%	
		Rear	3.1 to 10	36	2	61-80	Type V	NO	18%	
		Left	0 to 3	14	2	21-41	Type V	NO	21%	
7	Determine Final Required Fire Flow	**Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min**								**13,000**
		Total Required Fire Flow in L/s								**217**
		Required Duration of Fire Flow (hrs)								**2.50**
		Required Volume of Fire Flow (m^3)								**1,950**

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 163401817
Project Name: Barrhaven Conservancy Development Project
Date: 4/20/2026
Fire Flow Calculation #: 4
Description: Phase 5-C; Block #82

Data inputted by: Andrew Buckley, P.Eng.
Data reviewed by: Alexandre Mineault-G, P.Eng.

Notes: *Block #82 is assumed to comprise a total of 5 townhouse units. For FUS calculations, each unit was considered with a basement (more than 50% below ground) and an average floor area of 389 sq. ft. Wood Frame Construction, Limited Combustible Occupancy Content, and no sprinklers.*

Step	Task	Notes										Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction										1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas										YES	-
		389	389									778	-
3	Determine Required Fire Flow	$(F = 220 \times C \times A^{1/2})$. Round to nearest 1000 L/min										-	9,000
4	Determine Occupancy Charge	Limited Combustible										-15%	7,650
5	Determine Sprinkler Reduction	None										0%	0
		Non-Standard Water Supply or N/A										0%	
		Not Fully Supervised or N/A										0%	
		% Coverage of Sprinkler System										0%	
5A	Determine Bylaw Requirement	Community bylaw requiring all building that may be built within 30m of subject building to be fully sprinkler protected										NO	-
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?			-	-
		Front	20.1 to 30	31	2	61-80	Type V		NO			6%	5,049
		Right	0 to 3	14	2	21-41	Type V		NO			21%	
		Rear	3.1 to 10	30	2	61-80	Type V		NO			18%	
		Left	0 to 3	14	2	21-41	Type V		NO			21%	
7	Determine Final Required Fire Flow	**Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min**											**13,000**
		Total Required Fire Flow in L/s											**217**
		Required Duration of Fire Flow (hrs)											**2.50**
		Required Volume of Fire Flow (m^3)											**1,950**

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 163401817
Project Name: Barrhaven Conservancy Development Project
Date: 4/20/2026
Fire Flow Calculation #: 5
Description: Phase 5-D; Block #112

Data inputted by: Andrew Buckley, P.Eng.
Data reviewed by: Alexandre Mineault-G, P.Eng.

Notes: *Block #112 is assumed to comprise a total of 6 townhouse units. For FUS calculations, each unit was considered with a basement (more than 50% below ground) and an average floor area of 560 sq. ft. Wood Frame Construction, Limited Combustible Occupancy Content, and no sprinklers.*

Step	Task	Notes							Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction							1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas							YES	-
		560	560						1,119	-
3	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min							-	11,000
4	Determine Occupancy Charge	Limited Combustible							-15%	9,350
5	Determine Sprinkler Reduction	None							0%	0
		Non-Standard Water Supply or N/A							0%	
		Not Fully Supervised or N/A							0%	
		% Coverage of Sprinkler System							0%	
5A	Determine Bylaw Requirement	Community bylaw requiring all building that may be built within 30m of subject building to be fully sprinkler protected							NO	-
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	Firewall / Sprinklered ?	-	-
		Front	20.1 to 30	48	3	> 100	Type V	NO	10%	6,732
		Right	0 to 3	15	2	21-41	Type V	NO	21%	
		Rear	3.1 to 10	61	2	> 100	Type V	NO	20%	
		Left	0 to 3	15	2	21-41	Type V	NO	21%	
7	Determine Final Required Fire Flow	**Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min**								**16,000**
		Total Required Fire Flow in L/s								**267**
		Required Duration of Fire Flow (hrs)								**3.50**
		Required Volume of Fire Flow (m^3)								**3,360**

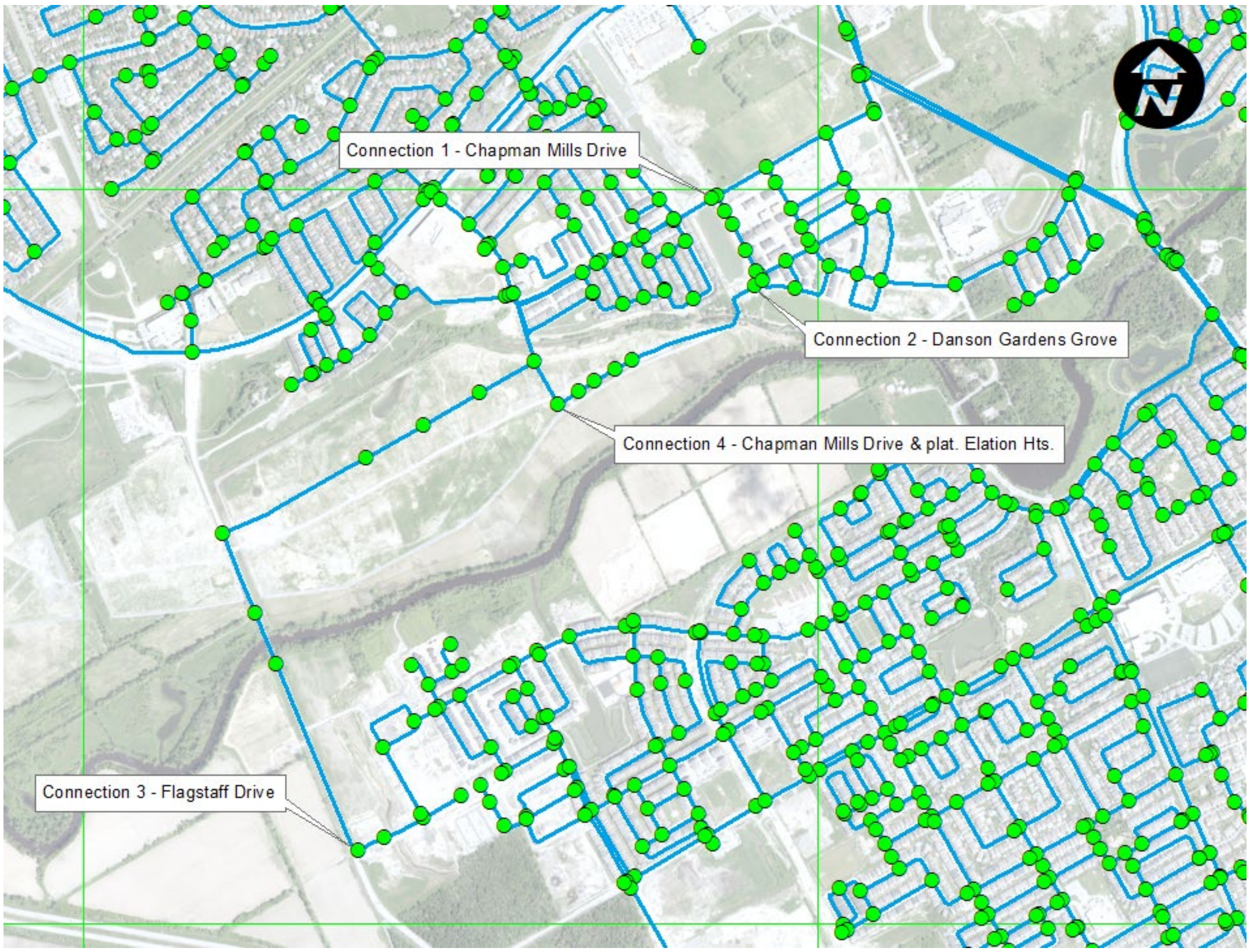
Appendix B Water Boundary Conditions

Boundary Conditions
Ultimate Scenario – Barrhaven Conservancy – East

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	737	12.28
Maximum Daily Demand	1,842	30.70
Peak Hour	4,053	67.55
Fire Flow Demand #1	13,000	216.67
Fire Flow Demand #2	15,000	250.00
Fire Flow Demand #3	16,000	266.67

Location



Results

Scenario 1 : Connection 1 & 2 at Chapman Mills Drive & Danson Gardens Grove

Existing Condition (Pre- SUC Pressure Zone Reconfiguration, 3SW)

Connection 1 - Chapman Mills Drive

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	156.4	90.1
Peak Hour	141.0	68.2
Max Day plus Fire Flow #1	141.2	68.5
Max Day plus Fire Flow #2	138.1	64.1
Max Day plus Fire Flow #3	136.4	61.6
[1] Ground Elevation =	93.1	m

Connection 2 - Danson Gardens Grove & DarJeeling Ave

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	156.4	91.9
Peak Hour	141.0	70.0
Basic Day Demands plus Fire Flow1*	137.9	65.5
Basic Day Demands plus Fire Flow2*	133.5	59.2
Basic Day Demands plus Fire Flow3*	131.1	55.8
Max Day plus Fire Flow #1	139.3	67.4
Max Day plus Fire Flow #2	135.5	62.2
Max Day plus Fire Flow #3	133.5	59.3
[1] Ground Elevation =	91.8	m

Future Condition (Post- SUC Pressure Zone Reconfiguration)

Connection 1 - Chapman Mills Drive

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	146.8	76.4
Peak Hour	142.7	70.6
Max Day plus Fire Flow #1	136.3	61.5
Max Day plus Fire Flow #2	133.9	58.0
Max Day plus Fire Flow #3	132.6	56.1
[1] Ground Elevation =	93.1	m

Connection 2 - Danson Gardens Grove & DarJeeling Ave

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	146.8	78.2
Peak Hour	142.7	72.3
Basic Day Demands plus Fire Flow1*	132.4	57.7
Basic Day Demands plus Fire Flow2*	128.7	52.5
Basic Day Demands plus Fire Flow3*	126.7	49.7
Max Day plus Fire Flow #1	134.3	60.4
Max Day plus Fire Flow #2	131.3	56.1
Max Day plus Fire Flow #3	129.7	53.8
[1] Ground Elevation =	91.8	m

Note:
* Basic day demands plus fire flow scenario shows boundary condition result with only one connection at #2 due to watermain break (failure scenario) at connection #1.

Scenario 2 : Connection 1 & 2 & 3 at Chapman Mills Drive, Danson Gardens Grove & Flagstaff Drive

Existing Condition (Pre- SUC Pressure Zone Reconfiguration, 3SW)

Connection 1 - Chapman Mills Drive

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	156.4	90.1
Peak Hour	141.0	68.1
Max Day plus Fire Flow #1	141.2	68.4
Max Day plus Fire Flow #2	140.6	67.5
Max Day plus Fire Flow #3	139.2	65.5
[1] Ground Elevation =	93.1	m

Connection 2 - Danson Gardens Grove & DarJeeling Ave

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	156.4	91.9
Peak Hour	141.0	69.9
Max Day plus Fire Flow #1	138.1	65.8
Max Day plus Fire Flow #2	133.9	59.9
Max Day plus Fire Flow #3	131.7	56.7
[1] Ground Elevation =	91.8	m

Connection 3 - Flagstaff Drive

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	156.3	90.9
Peak Hour	140.6	68.7
Max Day plus Fire Flow #1	136.4	62.7
Max Day plus Fire Flow #2	132.0	56.4
Max Day plus Fire Flow #3	129.6	53.0
Basic Day Demands plus Fire Flow1*	136.9	63.3
Basic Day Demands plus Fire Flow2*	132.5	57.1
Basic Day Demands plus Fire Flow3*	130.1	53.7
[1] Ground Elevation =	92.3	m

Future Condition (Post- SUC Pressure Zone Reconfiguration)

Connection 1 - Chapman Mills Drive

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	146.8	76.4
Peak Hour	142.8	70.7
Max Day plus Fire Flow #1	138.4	64.4
Max Day plus Fire Flow #2	136.5	61.8
Max Day plus Fire Flow #3	135.5	60.3
[1] Ground Elevation =	93.1	m

Connection 2 - Danson Gardens Grove & DarJeeling Ave

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	146.8	78.2
Peak Hour	142.9	72.6
Max Day plus Fire Flow #1	133.2	58.9
Max Day plus Fire Flow #2	129.8	54.0
Max Day plus Fire Flow #3	128.0	51.4
[1] Ground Elevation =	91.8	m

Connection 3 - Flagstaff Drive

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	146.7	77.3
Peak Hour	142.1	70.8
Max Day plus Fire Flow #1	132.4	56.9
Max Day plus Fire Flow #2	128.8	51.8
Max Day plus Fire Flow #3	126.8	49.1
Basic Day Demands plus Fire Flow1*	132.3	56.9
Basic Day Demands plus Fire Flow2*	128.7	51.8
Basic Day Demands plus Fire Flow3*	126.8	49.0
[1] Ground Elevation =	92.3	m

Scenario 3 : Connection 4 at Chapman Mills Drive & plat. Elation Hts.

Existing Condition (Pre- SUC Pressure Zone Reconfiguration, 3SW)

Connection 4 - Chapman Mills Dr. & plat. Elation Hts.

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	156.3	92.3
Peak Hour	138.1	66.5
Max Day plus Fire Flow #1	106.4	21.4
Max Day plus Fire Flow #2	93.9	3.6
Max Day plus Fire Flow #3	87.1	-6.0
Basic Day Demands plus Fire Flow1*	111.5	28.6
Basic Day Demands plus Fire Flow2*	99.5	11.6
Basic Day Demands plus Fire Flow3*	93.0	2.4

[1] Ground Elevation = 91.4 m

Future Condition (Post- SUC Pressure Zone Reconfiguration)

Connection 4 - Chapman Mills Dr. & plat. Elation Hts.

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	146.7	78.7
Peak Hour	138.5	67.0
Max Day plus Fire Flow #1	101.5	14.4
Max Day plus Fire Flow #2	89.7	-2.4
Max Day plus Fire Flow #3	83.3	-11.5
Basic Day Demands plus Fire Flow1*	106.0	20.8
Basic Day Demands plus Fire Flow2*	94.8	4.8
Basic Day Demands plus Fire Flow3*	88.6	-3.9

[1] Ground Elevation = 91.4 m

Notes

1. As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:
    a. If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.
    b. Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.
2. Per the OWDG Section 4.2.2:
    a. During periods of maximum day and fire flow demand, the residual pressure at any point in the distribution system shall not be less than 20 psi.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

Table B-1: Extrapolated HGL Boundary Conditions (Existing Conditions)

Phase	Demand Scenario	Fire Flow (L/min)	Existing Conditions (Zone 3SW)	
			Connection 1 [(1)]	Connection 2 [(2)]
Up to and including 5-A and 6	AVDY	N/A	155.4	155.4
	PKHR		140.8	140.8
	AVDY+FF [(3)]	10,000	-	138.8
	MXDY+FF	10,000	139.7	139.7
Up to and including 5-A, 5-B and 6	AVDY	N/A	155.2	155.2
	PKHR		140.8	140.8
	AVDY+FF [(3)]	10,000	-	138.8
	MXDY+FF	10,000	139.7	139.7

Notes:

1- Ground Elevation @ Connection 1 (Chapman Mills Dr) = 93.1 m.
2- Ground Elevation @ Connection 2 (Danson Gardens Grv / Darjeeling Ave) = 91.8 m.
3- For the reliability analysis, it is assumed that the connection 1 would be offline and connection 2 would service the AVDY+FF demand scenario.

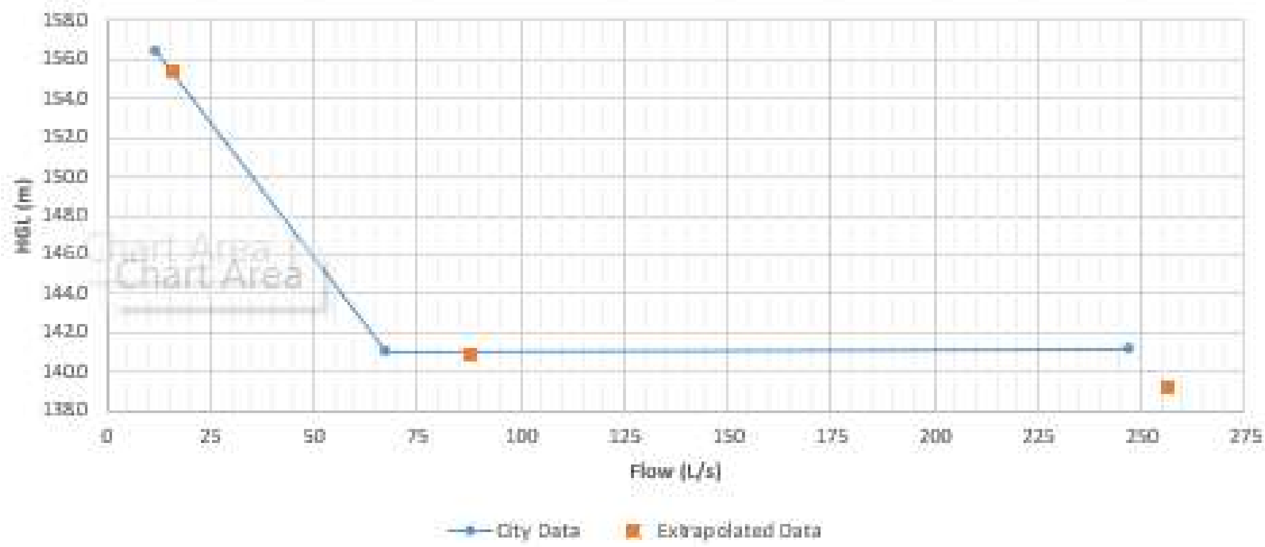
Table B-2: Extrapolated HGL Boundary Conditions (Post-SUC Conditions)

Phase	Demand Scenario	Fire Flow (L/min)	Existing Conditions (Zone SUC)		
			Connection 1 (1)	Connection 2 (2)	Connection 3 (3)
Up to and including 5-A, 5-B, 5-C and 6	AVDY	N/A	146.4	146.5	146.3
	PKHR		141.9	141.1	140.3
	AVDY+FF (4)	14,000	-	129.0	128.9
	MXDY+FF	14,000	136.2	129.4	128.2
Up to and including 5-A, 5-B, 5-C, 5-D and 6	AVDY	N/A	146.4	146.4	146.2
	PKHR		141.7	140.7	139.9
	AVDY+FF (4)	16,000	-	126.3	126.4
	MXDY+FF	16,000	135.0	127.0	125.8

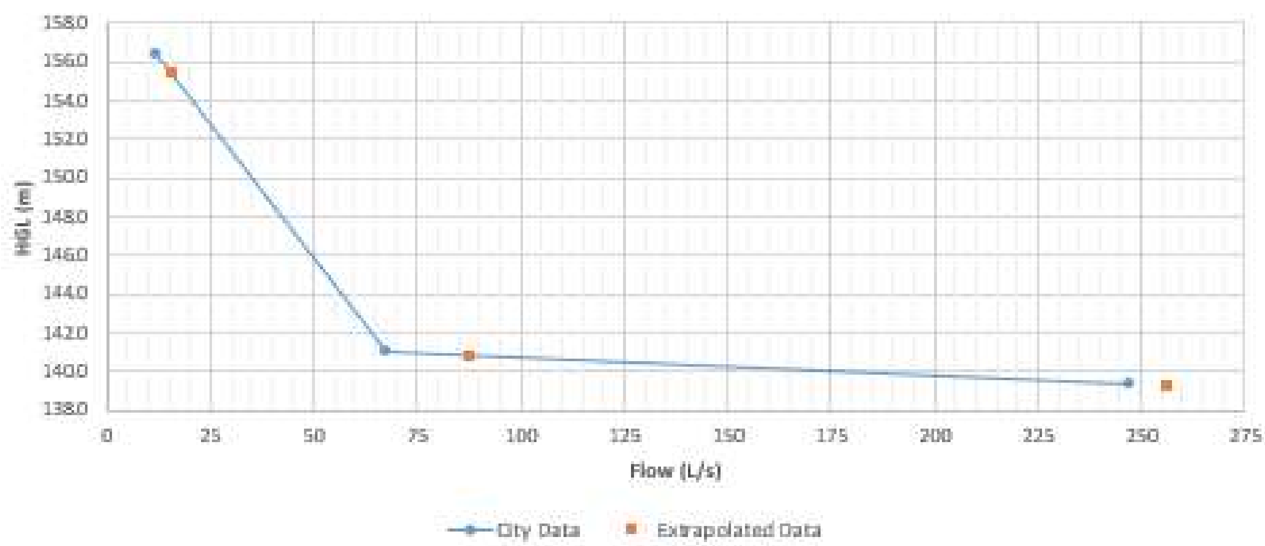
Notes:

1. Ground Elevation @ Connection 1 (Chapman Mills Dr) = 93.1 m.
2. Ground Elevation @ Connection 2 (Danson Gardens Grv / Darjeeling Ave) = 91.8 m.
3. Ground Elevation @ Connection 3 (Flagstaff Drive) = 92.3 m.
4. For the reliability analysis, it is assumed that the connection 1 would be offline and connections 2 and 3 would service the AVDY+FF demand scenario.

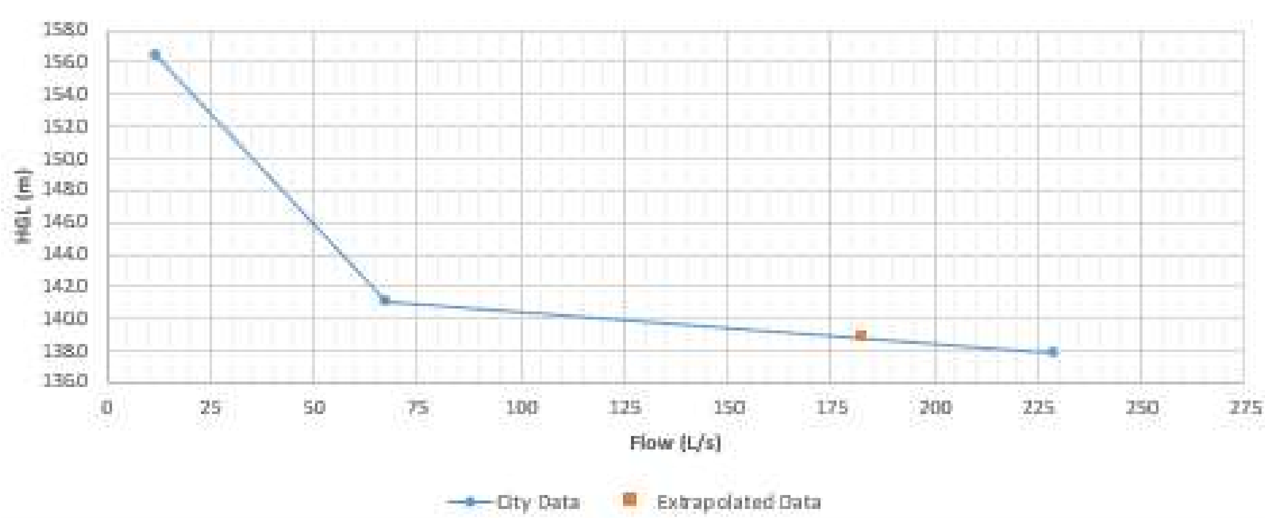
PH 5-A & 6 : Connection 1 - Chapman Mills Drive (Existing Conditions)

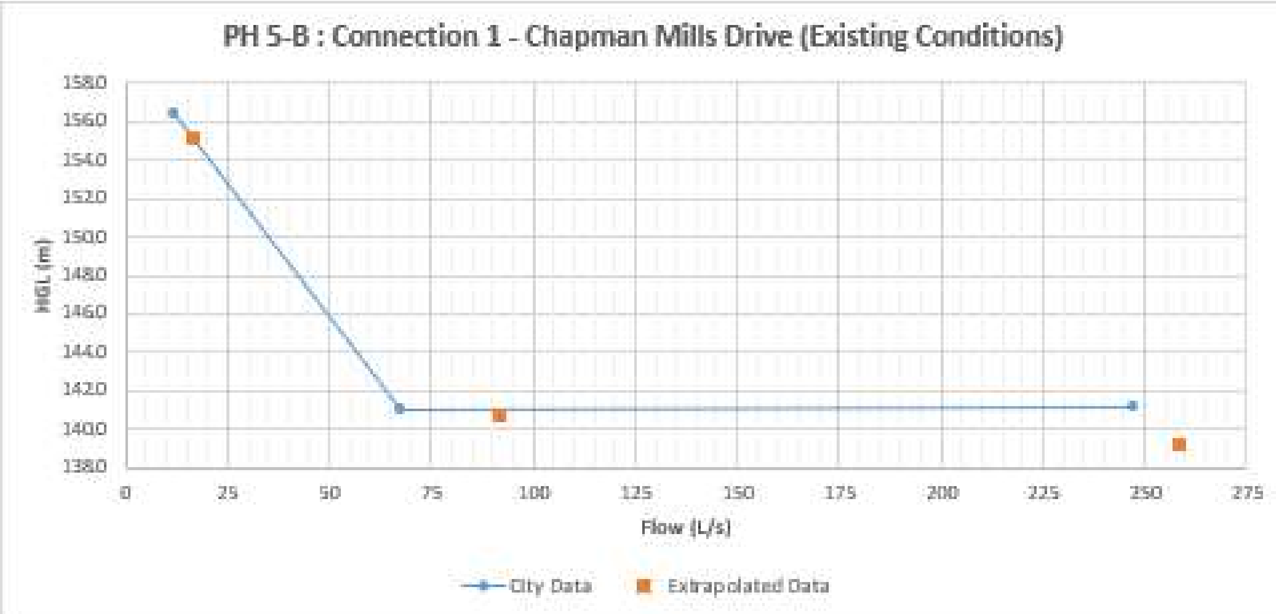


PH 5-A & 6: Connection 2 - Danson Gardens Grove (Existing Conditions)

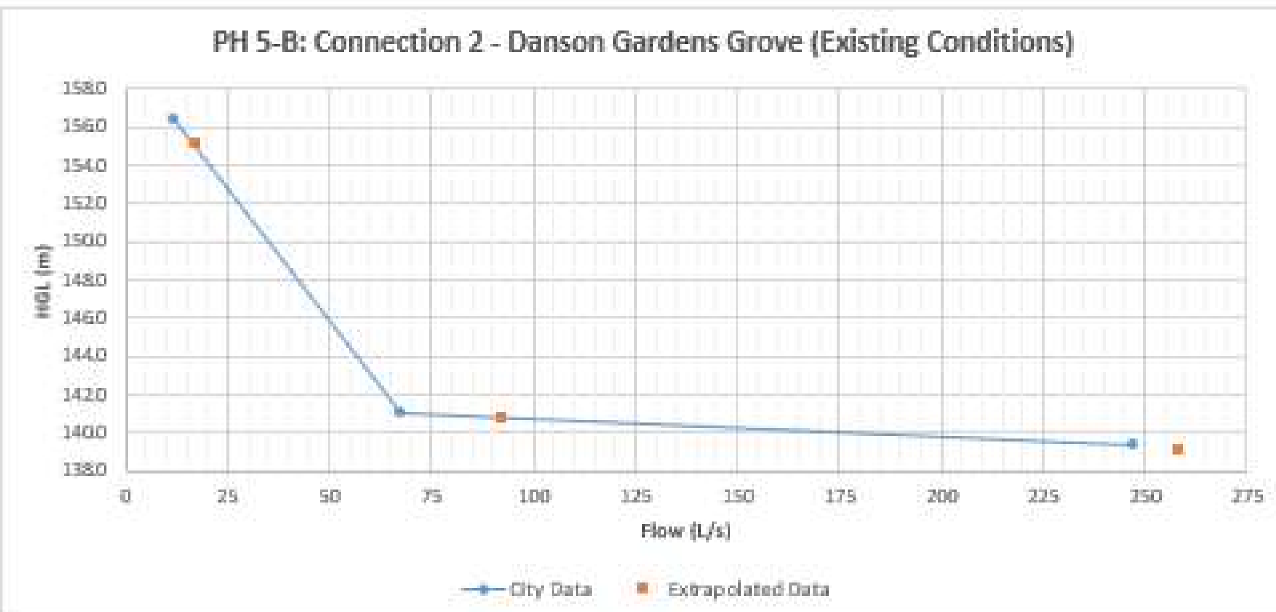


PH 5-A & 6: Connection 2 - Danson Gardens Grove (Existing Conditions, Reliability Scenario)

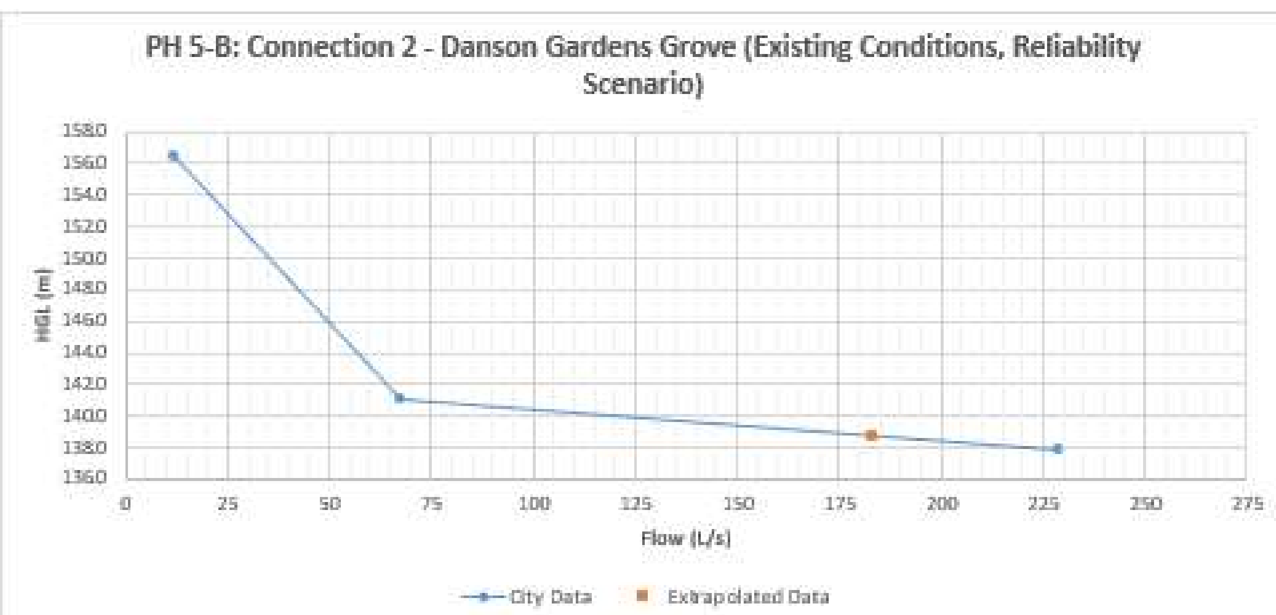




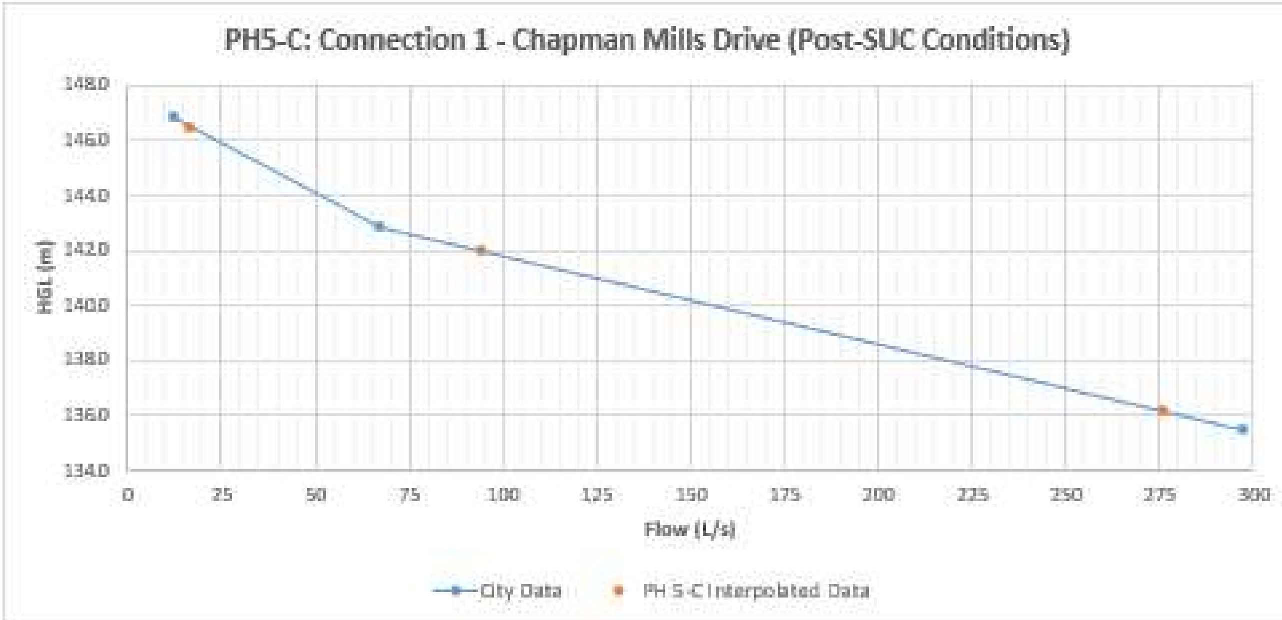
PH 5-B : Connection 1 - Chapman Mills Drive (Existing Conditions)
HGL (m)
158.0
156.0
154.0
152.0
150.0
148.0
146.0
144.0
142.0
140.0
138.0
0
25
50
75
100
125
150
175
200
225
250
275
Flow (L/s)
City Data
Extrapolated Data



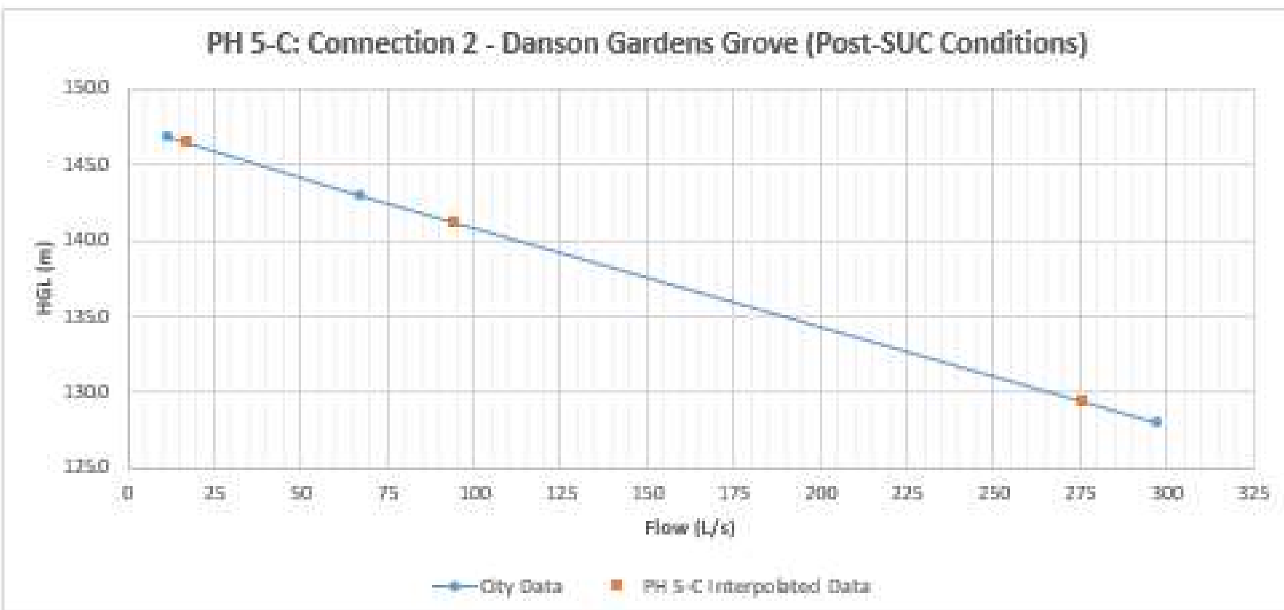
PH 5-B: Connection 2 - Danson Gardens Grove (Existing Conditions)
HGL (m)
158.0
156.0
154.0
152.0
150.0
148.0
146.0
144.0
142.0
140.0
138.0
0
25
50
75
100
125
150
175
200
225
250
275
Flow (L/s)
City Data
Extrapolated Data



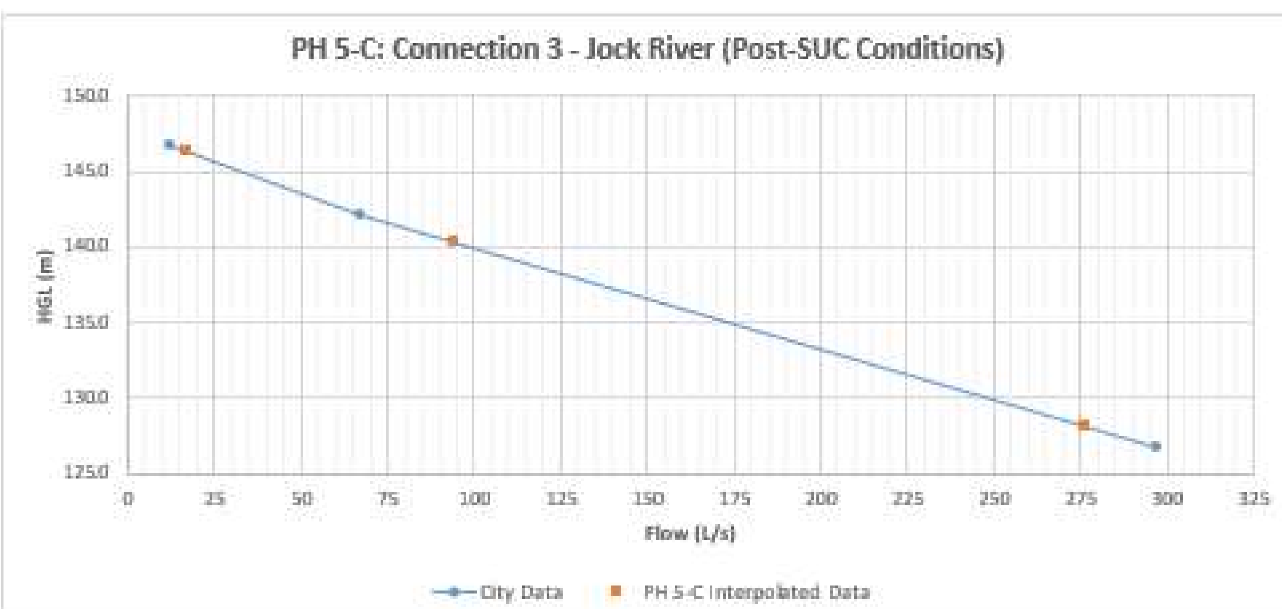
PH 5-B: Connection 2 - Danson Gardens Grove (Existing Conditions, Reliability Scenario)
HGL (m)
158.0
156.0
154.0
152.0
150.0
148.0
146.0
144.0
142.0
140.0
138.0
136.0
0
25
50
75
100
125
150
175
200
225
250
275
Flow (L/s)
City Data
Extrapolated Data



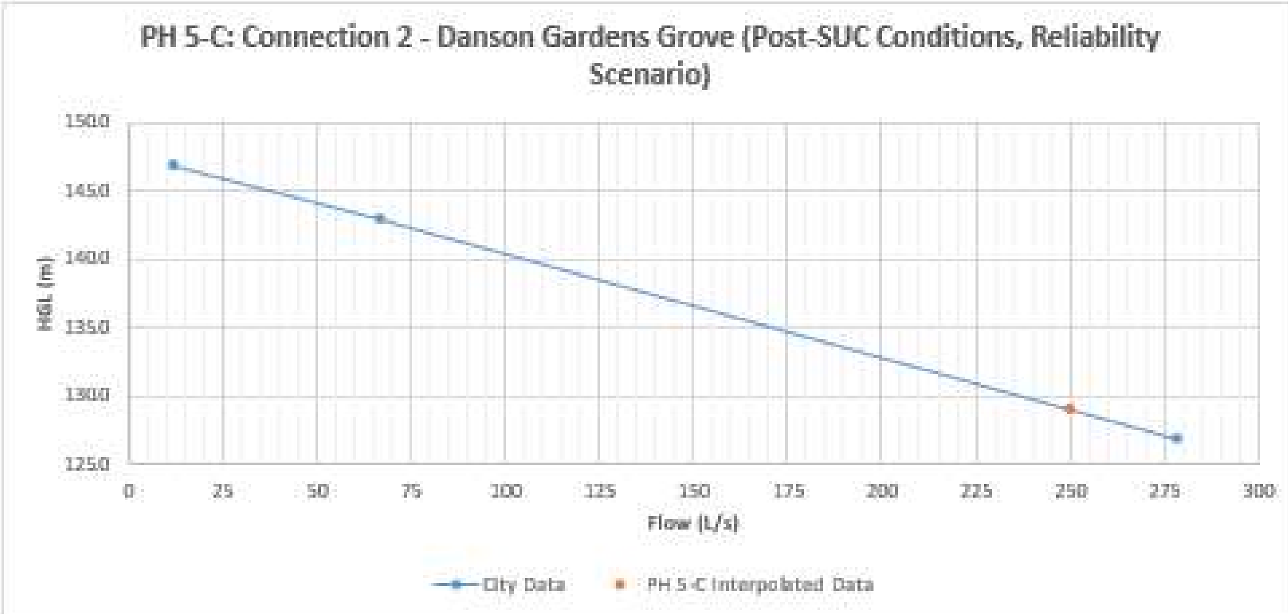
PH5-C: Connection 1 - Chapman Mills Drive (Post-SUC Conditions)
HGL (m)
148.0
146.0
144.0
142.0
140.0
138.0
136.0
134.0
0
25
50
75
100
125
150
175
200
225
250
275
300
Flow (L/s)
City Data
PH 5-C Interpolated Data

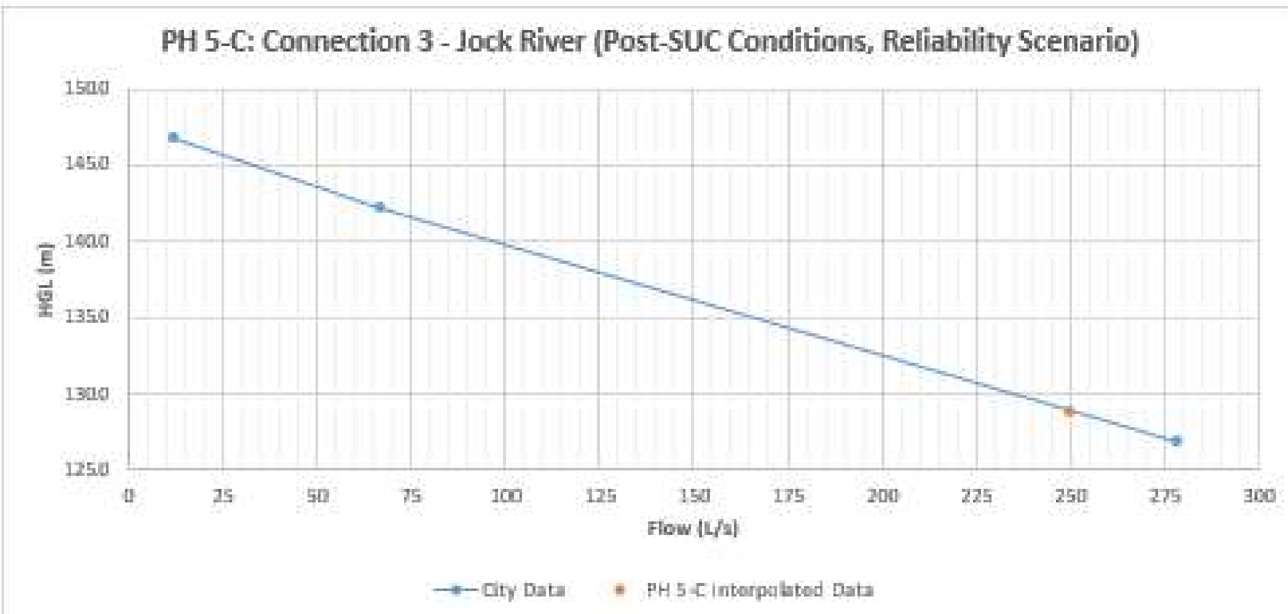


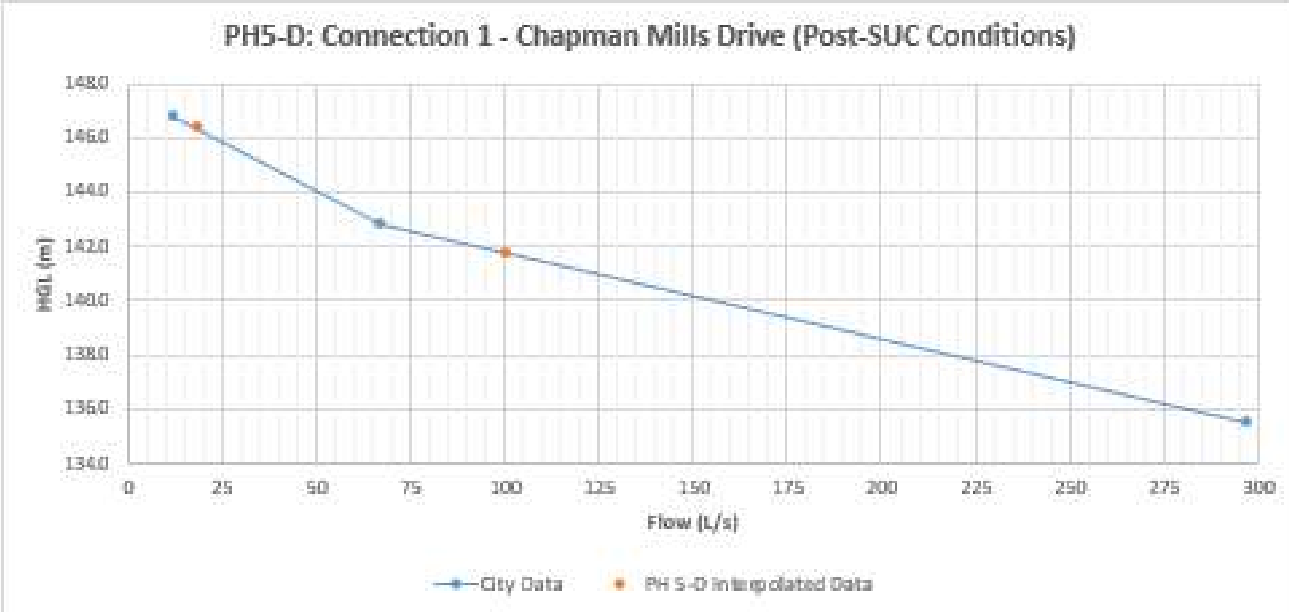
PH 5-C: Connection 2 - Danson Gardens Grove (Post-SUC Conditions)
HGL (m)
150.0
145.0
140.0
135.0
130.0
125.0
0
25
50
75
100
125
150
175
200
225
250
275
300
325
Flow (L/s)
City Data
PH 5-C Interpolated Data



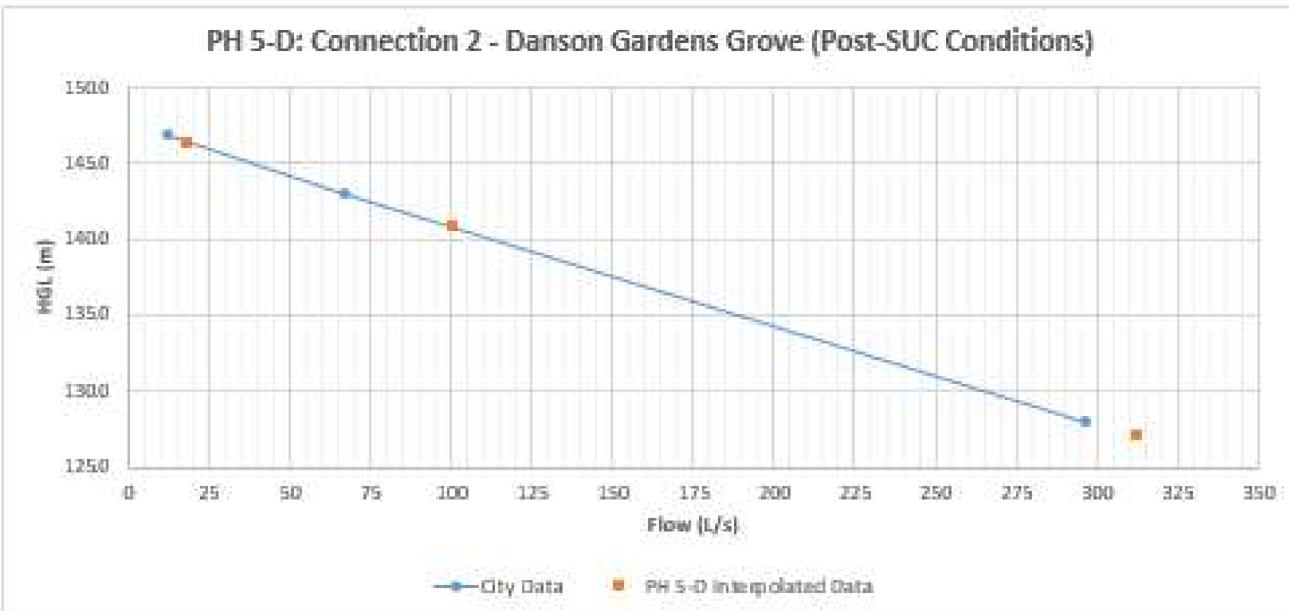
PH 5-C: Connection 3 - Jock River (Post-SUC Conditions)
HGL (m)
150.0
145.0
140.0
135.0
130.0
125.0
0
25
50
75
100
125
150
175
200
225
250
275
300
325
Flow (L/s)
City Data
PH 5-C Interpolated Data


PH 5-C: Connection 2 - Danson Gardens Grove (Post-SUC Conditions, Reliability Scenario)
150.0
145.0
140.0
135.0
130.0
125.0
HGL (m)
0
25
50
75
100
125
150
175
200
225
250
275
300
Flow (L/s)
City Data
PH 5-C Interpolated Data

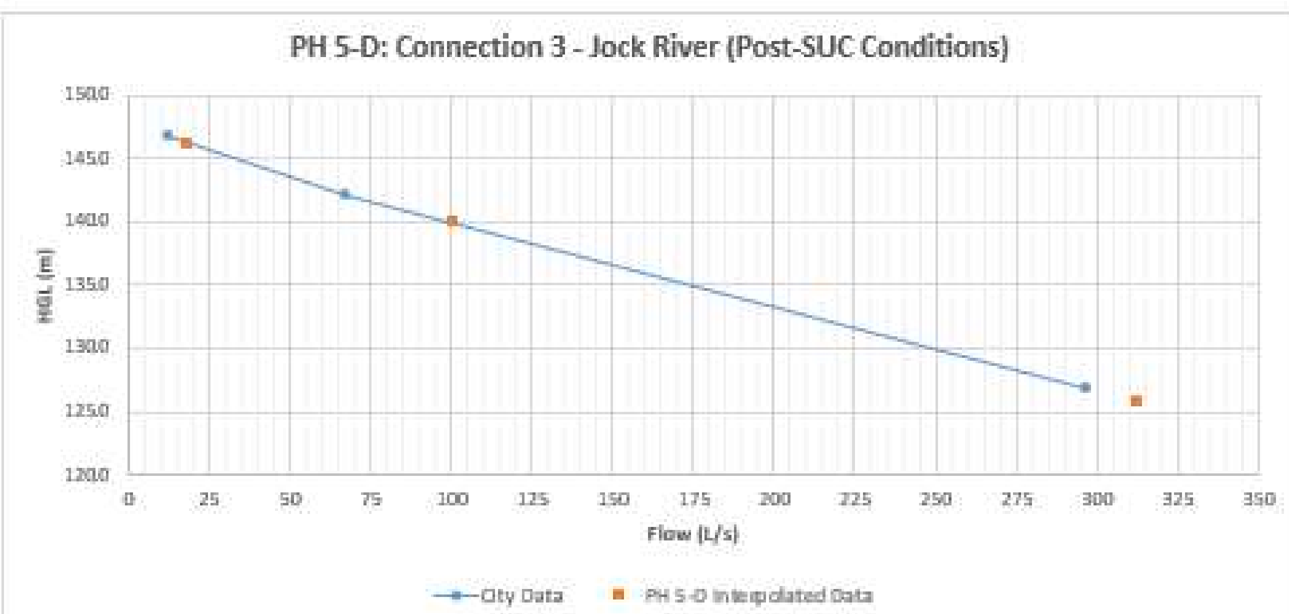

PH 5-C: Connection 3 - Jock River (Post-SUC Conditions, Reliability Scenario)
150.0
145.0
140.0
135.0
130.0
125.0
HGL (m)
0
25
50
75
100
125
150
175
200
225
250
275
300
Flow (L/s)
City Data
PH 5-C Interpolated Data



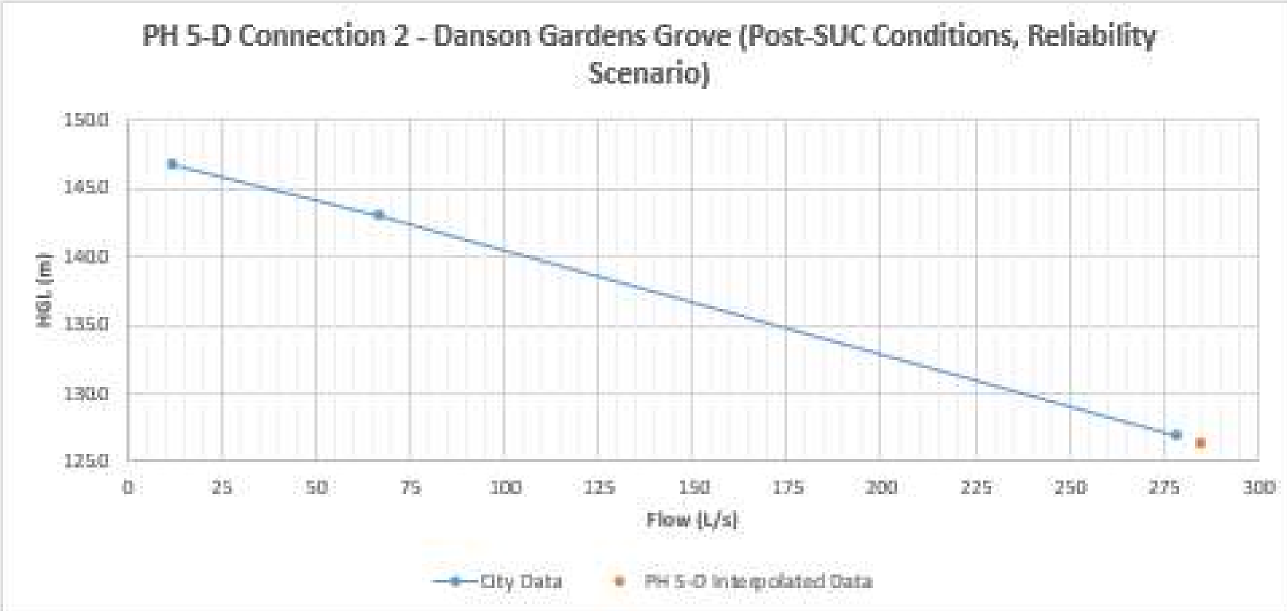
PH5-D: Connection 1 - Chapman Mills Drive (Post-SUC Conditions)
HGL (m)
148.0
146.0
144.0
142.0
140.0
138.0
136.0
134.0
0
25
50
75
100
125
150
175
200
225
250
275
300
Flow (L/s)
City Data
PH 5-D Interpolated Data

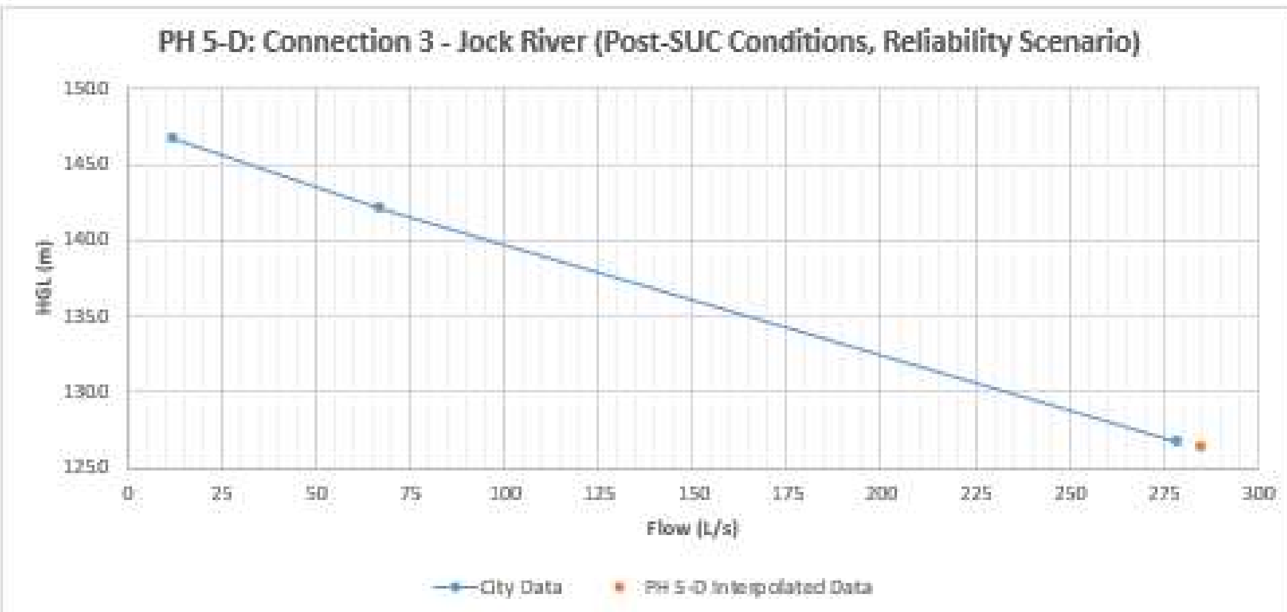


PH 5-D: Connection 2 - Danson Gardens Grove (Post-SUC Conditions)
HGL (m)
150.0
145.0
140.0
135.0
130.0
125.0
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
Flow (L/s)
City Data
PH 5-D Interpolated Data



PH 5-D: Connection 3 - Jock River (Post-SUC Conditions)
HGL (m)
150.0
145.0
140.0
135.0
130.0
125.0
120.0
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
Flow (L/s)
City Data
PH 5-D Interpolated Data


PH 5-D Connection 2 - Danson Gardens Grove (Post-SUC Conditions, Reliability Scenario)
HGL (m)
150.0
145.0
140.0
135.0
130.0
125.0
0
25
50
75
100
125
150
175
200
225
250
275
300
Flow (L/s)
City Data
PH 5-D Interpolated Data


PH 5-D: Connection 3 - Jock River (Post-SUC Conditions, Reliability Scenario)
HGL (m)
150.0
145.0
140.0
135.0
130.0
125.0
0
25
50
75
100
125
150
175
200
225
250
275
300
Flow (L/s)
City Data
PH 5-D Interpolated Data

Appendix C Detailed Modelling Results

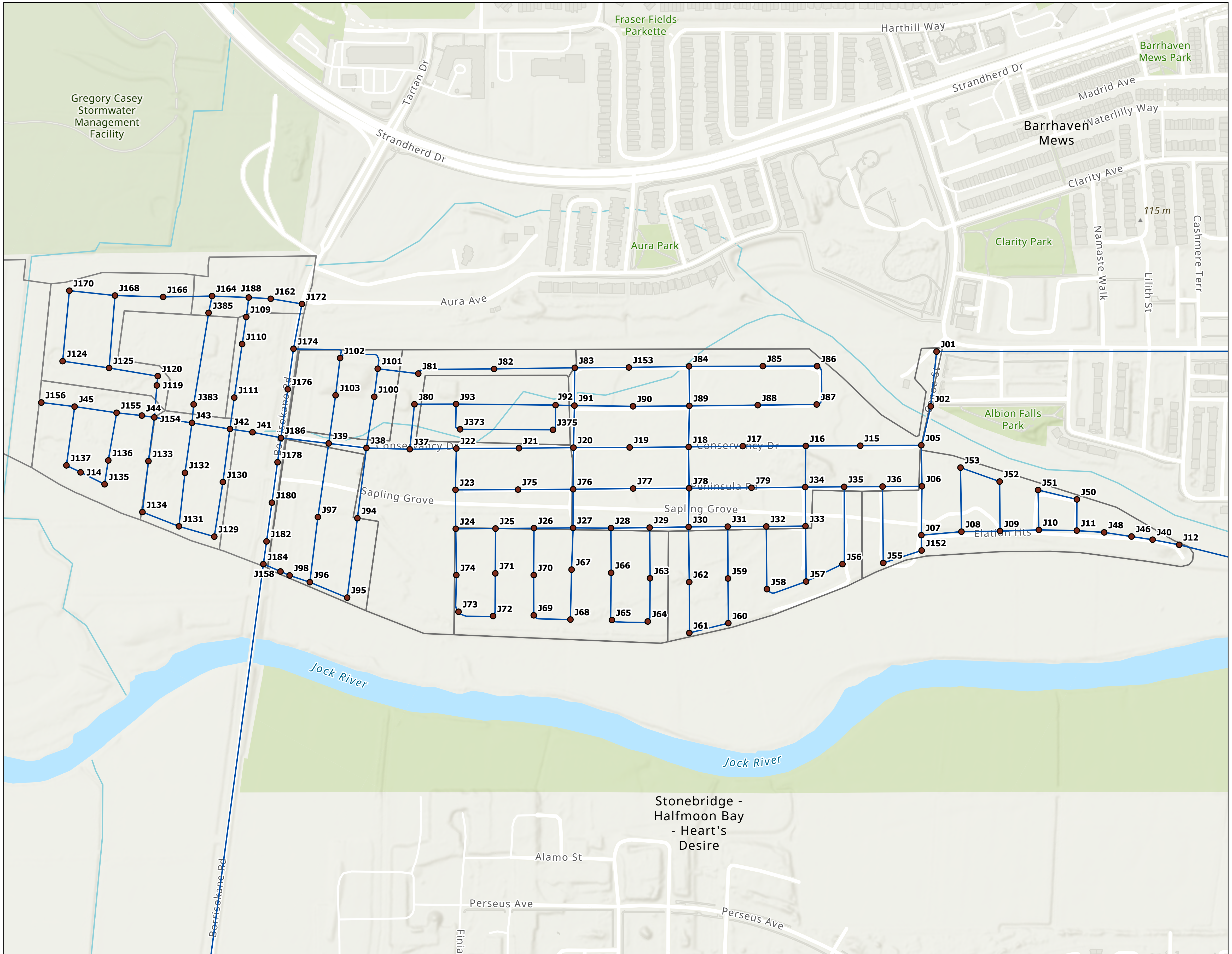


Figure No.

C-1

Title

Model Setup

Client/Project

David Schaeffer Engineering Ltd
Barrhaven Conservancy West Lands

Project Location

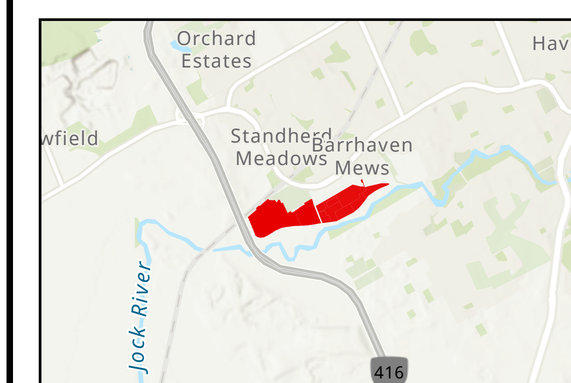
Ottawa, Ontario, Canada

N

0 100 200 Meters
(At original document size of 11x17)
1:6,000

Legend

- Junctions
- Watermain Network
- Phase Boundary



Notes

1. Coordinate System: MTM 3Degree
2. Background: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Stantec

163401817 - Barrhaven Conservancy West: Water Distribution System Analysis

Table C-1: Modelling Results (Existing Conditions - PH 5A & 6)

Junction	Maximum Pressure under AVDY	Minimum Pressure under PKHR	Available Fire Flow under MXDY+FF @ 20 psi Residual Pressure	Failure Scenario 1 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 2 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 3 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure
ID	(psi)	(psi)	(L/min)	(L/min)	(L/min)	(L/min)
J01	87.9	66.0	10,000	10,000	10,000	10,000
J02	88.5	66.3	10,000	10,000	10,000	10,000
J05	89.0	66.7	10,000	10,000	10,000	10,000
J06	89.2	66.8	10,000	10,000	10,000	10,000
J07	89.3	67.1	10,000	10,000	10,000	10,000
J08	89.2	67.1	10,000	10,000	10,000	10,000
J09	88.7	66.6	10,000	10,000	10,000	10,000
J10	89.0	67.0	10,000	10,000	10,000	10,000
J100	88.4	65.4	10,000	10,000	10,000	10,000
J101	88.5	65.5	10,000	10,000	10,000	10,000
J102	88.4	65.4	10,000	10,000	10,000	10,000
J103	88.3	65.2	10,000	10,000	10,000	10,000
J11	88.9	67.0	10,000	10,000	10,000	10,000
J119	88.8	65.8	10,000	10,000	10,000	10,000
J12	88.7	67.2	10,000	10,000	10,000	10,000
J120	88.8	65.8	10,000	10,000	10,000	10,000
J125	88.9	65.9	10,000	10,000	10,000	10,000
J129	89.3	66.2	10,000	10,000	10,000	10,000
J130	89.0	66.0	10,000	10,000	10,000	10,000
J131	89.2	66.1	10,000	10,000	10,000	10,000
J132	89.0	65.9	10,000	10,000	10,000	10,000
J133	89.1	66.0	10,000	10,000	10,000	10,000
J134	89.2	66.2	10,000	10,000	10,000	10,000
J15	88.9	66.4	10,000	10,000	10,000	10,000
J152	89.4	67.1	10,000	10,000	10,000	10,000
J153	88.4	65.4	10,000	10,000	10,000	10,000
J154	88.9	65.9	10,000	10,000	10,000	10,000
J158	89.3	66.3	10,000	10,000	10,000	10,000
J16	89.0	66.4	10,000	10,000	10,000	10,000
J162	88.4	65.4	10,000	10,000	10,000	10,000
J164	88.5	65.5	10,000	10,000	10,000	10,000
J166	88.3	65.3	10,000	10,000	10,000	10,000
J168	88.6	65.6	10,000	10,000	10,000	10,000
J17	88.9	66.1	10,000	10,000	10,000	10,000
J172	88.4	65.4	10,000	10,000	10,000	10,000
J174	88.6	65.6	10,000	10,000	10,000	10,000
J176	88.7	65.7	10,000	10,000	10,000	10,000
J178	88.9	65.9	10,000	10,000	10,000	10,000
J18	88.6	65.8	10,000	10,000	10,000	10,000
J180	89.1	66.1	10,000	10,000	10,000	10,000
J182	89.3	66.2	10,000	10,000	10,000	10,000
J184	89.3	66.3	10,000	10,000	10,000	10,000
J186	88.8	65.8	10,000	10,000	10,000	10,000
J188	88.5	65.4	10,000	10,000	10,000	10,000
J19	88.4	65.5	10,000	10,000	10,000	10,000
J20	88.9	66.0	10,000	10,000	10,000	10,000
J21	88.7	65.8	10,000	10,000	10,000	10,000
J22	88.8	65.8	10,000	10,000	10,000	10,000
J23	88.9	66.0	10,000	10,000	10,000	10,000
J24	89.1	66.1	10,000	10,000	10,000	10,000
J25	88.9	66.0	10,000	10,000	10,000	10,000
J26	89.0	66.1	10,000	10,000	10,000	10,000
J27	89.2	66.3	10,000	10,000	10,000	10,000
J28	89.1	66.2	10,000	10,000	10,000	10,000
J29	89.1	66.3	10,000	10,000	10,000	10,000
J30	89.0	66.2	10,000	10,000	10,000	10,000
J31	89.2	66.4	10,000	10,000	10,000	10,000
J32	89.1	66.4	10,000	10,000	10,000	10,000
J33	89.3	66.6	10,000	10,000	10,000	10,000
J34	89.2	66.5	10,000	10,000	10,000	10,000
J35	89.1	66.6	10,000	10,000	10,000	10,000
J36	89.3	66.8	10,000	10,000	10,000	10,000
J37	88.7	65.7	10,000	10,000	10,000	10,000
J373	88.5	65.4	Not fire flow node	Not fire flow node	Not fire flow node	Not fire flow node
J375	88.6	65.5	Not fire flow node	Not fire flow node	Not fire flow node	Not fire flow node
J38	88.8	65.8	10,000	10,000	10,000	10,000
J383	88.8	65.8	10,000	10,000	10,000	10,000
J385	88.5	65.4	10,000	10,000	10,000	10,000
J39	88.8	65.8	10,000	10,000	10,000	10,000
J40	88.8	67.2	10,000	10,000	10,000	10,000

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163401817 - Barrhaven Conservancy West: Water Distribution System Analysis

Table C-1: Modelling Results (Existing Conditions - PH 5A & 6)				Failure Scenario 1	Failure Scenario 2	Failure Scenario 3
Junction	Maximum Pressure under AVDY	Minimum Pressure under PKHR	Available Fire Flow under MXDY+FF @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure
ID	(psi)	(psi)	(L/min)	(L/min)	(L/min)	(L/min)
J41	88.9	65.8	10,000	10,000	10,000	10,000
J42	88.9	65.9	10,000	10,000	10,000	10,000
J43	88.8	65.8	10,000	10,000	10,000	10,000
J44	89.0	65.9	10,000	10,000	10,000	10,000
J46	88.8	67.1	10,000	10,000	10,000	10,000
J48	88.8	67.1	10,000	10,000	10,000	10,000
J50	88.7	66.9	10,000	10,000	10,000	10,000
J51	88.9	67.0	10,000	10,000	10,000	10,000
J52	88.9	66.8	10,000	10,000	10,000	10,000
J53	89.0	66.9	10,000	10,000	10,000	10,000
J55	89.5	67.1	10,000	10,000	10,000	10,000
J56	89.3	66.7	10,000	10,000	10,000	10,000
J57	89.5	66.8	10,000	10,000	10,000	10,000
J58	89.3	66.7	10,000	10,000	10,000	10,000
J59	89.2	66.5	10,000	10,000	10,000	10,000
J60	89.5	66.7	10,000	10,000	10,000	10,000
J61	89.3	66.6	10,000	10,000	10,000	10,000
J62	89.2	66.4	10,000	10,000	10,000	10,000
J63	89.3	66.4	10,000	10,000	10,000	10,000
J64	89.4	66.6	10,000	10,000	10,000	10,000
J65	89.4	66.6	10,000	10,000	10,000	10,000
J66	89.3	66.4	10,000	10,000	10,000	10,000
J67	89.3	66.4	10,000	10,000	10,000	10,000
J68	89.5	66.5	10,000	10,000	10,000	10,000
J69	89.3	66.4	10,000	10,000	10,000	10,000
J70	89.2	66.2	10,000	10,000	10,000	10,000
J71	89.1	66.2	10,000	10,000	10,000	10,000
J72	89.2	66.3	10,000	10,000	10,000	10,000
J73	89.3	66.4	10,000	10,000	10,000	10,000
J74	89.2	66.3	10,000	10,000	10,000	10,000
J75	88.9	65.9	10,000	10,000	10,000	10,000
J76	89.0	66.1	10,000	10,000	10,000	10,000
J77	88.8	65.9	10,000	10,000	10,000	10,000
J78	88.9	66.1	10,000	10,000	10,000	10,000
J79	89.0	66.3	10,000	10,000	10,000	10,000
J80	88.6	65.6	10,000	10,000	10,000	10,000
J81	88.4	65.4	10,000	10,000	10,000	10,000
J82	88.4	65.4	10,000	10,000	10,000	10,000
J83	88.6	65.7	10,000	10,000	10,000	10,000
J84	88.5	65.6	10,000	10,000	10,000	10,000
J85	88.6	65.7	10,000	10,000	10,000	10,000
J86	88.8	65.9	10,000	10,000	10,000	10,000
J87	88.8	65.9	10,000	10,000	10,000	10,000
J88	88.6	65.7	10,000	10,000	10,000	10,000
J89	88.6	65.7	10,000	10,000	10,000	10,000
J90	88.5	65.5	10,000	10,000	10,000	10,000
J91	88.8	65.8	10,000	10,000	10,000	10,000
J92	88.6	65.6	10,000	10,000	10,000	10,000
J93	88.5	65.5	10,000	10,000	10,000	10,000
J94	89.1	66.1	10,000	10,000	10,000	10,000
J95	89.3	66.3	10,000	10,000	10,000	10,000
J96	89.2	66.2	10,000	10,000	10,000	10,000
J97	88.9	65.9	10,000	10,000	10,000	10,000
J98	89.1	66.1	10,000	10,000	10,000	10,000

163401817 - Barrhaven Conservancy West: Water Distribution System Analysis

Table C-2: Modelling Results (Existing Conditions - PH 5B)

Junction	Maximum Pressure under AVDY	Minimum Pressure under PKHR	Available Fire Flow under MXDY+FF @ 20 psi Residual Pressure	Failure Scenario 1: Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 2: Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 3: Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure
ID	(psi)	(psi)	(L/min)	(L/min)	(L/min)	(L/min)
J01	87.7	65.9	10,000	10,000	10,000	10,000
J02	88.3	66.2	10,000	10,000	10,000	10,000
J05	88.7	66.5	10,000	10,000	10,000	10,000
J06	88.9	66.7	10,000	10,000	10,000	10,000
J07	89.0	66.9	10,000	10,000	10,000	10,000
J08	88.9	66.9	10,000	10,000	10,000	10,000
J09	88.4	66.5	10,000	10,000	10,000	10,000
J10	88.7	66.9	10,000	10,000	10,000	10,000
J100	88.1	65.1	10,000	10,000	10,000	10,000
J101	88.2	65.3	10,000	10,000	10,000	10,000
J102	88.1	65.2	10,000	10,000	10,000	10,000
J103	88.0	65.0	10,000	10,000	10,000	10,000
J11	88.6	66.9	10,000	10,000	10,000	10,000
J119	88.5	65.5	10,000	10,000	10,000	10,000
J12	88.4	67.2	10,000	10,000	10,000	10,000
J120	88.5	65.5	10,000	10,000	10,000	10,000
J124	88.5	65.5	10,000	10,000	10,000	10,000
J125	88.6	65.6	10,000	10,000	10,000	10,000
J129	89.0	66.0	10,000	10,000	10,000	10,000
J130	88.8	65.8	10,000	10,000	10,000	10,000
J131	88.9	65.9	10,000	10,000	10,000	10,000
J132	88.7	65.7	10,000	10,000	10,000	10,000
J133	88.8	65.8	10,000	10,000	10,000	10,000
J134	88.9	65.9	10,000	10,000	10,000	10,000
J15	88.6	66.2	10,000	10,000	10,000	10,000
J152	89.1	66.9	10,000	10,000	10,000	10,000
J153	88.1	65.2	10,000	10,000	10,000	10,000
J154	88.7	65.7	10,000	10,000	10,000	10,000
J158	89.0	66.1	10,000	10,000	10,000	10,000
J16	88.7	66.2	10,000	10,000	10,000	10,000
J162	88.1	65.2	10,000	10,000	10,000	10,000
J164	88.2	65.2	10,000	10,000	10,000	10,000
J166	88.0	65.0	10,000	10,000	10,000	10,000
J168	88.3	65.3	10,000	10,000	10,000	10,000
J17	88.6	65.9	10,000	10,000	10,000	10,000
J170	87.8	64.8	10,000	10,000	10,000	10,000
J172	88.1	65.2	10,000	10,000	10,000	10,000
J174	88.3	65.3	10,000	10,000	10,000	10,000
J176	88.4	65.5	10,000	10,000	10,000	10,000
J178	88.6	65.7	10,000	10,000	10,000	10,000
J18	88.3	65.6	10,000	10,000	10,000	10,000
J180	88.9	65.9	10,000	10,000	10,000	10,000
J182	89.0	66.0	10,000	10,000	10,000	10,000
J184	89.0	66.1	10,000	10,000	10,000	10,000
J186	88.5	65.6	10,000	10,000	10,000	10,000
J188	88.2	65.2	10,000	10,000	10,000	10,000
J19	88.1	65.3	10,000	10,000	10,000	10,000
J20	88.6	65.8	10,000	10,000	10,000	10,000
J21	88.4	65.6	10,000	10,000	10,000	10,000
J22	88.5	65.6	10,000	10,000	10,000	10,000
J23	88.6	65.8	10,000	10,000	10,000	10,000
J24	88.8	65.9	10,000	10,000	10,000	10,000
J25	88.6	65.8	10,000	10,000	10,000	10,000
J26	88.7	65.9	10,000	10,000	10,000	10,000
J27	88.9	66.1	10,000	10,000	10,000	10,000
J28	88.8	66.0	10,000	10,000	10,000	10,000
J29	88.8	66.1	10,000	10,000	10,000	10,000
J30	88.7	66.0	10,000	10,000	10,000	10,000
J31	88.9	66.2	10,000	10,000	10,000	10,000
J32	88.8	66.2	10,000	10,000	10,000	10,000
J33	89.0	66.5	10,000	10,000	10,000	10,000
J34	88.9	66.4	10,000	10,000	10,000	10,000
J35	88.8	66.4	10,000	10,000	10,000	10,000
J36	89.0	66.7	10,000	10,000	10,000	10,000
J37	88.4	65.5	10,000	10,000	10,000	10,000
J373	88.2	65.1	Not fire flow node	Not fire flow node	Not fire flow node	Not fire flow node
J375	88.3	65.3	Not fire flow node	Not fire flow node	Not fire flow node	Not fire flow node
J38	88.5	65.6	10,000	10,000	10,000	10,000
J383	88.5	65.5	10,000	10,000	10,000	10,000
J385	88.2	65.2	10,000	10,000	10,000	10,000

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163401817 - Barrhaven Conservancy West: Water Distribution System Analysis

Table C-2: Modelling Results (Existing Conditions - PH 5B)				Failure Scenario 1	Failure Scenario 2	Failure Scenario 3
Junction	Maximum Pressure under AVDY	Minimum Pressure under PKHR	Available Fire Flow under MXDY+FF @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure
ID	(psi)	(psi)	(L/min)	(L/min)	(L/min)	(L/min)
J39	88.5	65.6	10,000	10,000	10,000	10,000
J40	88.5	67.1	10,000	10,000	10,000	10,000
J41	88.6	65.6	10,000	10,000	10,000	10,000
J42	88.6	65.7	10,000	10,000	10,000	10,000
J43	88.5	65.5	10,000	10,000	10,000	10,000
J44	88.7	65.7	10,000	10,000	10,000	10,000
J46	88.5	67.0	10,000	10,000	10,000	10,000
J48	88.5	67.0	10,000	10,000	10,000	10,000
J50	88.5	66.8	10,000	10,000	10,000	10,000
J51	88.6	66.9	10,000	10,000	10,000	10,000
J52	88.6	66.7	10,000	10,000	10,000	10,000
J53	88.7	66.7	10,000	10,000	10,000	10,000
J55	89.2	67.0	10,000	10,000	10,000	10,000
J56	89.0	66.5	10,000	10,000	10,000	10,000
J57	89.2	66.7	10,000	10,000	10,000	10,000
J58	89.1	66.5	10,000	10,000	10,000	10,000
J59	89.0	66.3	10,000	10,000	10,000	10,000
J60	89.2	66.5	10,000	10,000	10,000	10,000
J61	89.0	66.4	10,000	10,000	10,000	10,000
J62	88.9	66.3	10,000	10,000	10,000	10,000
J63	89.0	66.3	10,000	10,000	10,000	10,000
J64	89.1	66.4	10,000	10,000	10,000	10,000
J65	89.1	66.4	10,000	10,000	10,000	10,000
J66	89.0	66.2	10,000	10,000	10,000	10,000
J67	89.0	66.2	10,000	10,000	10,000	10,000
J68	89.2	66.3	10,000	10,000	10,000	10,000
J69	89.0	66.2	10,000	10,000	10,000	10,000
J70	88.9	66.0	10,000	10,000	10,000	10,000
J71	88.8	66.0	10,000	10,000	10,000	10,000
J72	88.9	66.1	10,000	10,000	10,000	10,000
J73	89.0	66.2	10,000	10,000	10,000	10,000
J74	88.9	66.1	10,000	10,000	10,000	10,000
J75	88.6	65.7	10,000	10,000	10,000	10,000
J76	88.7	65.9	10,000	10,000	10,000	10,000
J77	88.5	65.7	10,000	10,000	10,000	10,000
J78	88.6	65.9	10,000	10,000	10,000	10,000
J79	88.7	66.1	10,000	10,000	10,000	10,000
J80	88.3	65.4	10,000	10,000	10,000	10,000
J81	88.1	65.2	10,000	10,000	10,000	10,000
J82	88.1	65.2	10,000	10,000	10,000	10,000
J83	88.3	65.5	10,000	10,000	10,000	10,000
J84	88.2	65.4	10,000	10,000	10,000	10,000
J85	88.3	65.5	10,000	10,000	10,000	10,000
J86	88.5	65.7	10,000	10,000	10,000	10,000
J87	88.5	65.7	10,000	10,000	10,000	10,000
J88	88.3	65.5	10,000	10,000	10,000	10,000
J89	88.3	65.5	10,000	10,000	10,000	10,000
J90	88.2	65.3	10,000	10,000	10,000	10,000
J91	88.5	65.6	10,000	10,000	10,000	10,000
J92	88.3	65.4	10,000	10,000	10,000	10,000
J93	88.2	65.3	10,000	10,000	10,000	10,000
J94	88.8	65.9	10,000	10,000	10,000	10,000
J95	89.0	66.1	10,000	10,000	10,000	10,000
J96	88.9	65.9	10,000	10,000	10,000	10,000
J97	88.7	65.7	10,000	10,000	10,000	10,000
J98	88.8	65.9	10,000	10,000	10,000	10,000

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163401817 - Barrhaven Conservancy West: Water Distribution System Analysis

Table C-3: Modelling Results (SUC - PH5-C)

Junction	Maximum Pressure under AVDY	Minimum Pressure under PKHR	Available Fire Flow under MXDY+FF @ 20 psi Residual Pressure	Failure Scenario 1 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 2 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 3 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure
ID	(psi)	(psi)	(L/min)	(L/min)	(L/min)	(L/min)
J01	75.2	67.3	14,000	14,000	14,000	14,000
J02	75.8	67.6	14,000	14,000	14,000	14,000
J05	76.3	67.9	14,000	14,000	14,000	14,000
J06	76.4	68.0	14,000	14,000	14,000	14,000
J07	76.6	68.2	14,000	14,000	14,000	14,000
J08	76.5	68.2	14,000	14,000	14,000	14,000
J09	76.0	67.7	14,000	14,000	14,000	14,000
J10	76.2	68.0	14,000	14,000	14,000	14,000
J100	75.6	66.8	14,000	14,000	14,000	14,000
J101	75.7	66.9	14,000	14,000	14,000	14,000
J102	75.6	66.8	14,000	14,000	14,000	14,000
J103	75.5	66.6	14,000	14,000	14,000	14,000
J11	76.1	68.0	14,000	14,000	14,000	14,000
J119	76.0	67.1	14,000	14,000	14,000	14,000
J12	76.0	68.0	14,000	14,000	14,000	14,000
J120	76.0	67.1	14,000	14,000	14,000	14,000
J124	75.9	67.1	14,000	14,000	13,400	14,000
J125	76.1	67.3	14,000	14,000	14,000	14,000
J129	76.4	67.6	14,000	14,000	11,200	14,000
J130	76.2	67.4	14,000	14,000	11,200	14,000
J131	76.3	67.5	14,000	14,000	11,800	14,000
J132	76.2	67.3	14,000	14,000	11,600	14,000
J133	76.3	67.4	14,000	14,000	11,700	14,000
J134	76.4	67.5	14,000	14,000	11,300	14,000
J135	76.5	67.6	14,000	14,000	11,000	13,300
J136	76.4	67.5	14,000	14,000	11,200	13,700
J137	76.3	67.4	14,000	14,000	11,000	13,400
J14	76.4	67.6	14,000	14,000	11,000	13,200
J15	76.1	67.7	14,000	14,000	14,000	14,000
J152	76.6	68.3	14,000	14,000	14,000	14,000
J153	75.6	66.8	14,000	14,000	14,000	14,000
J154	76.1	67.3	14,000	14,000	13,600	14,000
J155	76.2	67.4	14,000	14,000	13,100	14,000
J156	76.0	67.1	14,000	14,000	12,200	14,000
J158	76.5	67.7	14,000	14,000	14,000	14,000
J16	76.2	67.7	14,000	14,000	14,000	14,000
J162	75.6	66.8	14,000	13,300	14,000	14,000
J164	75.7	66.8	14,000	14,000	14,000	14,000
J166	75.5	66.6	14,000	14,000	14,000	14,000
J168	75.8	66.9	14,000	14,000	14,000	14,000
J17	76.1	67.4	14,000	14,000	14,000	14,000
J170	75.3	66.4	14,000	14,000	14,000	14,000
J172	75.6	66.8	14,000	12,900	14,000	14,000
J174	75.8	67.0	14,000	14,000	14,000	14,000
J176	75.9	67.1	14,000	14,000	14,000	14,000
J178	76.1	67.3	14,000	14,000	14,000	14,000
J18	75.8	67.1	14,000	14,000	14,000	14,000
J180	76.3	67.5	14,000	14,000	14,000	14,000
J182	76.4	67.6	14,000	14,000	14,000	14,000
J184	76.5	67.7	14,000	14,000	14,000	14,000
J186	76.0	67.2	14,000	14,000	14,000	14,000
J188	75.7	66.8	14,000	13,600	14,000	14,000
J19	75.6	66.9	14,000	14,000	14,000	14,000
J20	76.1	67.3	14,000	14,000	14,000	14,000
J21	75.9	67.2	14,000	14,000	14,000	14,000
J22	76.0	67.2	14,000	14,000	14,000	14,000
J23	76.1	67.3	14,000	14,000	14,000	14,000
J24	76.2	67.5	14,000	14,000	14,000	14,000
J25	76.1	67.4	14,000	14,000	14,000	14,000
J26	76.2	67.5	14,000	14,000	14,000	14,000
J27	76.4	67.6	14,000	14,000	14,000	14,000
J28	76.3	67.6	14,000	14,000	14,000	14,000
J29	76.3	67.6	14,000	14,000	14,000	14,000
J30	76.2	67.6	14,000	14,000	14,000	14,000
J31	76.4	67.7	14,000	14,000	14,000	14,000

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163401817 - Barrhaven Conservancy West: Water Distribution System Analysis

Table C-3: Modelling Results (SUC - PH5-C)				Failure Scenario 1	Failure Scenario 2	Failure Scenario 3
Junction	Maximum Pressure under AVDY	Minimum Pressure under PKHR	Available Fire Flow under MXDY+FF @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure
ID	(psi)	(psi)	(L/min)	(L/min)	(L/min)	(L/min)
J32	76.3	67.7	14,000	14,000	14,000	14,000
J33	76.5	67.9	14,000	14,000	14,000	14,000
J34	76.4	67.8	14,000	14,000	14,000	14,000
J35	76.3	67.8	14,000	14,000	14,000	14,000
J36	76.5	68.1	14,000	14,000	14,000	14,000
J37	75.9	67.1	14,000	14,000	14,000	14,000
J373	75.7	66.7	Not fire flow node	Not fire flow node	Not fire flow node	Not fire flow node
J375	75.8	66.8	Not fire flow node	Not fire flow node	Not fire flow node	Not fire flow node
J38	76.0	67.2	14,000	14,000	14,000	14,000
J383	76.0	67.1	14,000	14,000	14,000	14,000
J385	75.7	66.8	14,000	14,000	14,000	14,000
J39	76.0	67.2	14,000	14,000	14,000	14,000
J40	76.0	68.0	14,000	14,000	14,000	14,000
J41	76.1	67.2	14,000	14,000	12,500	14,000
J42	76.1	67.3	14,000	14,000	12,800	14,000
J43	76.0	67.2	14,000	14,000	13,100	14,000
J44	76.2	67.3	14,000	14,000	13,400	14,000
J45	76.1	67.2	14,000	14,000	12,600	14,000
J46	76.1	68.0	14,000	14,000	14,000	14,000
J48	76.1	68.0	14,000	14,000	14,000	14,000
J50	76.0	67.8	14,000	14,000	14,000	14,000
J51	76.1	68.0	14,000	14,000	14,000	14,000
J52	76.1	67.9	14,000	14,000	14,000	14,000
J53	76.2	68.0	14,000	14,000	14,000	14,000
J55	76.7	68.3	14,000	14,000	14,000	14,000
J56	76.5	68.0	14,000	14,000	14,000	14,000
J57	76.7	68.1	14,000	14,000	14,000	14,000
J58	76.6	68.0	14,000	14,000	14,000	14,000
J59	76.4	67.8	14,000	14,000	14,000	14,000
J60	76.7	68.0	14,000	14,000	14,000	13,300
J61	76.5	67.9	14,000	14,000	14,000	13,100
J62	76.4	67.8	14,000	14,000	14,000	14,000
J63	76.5	67.8	14,000	14,000	14,000	14,000
J64	76.6	67.9	14,000	14,000	14,000	13,500
J65	76.6	67.9	14,000	14,000	14,000	13,500
J66	76.5	67.7	14,000	14,000	14,000	14,000
J67	76.5	67.8	14,000	14,000	14,000	14,000
J68	76.7	67.9	14,000	14,000	14,000	13,600
J69	76.5	67.8	14,000	14,000	14,000	13,600
J70	76.3	67.6	14,000	14,000	14,000	14,000
J71	76.3	67.5	14,000	14,000	14,000	14,000
J72	76.4	67.6	14,000	14,000	14,000	13,800
J73	76.5	67.7	14,000	14,000	14,000	13,900
J74	76.4	67.6	14,000	14,000	14,000	14,000
J75	76.1	67.3	14,000	14,000	14,000	14,000
J76	76.2	67.5	14,000	14,000	14,000	14,000
J77	76.0	67.2	14,000	14,000	14,000	14,000
J78	76.1	67.4	14,000	14,000	14,000	14,000
J79	76.2	67.6	14,000	14,000	14,000	14,000
J80	75.8	67.0	14,000	14,000	14,000	14,000
J81	75.6	66.8	14,000	14,000	14,000	14,000
J82	75.6	66.8	14,000	14,000	14,000	14,000
J83	75.8	67.1	14,000	14,000	14,000	14,000
J84	75.7	67.0	14,000	14,000	14,000	14,000
J85	75.8	67.1	14,000	14,000	14,000	13,100
J86	76.0	67.3	13,600	14,000	14,000	12,300
J87	76.0	67.2	13,600	14,000	14,000	12,300
J88	75.8	67.1	14,000	14,000	14,000	13,300
J89	75.8	67.1	14,000	14,000	14,000	14,000
J90	75.7	66.9	14,000	14,000	14,000	14,000
J91	76.0	67.2	14,000	14,000	14,000	14,000
J92	75.8	67.0	14,000	14,000	14,000	14,000
J93	75.7	66.9	14,000	14,000	14,000	14,000
J94	76.3	67.5	14,000	14,000	14,000	14,000
J95	76.5	67.7	14,000	14,000	14,000	14,000

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163401817 - Barrhaven Conservancy West: Water Distribution System Analysis

Table C-3: Modelling Results (SUC - PH5-C)

				Failure Scenario 1	Failure Scenario 2	Failure Scenario 3
Junction	Maximum Pressure under AVDY	Minimum Pressure under PKHR	Available Fire Flow under MXDY+FF @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure
ID	(psi)	(psi)	(L/min)	(L/min)	(L/min)	(L/min)
J96	76.4	67.6	14,000	14,000	14,000	14,000
J97	76.1	67.3	14,000	14,000	14,000	14,000
J98	76.3	67.5	14,000	14,000	14,000	14,000

Table C-4: Modelling Results (SUC - PH5-D)

Junction	Maximum Pressure under AVDY	Minimum Pressure under PKHR	Available Fire Flow under MXDY+FF @ 20 psi Residual Pressure	Failure Scenario 1 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 2 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 3 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure
ID	(psi)	(psi)	(L/min)	(L/min)	(L/min)	(L/min)
J01	75.1	66.9	16,000	16,000	16,000	14,500
J02	75.7	67.0	16,000	16,000	16,000	16,000
J05	76.2	67.3	16,000	16,000	16,000	16,000
J06	76.3	67.5	16,000	16,000	16,000	16,000
J07	76.5	67.7	16,000	16,000	16,000	16,000
J08	76.3	67.6	16,000	16,000	16,000	16,000
J09	75.8	67.1	16,000	16,000	16,000	16,000
J10	76.1	67.5	16,000	16,000	16,000	16,000
J100	75.5	66.1	16,000	16,000	16,000	16,000
J101	75.6	66.3	16,000	16,000	16,000	16,000
J102	75.5	66.1	16,000	16,000	16,000	16,000
J103	75.3	66.0	16,000	16,000	16,000	16,000
J109	75.6	66.2	16,000	16,000	16,000	16,000
J11	76.0	67.4	16,000	16,000	16,000	16,000
J110	75.8	66.4	16,000	16,000	16,000	16,000
J111	75.9	66.5	16,000	16,000	16,000	16,000
J119	75.9	66.5	16,000	16,000	16,000	16,000
J12	75.9	67.4	16,000	16,000	16,000	16,000
J120	75.9	66.5	16,000	16,000	16,000	16,000
J124	75.8	66.4	15,700	15,500	14,200	13,900
J125	76.0	66.6	16,000	16,000	16,000	16,000
J129	76.3	66.9	15,100	15,400	13,300	13,400
J130	76.1	66.7	15,500	15,800	13,500	13,800
J131	76.2	66.8	16,000	16,000	14,300	14,600
J132	76.1	66.7	16,000	16,000	13,900	14,100
J133	76.2	66.8	15,800	15,900	13,800	13,900
J134	76.3	66.9	15,100	15,300	13,300	13,400
J135	76.4	67.0	13,700	14,000	12,600	12,400
J136	76.3	66.9	14,300	14,500	12,900	12,800
J137	76.2	66.8	13,800	14,100	12,600	12,400
J14	76.3	66.9	13,600	13,900	12,500	12,300
J15	76.0	67.1	16,000	16,000	16,000	16,000
J152	76.5	67.7	16,000	16,000	16,000	16,000
J153	75.4	66.2	16,000	16,000	16,000	16,000
J154	76.0	66.6	16,000	16,000	16,000	16,000
J155	76.1	66.7	16,000	16,000	16,000	16,000
J156	75.9	66.5	16,000	16,000	14,700	14,800
J158	76.4	67.1	16,000	16,000	16,000	16,000
J16	76.1	67.1	16,000	16,000	16,000	16,000
J162	75.5	66.1	16,000	16,000	16,000	16,000
J164	75.6	66.2	16,000	16,000	16,000	16,000
J166	75.4	66.0	16,000	16,000	16,000	16,000
J168	75.7	66.3	16,000	16,000	16,000	16,000
J17	76.0	66.8	16,000	16,000	16,000	16,000
J170	75.2	65.8	16,000	16,000	16,000	16,000
J172	75.5	66.1	16,000	16,000	16,000	16,000
J174	75.7	66.3	16,000	16,000	16,000	16,000
J176	75.8	66.4	16,000	16,000	16,000	16,000
J178	76.0	66.7	16,000	16,000	16,000	16,000
J18	75.7	66.5	16,000	16,000	16,000	16,000
J180	76.2	66.9	16,000	16,000	16,000	16,000
J182	76.3	67.0	16,000	16,000	16,000	16,000
J184	76.4	67.1	16,000	16,000	16,000	16,000
J186	75.9	66.5	16,000	16,000	16,000	16,000
J188	75.5	66.2	16,000	16,000	16,000	16,000
J19	75.5	66.3	16,000	16,000	16,000	16,000
J20	76.0	66.7	16,000	16,000	16,000	16,000
J21	75.8	66.5	16,000	16,000	16,000	16,000
J22	75.9	66.6	16,000	16,000	16,000	16,000
J23	76.0	66.7	16,000	16,000	16,000	16,000
J24	76.1	66.8	16,000	16,000	16,000	16,000
J25	76.0	66.7	16,000	16,000	16,000	16,000
J26	76.1	66.8	16,000	16,000	16,000	16,000
J27	76.3	67.0	16,000	16,000	16,000	16,000
J28	76.2	66.9	16,000	16,000	16,000	16,000
J29	76.2	67.0	16,000	16,000	16,000	16,000
J30	76.1	66.9	16,000	16,000	16,000	16,000
J31	76.3	67.1	16,000	16,000	16,000	16,000
J32	76.2	67.1	16,000	16,000	16,000	16,000

Table C-4: Modelling Results (SUC - PH5-D)

Junction	Maximum Pressure under AVDY	Minimum Pressure under PKHR	Available Fire Flow under MXDY+FF @ 20 psi Residual Pressure	Failure Scenario 1 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 2 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure	Failure Scenario 3 Available Fire Flow under AVDY+FF (Reliability Analysis) @ 20 psi Residual Pressure
ID	(psi)	(psi)	(L/min)	(L/min)	(L/min)	(L/min)
J33	76.4	67.3	16,000	16,000	16,000	16,000
J34	76.3	67.2	16,000	16,000	16,000	16,000
J35	76.2	67.3	16,000	16,000	16,000	16,000
J36	76.4	67.5	16,000	16,000	16,000	16,000
J37	75.8	66.5	16,000	16,000	16,000	16,000
J373	75.5	66.1	Not fire flow node	Not fire flow node	Not fire flow node	Not fire flow node
J375	75.7	66.2	Not fire flow node	Not fire flow node	Not fire flow node	Not fire flow node
J38	75.9	66.6	16,000	16,000	16,000	16,000
J383	75.9	66.5	16,000	16,000	15,900	15,900
J385	75.6	66.2	16,000	16,000	16,000	15,800
J39	75.9	66.6	16,000	16,000	16,000	16,000
J40	75.9	67.4	16,000	16,000	16,000	16,000
J41	76.0	66.6	16,000	16,000	16,000	16,000
J42	76.0	66.6	16,000	16,000	16,000	16,000
J43	75.9	66.5	16,000	16,000	16,000	16,000
J44	76.1	66.7	16,000	16,000	16,000	16,000
J45	75.9	66.5	16,000	16,000	15,400	15,700
J46	76.0	67.4	16,000	16,000	16,000	16,000
J48	76.0	67.4	16,000	16,000	16,000	16,000
J50	75.9	67.3	16,000	16,000	16,000	16,000
J51	76.0	67.4	16,000	16,000	16,000	16,000
J52	76.0	67.3	16,000	16,000	16,000	15,300
J53	76.1	67.4	16,000	16,000	16,000	15,000
J55	76.6	67.8	16,000	16,000	16,000	15,600
J56	76.4	67.4	16,000	16,000	16,000	14,100
J57	76.6	67.5	16,000	16,000	16,000	14,800
J58	76.4	67.4	16,000	16,000	16,000	14,400
J59	76.3	67.2	15,600	16,000	16,000	13,300
J60	76.6	67.4	14,200	15,100	15,100	12,400
J61	76.4	67.3	14,100	15,000	15,000	12,200
J62	76.3	67.2	15,400	16,000	16,000	13,200
J63	76.4	67.2	15,700	16,000	16,000	13,500
J64	76.5	67.3	14,400	15,400	15,400	12,500
J65	76.5	67.3	14,400	15,400	15,400	12,600
J66	76.3	67.1	16,000	16,000	16,000	13,700
J67	76.4	67.1	16,000	16,000	16,000	13,900
J68	76.6	67.3	14,500	15,500	15,500	12,700
J69	76.4	67.1	14,600	15,600	15,600	12,700
J70	76.2	67.0	15,900	16,000	16,000	13,600
J71	76.2	66.9	16,000	16,000	16,000	13,900
J72	76.3	67.0	14,700	15,800	15,800	12,800
J73	76.4	67.1	14,800	15,900	15,900	12,900
J74	76.3	67.0	16,000	16,000	16,000	13,900
J75	76.0	66.7	16,000	16,000	16,000	14,700
J76	76.1	66.9	16,000	16,000	16,000	16,000
J77	75.8	66.6	16,000	16,000	16,000	14,300
J78	76.0	66.8	16,000	16,000	16,000	16,000
J79	76.1	67.0	16,000	16,000	16,000	15,000
J80	75.6	66.3	16,000	16,000	16,000	16,000
J81	75.5	66.1	16,000	16,000	16,000	16,000
J82	75.5	66.2	16,000	16,000	16,000	16,000
J83	75.7	66.4	16,000	16,000	16,000	16,000
J84	75.6	66.3	16,000	16,000	16,000	16,000
J85	75.7	66.4	13,900	14,800	14,800	12,200
J86	75.9	66.6	12,800	13,700	13,700	11,400
J87	75.9	66.6	12,800	13,700	13,700	11,400
J88	75.7	66.5	14,100	15,100	15,100	12,400
J89	75.7	66.5	16,000	16,000	16,000	16,000
J90	75.6	66.3	16,000	16,000	16,000	14,800
J91	75.8	66.6	16,000	16,000	16,000	16,000
J92	75.7	66.3	16,000	16,000	16,000	16,000
J93	75.5	66.2	16,000	16,000	16,000	14,600
J94	76.2	66.8	16,000	16,000	16,000	16,000
J95	76.4	67.1	16,000	16,000	16,000	16,000
J96	76.3	66.9	16,000	16,000	16,000	16,000
J97	76.0	66.7	16,000	16,000	16,000	14,900
J98	76.2	66.9	16,000	16,000	16,000	16,000

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APPENDIX C

Wastewater Collection

LICENSED PROFESSIONAL ENGINEER
X. WEI
100531124
26-04-10
PROVINCE OF ONTARIO

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
BLK 125 (FUT. DEVELOPMENT)																											
			0.10		0	0.10	0				0.00		0.00		0.00		0.10	0.10									
	30A	31A	0.96	106	243	1.06	243	3.5	2.75		0.00		0.00		0.00	0.00	0.96	1.06	0.35	3.10	15.0	200	0.65	26.44	0.12	0.84	0.56
To STREET 1, Pipe 31A - 32A						1.06	243				0.00		0.00		0.00			1.06									
STREET 1 TO STREET 8 STORM SEWER																											
Contribution From STREET 1, Pipe 31A - 32A						1.34	308				0.00		0.00		0.00		1.34	1.34									
	32A	33A	0.22		0	1.56	308	3.5	3.45		0.00		0.00		0.00	0.00	0.22	1.56	0.51	3.97	28.5	200	0.35	19.40	0.20	0.62	0.48
To STREET 8, Pipe 33A - 34A						1.56	308				0.00		0.00		0.00			1.56									
STREET 8																											
Contribution From STREET 1 TO STREET 8 STORM SEWER, Pipe 32A - 33A						1.56	308				0.00		0.00		0.00		1.56	1.56									
			0.15	32	87	1.71	395				0.00		0.00		0.00		0.15	1.71									
	33A	34A	0.40	12	33	2.11	428	3.4	4.72		0.00		0.00		0.00	0.00	0.40	2.11	0.70	5.42	88.5	200	0.35	19.40	0.28	0.62	0.53
			0.06	16	44	2.17	472				0.00		0.00		0.00		0.06	2.17									
	34A	37A	0.32	11	30	2.49	502	3.4	5.50		0.00		0.00		0.00	0.00	0.32	2.49	0.82	6.32	80.5	200	0.35	19.40	0.33	0.62	0.55
To STREET 4, Pipe 37A - Ex.Plug						2.49	502				0.00		0.00		0.00			2.49									
STREET 7																											
	26A	27A	0.46	11	38	0.46	38	3.7	0.45		0.00		0.00		0.00	0.00	0.46	0.46	0.15	0.60	56.5	200	0.65	26.44	0.02	0.84	0.34
	27A	29A	0.48	14	48	0.94	86	3.6	1.01		0.00		0.00		0.00	0.00	0.48	0.94	0.31	1.32	91.5	200	0.35	19.40	0.07	0.62	0.35
To STREET 4, Pipe 29A - 37A						0.94	86				0.00		0.00		0.00			0.94									
PRIVATE STREET 4																											
	613A	614A	0.19	20	54	0.19	54	3.6	0.64		0.00		0.00		0.00	0.00	0.19	0.19	0.06	0.70	46.5	200	0.65	26.44	0.03	0.84	0.36
To PRIVATE STREET 6, Pipe 614A - 28A						0.19	54				0.00		0.00		0.00			0.19									
SERVICE CONNECTIONS																											
	603A	604A	0.07	12	33	0.07	33	3.7	0.39		0.00		0.00		0.00	0.00	0.07	0.07	0.02	0.42	20.5	135	1.00	11.50	0.04	0.80	0.38
	604A	605A	0.14	4	11	0.21	44	3.7	0.52		0.00		0.00		0.00	0.00	0.14	0.21	0.07	0.59	10.5	135	1.00	11.50	0.05	0.80	0.42
	605A	609A	0.11		0	0.32	44	3.7	0.52		0.00		0.00		0.00	0.00	0.11	0.32	0.11	0.63	34.0	200	0.35	19.40	0.03	0.62	0.28
To PRIVATE STREET 1, Pipe 609A - 611A						0.32	44				0.00		0.00		0.00			0.32									
PRIVATE STREET 1																											
	608A	609A	0.31	32	87	0.31	87	3.6	1.02		0.00		0.00		0.00	0.00	0.31	0.31	0.10	1.12	71.0	200	0.65	26.44	0.04	0.84	0.42
Contribution From SERVICE CONNECTIONS, Pipe 605aA - 609A						0.32	44				0.00		0.00		0.00		0.32	0.63									
	609A	611A	0.21	24	65	0.84	196	3.5	2.24		0.00		0.00		0.00	0.00	0.21	0.84	0.28	2.51	56.0	200	0.35	19.40	0.13	0.62	0.42
To PRIVATE STREET 6, Pipe 611A - 614A						0.84	196				0.00		0.00		0.00			0.84									
PRIVATE STREET 6																											
Contribution From PRIVATE STREET 1, Pipe 609A - 611A						0.84	196				0.00		0.00		0.00		0.84	0.84									
	611A	614A	0.36	16	44	1.20	240	3.5	2.72		0.00		0.00		0.00	0.00	0.36	1.20	0.40	3.11	98.0	200	0.35	19.40	0.16	0.62	0.45
Contribution From PRIVATE STREET 4, Pipe 613A - 614A						0.19	54				0.00		0.00		0.00		0.19	1.39									
	614A	28A	0.27		0	1.66	294	3.5	3.30		0.00		0.00		0.00	0.00	0.27	1.66	0.55	3.85	32.5	200	0.90	31.12	0.12	0.99	0.67
	28A	29A	0.05		0	1.71	294	3.5	3.30		0.00		0.00		0.00	0.00	0.05	1.71	0.56	3.87	11.0	200	0.70	27.44	0.14	0.87	0.61
To STREET 4, Pipe 29A - 37A						1.71	294				0.00		0.00		0.00			1.71									

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha				
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph			
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =		0.330	L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =		0.600	m/s
Max Res. Peak Factor =	4.00				Manning's n =	(Conc)	0.013	(Pvc) 0.013
Commercial/Inst./Park Peak Factor =	1.50				Townhouse coeff=		2.7	
Institutional =	0.32	l/s/Ha			Single house coeff=		3.4	

Designed: V.W.	PROJECT: **BCDC WEST PH5&6**	
Checked: V.W.	LOCATION: **City of Ottawa**	
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No.	File Ref:	Date: **05 May 2026** / Sheet No. 1 of 4

LICENSED PROFESSIONAL ENGINEER
X. WEI
100531124
26-04-10
PROVINCE OF ONTARIO

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
STREET 6																											
	23A	24A	0.54	12	41	0.54	41	3.7	0.49		0.00		0.00		0.00	0.00	0.54	0.54	0.18	0.67	62.5	200	0.65	26.44	0.03	0.84	0.35
	24A	25A	0.41	12	41	0.95	82	3.6	0.96		0.00		0.00		0.00	0.00	0.41	0.95	0.31	1.27	80.0	250	0.25	29.73	0.04	0.61	0.30
To STREET 4, Pipe 25A - 29A						0.95	82				0.00		0.00		0.00			0.95									
	35A	36A	0.58	23	63	0.58	63	3.6	0.74		0.00		0.00		0.00	0.00	0.58	0.58	0.19	0.93	77.5	200	0.65	26.44	0.04	0.84	0.39
	36A	37A	0.51	23	63	1.09	126	3.6	1.46		0.00		0.00		0.00	0.00	0.51	1.09	0.36	1.82	90.5	250	0.25	29.73	0.06	0.61	0.33
To STREET 4, Pipe 37A - Ex.Plug						1.09	126				0.00		0.00		0.00			1.09									
STREET 1																											
	1A	3A	0.67	18	49	0.67	49	3.7	0.58		0.00		0.00		0.00	0.00	0.67	0.67	0.22	0.80	117.0	200	0.65	26.44	0.03	0.84	0.37
To STREET 2, Pipe 3A - 4A						0.67	49				0.00		0.00		0.00			0.67									
	2A	3A	0.31	3	9	0.31	9	3.7	0.11		0.00		0.00		0.00	0.00	0.31	0.31	0.10	0.21	17.0	200	0.65	26.44	0.01	0.84	0.24
To STREET 2, Pipe 3A - 4A						0.31	9				0.00		0.00		0.00			0.31									
Contribution From BLK 125 (FUT. DEVELOPMENT), Pipe 30A - 31A						1.06	243				0.00		0.00		0.00		1.06	1.06									
			0.12	24	65	1.18	308				0.00		0.00		0.00		0.12	1.18									
	31A	32A	0.16		0	1.34	308	3.5	3.45		0.00		0.00		0.00	0.00	0.16	1.34	0.44	3.89	50.5	200	0.35	19.40	0.20	0.62	0.48
To STREET 1 TO STREET 8 STORM SEWER, Pipe 32A - 33A						1.34	308				0.00		0.00		0.00			1.34									
STREET 2																											
Contribution From STREET 1, Pipe 1A - 3A						0.67	49				0.00		0.00		0.00		0.67	0.67									
Contribution From STREET 1, Pipe 2A - 3A						0.31	9				0.00		0.00		0.00		0.31	0.98									
	3A	4A	0.03		0	1.01	58	3.6	0.68		0.00		0.00		0.00	0.00	0.03	1.01	0.33	1.02	18.5	200	0.35	19.40	0.05	0.62	0.33
			0.11	24	65	1.12	123				0.00		0.00		0.00		0.11	1.12									
	4A	8A	0.36	12	33	1.48	156	3.5	1.79		0.00		0.00		0.00	0.00	0.36	1.48	0.49	2.28	92.5	200	0.35	19.40	0.12	0.62	0.41
To STREET 3, Pipe 8A - 9A						1.48	156				0.00		0.00		0.00			1.48									
STREET 3																											
	5A	6A	0.57	25	68	0.57	68	3.6	0.80		0.00		0.00		0.00	0.00	0.57	0.57	0.19	0.99	81.5	200	0.65	26.44	0.04	0.84	0.40
	6A	7A	0.12	3	9	0.69	77	3.6	0.90		0.00		0.00		0.00	0.00	0.12	0.69	0.23	1.13	10.5	200	0.35	19.40	0.06	0.62	0.33
	7A	8A	0.27	10	27	0.96	104	3.6	1.21		0.00		0.00		0.00	0.00	0.27	0.96	0.32	1.53	58.5	200	0.35	19.40	0.08	0.62	0.36
Contribution From STREET 2, Pipe 4A - 8A						1.48	156				0.00		0.00		0.00		1.48	2.44									
			0.09	18	49	2.53	309				0.00		0.00		0.00		0.09	2.53									
	8A	9A	0.29	10	27	2.82	336	3.4	3.75		0.00		0.00		0.00	0.00	0.29	2.82	0.93	4.68	72.5	200	0.35	19.40	0.24	0.62	0.50
			0.02		0	2.84	336				0.00		0.00		0.00		0.02	2.84									
	9A	101A	0.04	6	17	2.88	353	3.4	3.93		0.00		0.00		0.00	0.00	0.04	2.88	0.95	4.88	11.0	200	0.35	19.40	0.25	0.62	0.51
	101A	25A	0.09		0	2.97	353	3.4	3.93		0.00		0.00		0.00	0.00	0.09	2.97	0.98	4.91	58.5	200	0.35	19.40	0.25	0.62	0.51
To STREET 4, Pipe 25A - 29A						2.97	353				0.00		0.00		0.00			2.97									
BLK 124 (PARK)																											
	13A	14A	0.42		0	0.42	0				0.00		0.00		0.00	0.00	0.42	0.42	0.14	0.14	11.0	200	0.65	26.44	0.01	0.84	0.22
To STREET 5, Pipe 14A - 19A						0.42	0				0.00		0.00		0.00			0.42									
STREET 5																											
	20A	21A	0.28	3	11	0.28	11	3.7	0.13		0.00		0.00		0.00	0.00	0.28	0.28	0.09	0.23	13.0	200	0.65	26.44	0.01	0.84	0.26
	21A	22A	0.56	14	48	0.84	59	3.6	0.70		0.00		0.00		0.00	0.00	0.56	0.84	0.28	0.97	98.5	250	0.25	29.73	0.03	0.61	0.27
To STREET 4, Pipe 22A - 25A						0.84	59				0.00		0.00		0.00			0.84									

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha				
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph			
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =		0.330	L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =		0.600	m/s
Max Res. Peak Factor =	4.00				Manning's n =	(Conc)	0.013	(Pvc) 0.013
Commercial/Inst./Park Peak Factor =	1.50				Townhouse coeff=		2.7	
Institutional =	0.32	l/s/Ha			Single house coeff=		3.4	

Designed: V.W.	PROJECT: **BCDC WEST PH5&6**		
Checked: V.W.	LOCATION: **City of Ottawa**		
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No.	File Ref:	Date: **05 May 2026**	Sheet No. 2 of 4

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
	11A	12A	0.11	2	7	0.11	7	3.7	0.08		0.00		0.00		0.00	0.00	0.11	0.11	0.04	0.12	14.5	200	0.65	26.44	0.00	0.84	0.20
	12A	14A				0.11	7	3.7	0.08		0.00		0.00		0.00	0.00	0.00	0.11	0.04	0.12	10.0	200	0.35	19.40	0.01	0.62	0.17
Contribution From BLK 124 (PARK), Pipe 13A - 14A						0.42	0				0.00		0.00		0.00		0.42	0.53									
	14A	19A	0.32	6	21	0.85	28	3.7	0.33		0.00		0.00		0.00	0.00	0.32	0.85	0.28	0.62	85.0	250	0.25	29.73	0.02	0.61	0.24
To STREET 4, Pipe 19A - 22A						0.85	28				0.00		0.00		0.00			0.85									
External Area																											
	External	MH 15A	25.04		2079	25.04	2079				0.00		0.00	2.56	2.56		27.60	27.60									
			2.19		555	27.23	2634				0.00		0.00		2.56		2.19	29.79									
			2.62		663	29.85	3297				0.00		0.00		2.56		2.62	32.41									
			2.85		722	32.70	4019				0.00		0.00		2.56		2.85	35.26									
To STREET 4, Pipe 15A - 18A						32.70	4019				0.00		0.00		2.56			35.26									
STREET 4																											
Contribution From External Area						32.70	4019				0.00		0.00		2.56		35.26	35.26									
	15A	18A	0.06	2	6	32.76	4025	2.9	37.37		0.00		0.00		2.56	0.41	0.06	35.32	11.66	49.44	8.5	375	0.15	67.91	0.73	0.61	0.67
Contribution From PUMP STATION, Pipe 17A - 18A						0.05	0				0.00		0.00		0.00		0.05	35.37									
	18A	19A	0.16	6	17	32.97	4042	2.9	37.51		0.00		0.00		2.56	0.41	0.16	35.53	11.72	49.65	43.0	525	0.10	136.00	0.37	0.63	0.58
Contribution From STREET 5, Pipe 14A - 19A						0.85	28				0.00		0.00		0.00		0.85	36.38									
	19A	22A	0.24	9	25	34.06	4095	2.9	37.95		0.00		0.00		2.56	0.41	0.24	36.62	12.08	50.44	60.0	525	0.10	136.00	0.37	0.63	0.58
Contribution From STREET 5, Pipe 21A - 22A						0.84	59				0.00		0.00		0.00		0.84	37.46									
	22A	25A	0.22	8	22	35.12	4176	2.9	38.61		0.00		0.00		2.56	0.41	0.22	37.68	12.43	51.46	60.0	525	0.10	136.00	0.38	0.63	0.58
Contribution From STREET 3, Pipe 101A - 25A						2.97	353				0.00		0.00		0.00		2.97	40.65									
Contribution From STREET 6, Pipe 24A - 25A						0.95	82				0.00		0.00		0.00		0.95	41.60									
			0.09	20	54	39.13	4665				0.00		0.00		2.56		0.09	41.69									
	25A	29A	0.09		0	39.22	4665	2.8	42.61		0.00		0.00		2.56	0.41	0.09	41.78	13.79	56.81	60.0	525	0.10	136.00	0.42	0.63	0.60
Contribution From STREET 7, Pipe 27A - 29A						0.94	86				0.00		0.00		0.00		0.94	42.72									
Contribution From PRIVATE STREET 6, Pipe 28A - 29A						1.71	294				0.00		0.00		0.00		1.71	44.43									
			0.09	20	54	41.96	5099				0.00		0.00		2.56		0.09	44.52									
	29A	37A	0.09		0	42.05	5099	2.8	46.10		0.00		0.00		2.56	0.41	0.09	44.61	14.72	61.23	60.0	525	0.10	136.00	0.45	0.63	0.61
Contribution From STREET 8, Pipe 34A - 37A						2.49	502				0.00		0.00		0.00		2.49	47.10									
Contribution From STREET 6, Pipe 36A - 37A						1.09	126				0.00		0.00		0.00		1.09	48.19									
			0.04		0	45.67	5727				0.00		0.00		2.56		0.04	48.23									
	37A	Ex.Plug	0.04		0	45.71	5727	2.8	51.07		0.00		0.00		2.56	0.41	0.04	48.27	15.93	67.42	66.5	525	0.10	136.00	0.50	0.63	0.63
	Ex.Plug	Ex.10A				45.71	5727	2.8	51.07		0.00		0.00		2.56	0.41	0.00	48.27	15.93	67.42	9.0	525	0.11	141.33	0.48	0.65	0.64
To Conservancy Drive, Pipe Ex.10A - Ex.11A						45.71	5727				0.00		0.00		2.56			48.27									
Borrisokane Road																											
			0.23	4	11	0.23	11				0.00		0.00		0.00		0.23	0.23									
	1002A	1001A	0.36	12	33	0.59	44	3.7	0.52		0.00		0.00		0.00	0.00	0.36	0.59	0.19	0.72	74.5	200	0.65	26.44	0.03	0.84	0.36
			0.39	12	33	0.98	77				0.00		0.00		0.00		0.39	0.98									
	1001A	Ex.Plug1	0.40	12	33	1.38	110	3.6	1.28		0.00		0.00		0.00	0.00	0.40	1.38	0.46	1.73	97.0	250	0.25	29.73	0.06	0.61	0.33
	Ex.Plug1	Ex.10A				1.38	110	3.6	1.28		0.00		0.00		0.00	0.00	0.00	1.38	0.46	1.73	3.0	250	0.25	29.73	0.06	0.61	0.33
To Conservancy Drive, Pipe Ex.10A - Ex.11A						1.38	110				0.00		0.00		0.00			1.38									
			0.15	4	11	0.15	11				0.00		0.00		0.00		0.15	0.15									
	1004A	1005A	0.21	6	17	0.36	28	3.7	0.33		0.00		0.00		0.00	0.00	0.21	0.36	0.12	0.45	35.5	200	0.65	26.44	0.02	0.84	0.32

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha					
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph				
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =		0.330	L/s/ha	
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =		0.600	m/s	
Max Res. Peak Factor =	4.00				Manning's n =	(Conc)	0.013	(Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.50				Townhouse coeff=		2.7		
Institutional =	0.32	l/s/Ha			Single house coeff=		3.4		

Designed: V.W.	PROJECT: **BCDC WEST PH5&6**		
Checked: V.W.	LOCATION: **City of Ottawa**		
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No.	File Ref:	Date: **05 May 2026**	Sheet No. 3 of 4

1527 SAN_Ph5&6_May0526.xlsx

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

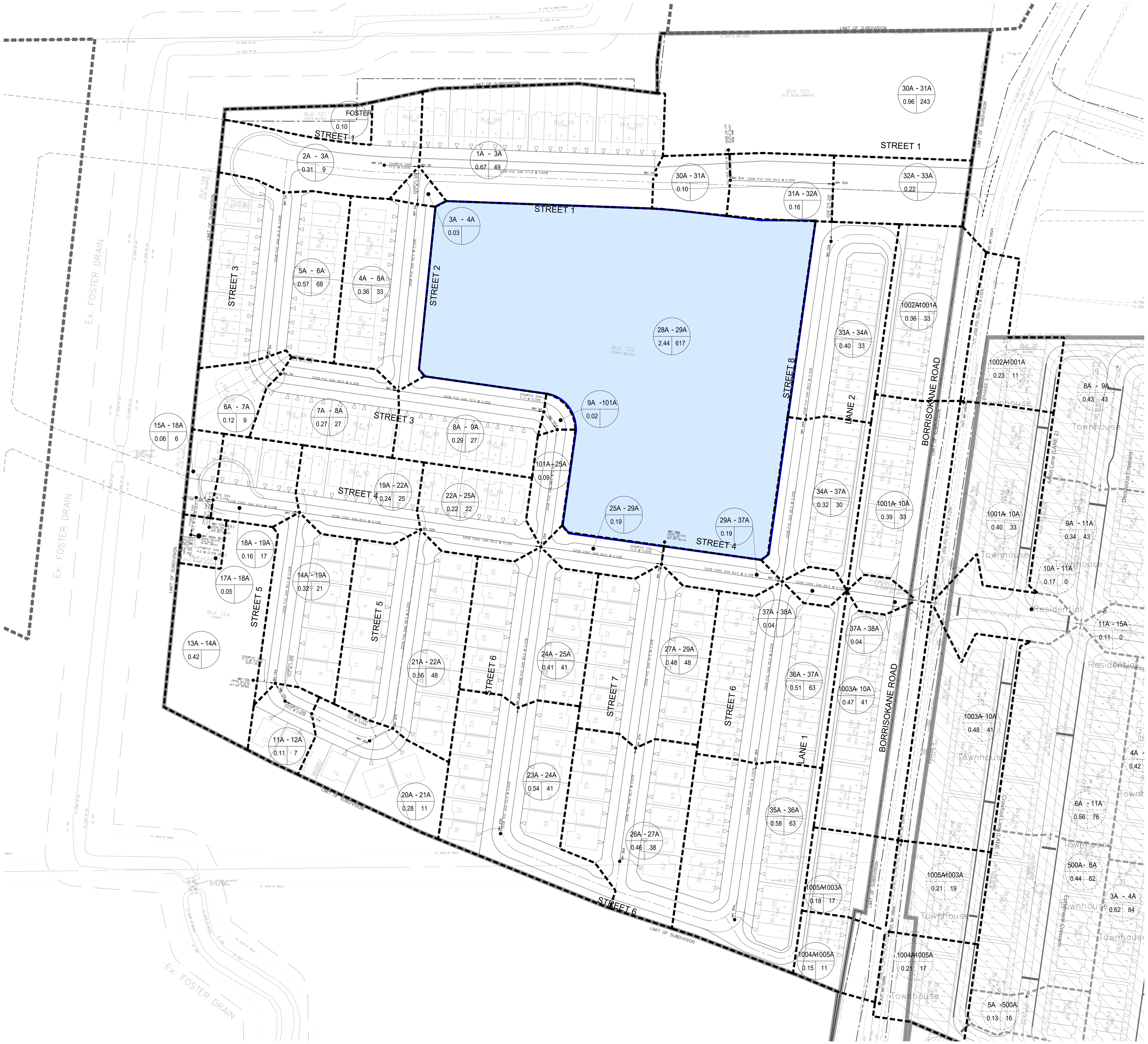
LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
			0.18	6	17	0.54	45				0.00		0.00		0.00		0.18	0.54									
	1005A	1003A	0.21	7	19	0.75	64	3.6	0.75		0.00		0.00		0.00	0.00	0.21	0.75	0.25	1.00	45.0	250	0.25	29.73	0.03	0.61	0.28
			0.47	15	41	1.22	105				0.00		0.00		0.00		0.47	1.22									
	1003A	Ex.Plug2	0.48	15	41	1.70	146	3.6	1.68		0.00		0.00		0.00	0.00	0.48	1.70	0.56	2.24	112.0	250	0.25	29.73	0.08	0.61	0.36
	Ex.Plug2	Ex.10A				1.70	146	3.6	1.68		0.00		0.00		0.00	0.00	0.00	1.70	0.56	2.24	6.0	250	0.25	29.73	0.08	0.61	0.36
To Conservancy Drive, Pipe Ex.10A - Ex.11A						1.70	146				0.00		0.00		0.00			1.70									
Conservancy Drive																											
Contribution From STREET 4, Pipe Ex.PLUG - Ex.10A						45.71	5727				0.00		0.00		0.00		48.27	48.27									
Contribution From Borrisokane Road, PLUG - Ex.10A						1.38	110				0.00		0.00		0.00		1.38	49.65									
Contribution From Borrisokane Road, PLUG - Ex.10A						1.70	146				0.00		0.00		0.00		1.70	51.35									
To Conservancy Drive, Pipe Ex.10A - Ex.11A						48.79	5983				0.00		0.00		0.00			51.35									
PUMP STATION																											
	17A	18A	0.05		0	0.05	0				0.00		0.00		0.00	0.00	0.05	0.05	0.02	0.02	13.5	375	0.15	67.91	0.00	0.61	0.05
To STREET 4, Pipe 18A - 19A						0.05	0				0.00		0.00		0.00			0.05									
	15A	16A				0.00					0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	18.5	375	0.15	67.91	0.00	0.61	0.03
	16A	160A				0.00	0				0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	4.0	375	0.15	67.91	0.00	0.61	0.03

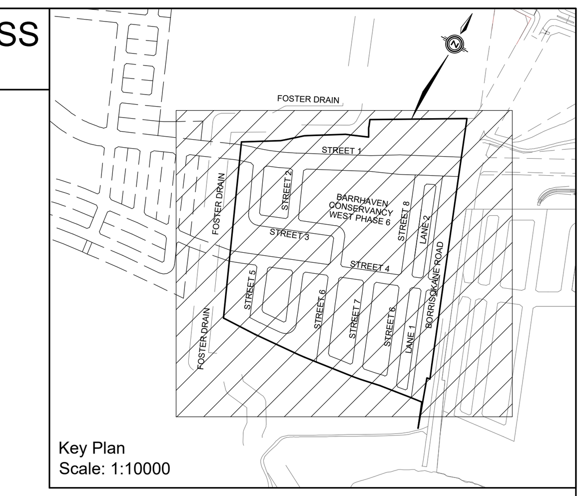
DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha				
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph			
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	0.330	L/s/ha	
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	0.600	m/s	
Max Res. Peak Factor =	4.00				Manning's n = (Conc)	0.013	(Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.50				Townhouse coeff=	2.7		
Institutional =	0.32	l/s/Ha			Single house coeff=	3.4		

Designed: V.W.	PROJECT: BCDC WEST PH5&6		
Checked: V.W.	LOCATION: City of Ottawa		
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No.	File Ref:	Date: 05 May 2026	Sheet No. 4 of 4

ALL DWELLINGS ARE TO BE PROVIDED WITH SUMP PUMPS, UNLESS OTHERWISE NOTED. SEE DWG. 3 FOR SUMP PUMP DETAIL.





LEGEND

SANITARY DRAINAGE BOUNDARY	
SANITARY DRAINAGE BOUNDARY IN OTHER PHASES	
UPSTREAM MH TO DOWNSTREAM MH / AREA IN HECTARES / POPULATION	43A - 44A 0.78 61
UPSTREAM MH TO DOWNSTREAM MH / AREA IN OTHER PHASES IN HECTARES / POPULATION	43A - 44A 0.78 61
EXTERNAL AREA IN HECTARES / EXTERNAL POPULATION / DENSITY (PERSONS/HECTARE) / EXTERNAL LAND USE	A=53.63 / 107 / POP=5739 / RESIDENTIAL
MAINTENANCE HOLE	MH202A
CAP / EXISTING SANITARY MAINTENANCE HOLE	

NOT FOR CONSTRUCTION

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-127-00, SURVEY DATED APRIL 10, 2018. PROJECT No. 16-10-127, SURVEY DATED FEBRUARY 2, 2021.

LEGAL INFORMATION

M-PLAN PROVIDED BY J.D. BARNES., PROJECT No. 21-10-134-00, RECEIVED ON MARCH 24, 2026.

ELEVATION NOTE

ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE REFERRED TO THE PUBLISHED BENCH MARK No. 0011964U3710. ELEVATION=71.724m

No.	BY	DATE	DESCRIPTION
1	W.L.	26-04-10	1st SUBMISSION

Ottawa — CITY OF OTTAWA

PROJECT No. 21-1226

LICENSED PROFESSIONAL ENGINEER W. LIU 100167932 PROVINCE OF ONTARIO

BARRHAVEN CONSERVANCY DEVELOPMENT CORPORATION

BARRHAVEN CONSERVANCY WEST
PHASE 5

DSEL
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

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SANITARY DRAINAGE PLAN

DRAWN BY: V.W.	CHECKED BY: W.L.	SHEET No.
DESIGNED BY: W.L.	CHECKED BY: C.M.	49 OF 54
SCALE: 1:1000	DATE: APRIL 2026	

CITY PLAN No. XXXXXX

CITY FILE No. D07-16-21-0036

David Schaeffer Engineering Ltd.
120 Iber Road, Suite 103
Stittsville, ON K2S 1E9
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APPENDIX D

Stormwater Management

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Arterial Roads Return Frequency = 10 years
Manning 0.013

LICENSED PROFESSIONAL ENGINEER X. WEI 100531124 26-04-10 PROVINCE OF ONTARIO

Ottawa

LOCATION: Location	From Node	To Node	2 YEAR AREA (Ha)	2 YEAR R	2 YEAR Indiv. 2.78 AC	2 YEAR Accum. 2.78 AC	5 YEAR AREA (Ha)	5 YEAR R	5 YEAR Indiv. 2.78 AC	5 YEAR Accum. 2.78 AC	10 YEAR AREA (Ha)	10 YEAR R	10 YEAR Indiv. 2.78 AC	10 YEAR Accum. 2.78 AC	100 YEAR AREA (Ha)	100 YEAR R	100 YEAR Indiv. 2.78 AC	100 YEAR Accum. 2.78 AC	FLOW: Time of Conc. (min)	Intensity 2 Year (mm/h)	Intensity 5 Year (mm/h)	Intensity 10 Year (mm/h)	Intensity 100 Year (mm/h)	Peak Flow Q (l/s)	SEWER DATA: DIA. (mm) (actual)	DIA. (mm) (nominal)	TYPE	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME OF FLOW (min.)	RATIO Q/Q full
BLK 124 (PARK)																																	
	117	118			0.00	0.00	0.47	0.40	0.52	0.52			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	54	375	375	PVC	0.30	14.5	96.0323	0.8695	0.2779	0.567
To STREET 5, Pipe 118 - 119						0.00				0.52				0.00				0.00	10.28														
STREET 2																																	
Contribution From STREET 1, Pipe 100 - 102						0.00				1.33				0.00				0.00	12.24														
Contribution From STREET 1, Pipe 101 - 102						0.00				0.49				0.00				0.00	10.45														
	102	103			0.00	0.00			0.00	1.82			0.00	0.00			0.00	0.00	12.24	69.15	93.68	109.76	160.37	171	600	600	CONC	0.15	15.5	237.8056	0.8411	0.3072	0.718
			0.10	0.80	0.22	0.22			0.00	1.82			0.00	0.00			0.00	0.00															
	103	107	0.27	0.77	0.58	0.80			0.00	1.82			0.00	0.00			0.00	0.00	12.55	68.23	92.42	108.27	158.19	223	675	675	CONC	0.15	95.5	325.5584	0.9098	1.7495	0.685
To STREET 3, Pipe 107 - 108						0.80				1.82				0.00				0.00	14.30														
STREET 3																																	
					0.00	0.00	0.04	0.81	0.09	0.09			0.00	0.00			0.00	0.00															
					0.00	0.00	0.04	0.90	0.10	0.19			0.00	0.00			0.00	0.00															
	104	105	0.38	0.77	0.81	0.81			0.00	0.19			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	82	450	450	CONC	0.20	96.5	127.5033	0.8017	2.0062	0.645
	105	106			0.00	0.81			0.00	0.19			0.00	0.00			0.00	0.00	12.01	69.87	94.67	110.93	162.09	75	450	450	CONC	0.20	11.0	127.5033	0.8017	0.2287	0.587
			0.18	0.57	0.29	1.10			0.00	0.19			0.00	0.00			0.00	0.00															
	106	107	0.23	0.77	0.49	1.59			0.00	0.19			0.00	0.00			0.00	0.00	12.23	69.17	93.70	109.79	160.42	128	600	600	CONC	0.15	62.5	237.8056	0.8411	1.2385	0.538
Contribution From STREET 2, Pipe 103 - 107						0.80				1.82				0.00				0.00	14.30														
			0.08	0.80	0.18	2.57			0.00	2.01			0.00	0.00			0.00	0.00															
	107	108	0.22	0.77	0.47	3.04			0.00	2.01			0.00	0.00			0.00	0.00	14.30	63.47	85.89	100.60	146.93	366	750	750	CONC	0.15	68.5	431.1703	0.9760	1.1698	0.848
	108	109			0.00	3.04			0.00	2.01			0.00	0.00			0.00	0.00	15.47	60.68	82.07	96.11	140.34	350	750	750	CONC	0.15	10.5	431.1703	0.9760	0.1793	0.811
			0.02	0.80	0.04	3.08			0.00	2.01			0.00	0.00			0.00	0.00															
			0.05	0.80	0.11	3.18			0.00	2.01			0.00	0.00			0.00	0.00															
			0.10	0.77	0.21	3.40			0.00	2.01			0.00	0.00			0.00	0.00															
	109	110	0.11	0.57	0.17	3.57			0.00	2.01			0.00	0.00			0.00	0.00	15.65	60.28	81.52	95.46	139.38	379	750	750	CONC	0.15	54.5	431.1703	0.9760	0.9307	0.880
To STREET 4, Pipe 110 - 113						3.57				2.01				0.00				0.00	16.58														
STREET 5																																	
	116	118	0.20	0.77	0.43	0.43			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	33	450	450	CONC	0.20	70.5	127.5033	0.8017	1.4657	0.258
Contribution From BLK 124 (PARK), Pipe 117 - 118						0.00				0.52				0.00				0.00	10.28														
	118	119			0.00	0.43			0.00	0.52			0.00	0.00			0.00	0.00	11.47	71.60	97.04	113.72	166.19	81	525	525	CONC	0.20	11.0	192.3297	0.8885	0.2063	0.423
	119	120			0.00	0.43			0.00	0.52			0.00	0.00			0.00	0.00	11.67	70.93	96.12	112.63	164.59	81	600	600	CONC	0.15	21.5	237.8056	0.8411	0.4260	0.339
To STM OUTLET 1, Pipe 120 - 122						0.43				0.52				0.00				0.00	12.10														
Contribution From STREET 4, Pipe 110 - 113						3.92				2.01				0.00				0.00	17.60														
Contribution From STREET 4, Pipe 111 - 113						1.11				0.00				0.00				0.00	11.88														
			0.25	0.77	0.54	5.56			0.00	2.01			0.00	0.00			0.00	0.00															
	113	114	0.28	0.50	0.39	5.95			0.00	2.01			0.00	0.00			0.00	0.00	17.60	56.24	75.99	88.96	129.85	488	825	825	CONC	0.15	99.0	555.9418	1.0400	1.5865	0.877
	114	115			0.00	5.95			0.00	2.01			0.00	0.00			0.00	0.00	19.19	53.37	72.08	84.36	123.11	463	825	825	CONC	0.15	11.5	555.9418	1.0400	0.1843	0.832
			0.18	0.50	0.25	6.20			0.00	2.01			0.00	0.00			0.00	0.00															
	115	120	0.32	0.77	0.68	6.89			0.00	2.01			0.00	0.00			0.00	0.00	19.37	53.06	71.66	83.86	122.37	510	825	825	CONC	0.15	21.0	555.9418	1.0400	0.3365	0.917
To STM OUTLET 1, Pipe 120 - 122						6.89				2.01				0.00				0.00	19.71														
STM OUTLET 1																																	
Contribution From STREET 5, Pipe 115 - 120						6.89				2.01				0.00				0.00	19.71														
Contribution From STREET 5, Pipe 119 - 120						0.43				0.52				0.00				0.00	12.10														
	120	122			0.00	7.32			0.00	2.53			0.00	0.00			0.00	0.00	19.71	52.50	70.89	82.97	121.06	564	825	825	CONC	0.20	15.0	641.9463	1.2009	0.2082	0.878
	122	HW1			0.00	7.32			0.00	2.53			0.00	0.00			0.00	0.00	19.92	52.16	70.43	82.42	120.26	560	900	900	CONC	0.15	30.5	701.1305	1.1021	0.4612	0.799
PRIVATE STREET 4																																	
	613	614	0.14	0.80	0.30	0.30			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	23	375	375	PVC	0.30	46.5	96.0323	0.8695	0.8913	0.244
To PRIVATE STREET 6, Pipe 614 - 617						0.30				0.00				0.00				0.00	10.89														
	616	614	0.14	0.80	0.31	0.31			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	24	300	300	PVC	0.35	22.0	57.2089	0.8093	0.4530	0.421
To PRIVATE STREET 6, Pipe 614 - 617						0.31				0.00				0.00				0.00	10.45														

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed: V.W.
Checked: V.W.
Dwg. Reference:
PROJECT: **BCDC WEST PH5&6**
LOCATION: **City of Ottawa**
File Ref:
Date: 05 May 2026
Sheet No. SHEET 1 OF 4

LICENSED PROFESSIONAL ENGINEER
X. WEI
100531124
26-04-10
PROVINCE OF ONTARIO

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

LOCATION			AREA (Ha) 2 YEAR				5 YEAR				10 YEAR				100 YEAR				FLOW Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	SEWER DATA DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year	10 Year	100 Year										
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	FLOW (min.)	Q/Q full
PRIVATE STREET 2																																	
	602	605	0.25	0.80	0.56	0.56			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	43	375	375	PVC	0.30	24.5	96.0323	0.8695	0.4696	0.446
To SERVICE CONNECTIONS, Pipe 605 - 606						0.56				0.00				0.00				0.00	10.47														
SERVICE CONNECTIONS																																	
	603	604			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	0	300	300	PVC	0.35	19.5	57.2089	0.8093	0.4016	0.000
	604	605			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	10.40	75.30	102.12	119.70	174.97	0	300	300	PVC	0.35	14.0	57.2089	0.8093	0.2883	0.000
Contribution From PRIVATE STREET 2, Pipe 602 - 605						0.56				0.00				0.00				0.00	10.47														
	605	606			0.00	0.56			0.00	0.00			0.00	0.00			0.00	0.00	10.69	74.25	100.68	118.01	172.49	41	450	450	CONC	0.20	18.5	127.5033	0.8017	0.3846	0.325
To PRIVATE STREET 3, Pipe 606 - 612						0.56				0.00				0.00				0.00	11.07														
PRIVATE STREET 3																																	
	608	606	0.14	0.80	0.32	0.32			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	25	450	450	CONC	0.20	41.0	127.5033	0.8017	0.8524	0.193
Contribution From SERVICE CONNECTIONS, Pipe 605 - 606						0.56				0.00				0.00				0.00	11.07														
			0.03	0.80	0.06	0.94			0.00	0.00			0.00	0.00			0.00	0.00															
	606	612	0.43	0.80	0.95	1.88			0.00	0.00			0.00	0.00			0.00	0.00	11.07	72.91	98.84	115.84	169.30	137	600	600	CONC	0.15	56.5	237.8056	0.8411	1.1196	0.578
To PRIVATE STREET 6, Pipe 612 - 614						1.88				0.00				0.00				0.00	12.19														
PRIVATE STREET 6																																	
Contribution From PRIVATE STREET 3, Pipe 606 - 612						1.88				0.00				0.00				0.00	12.19														
			0.09	0.80	0.20	2.08			0.00	0.00			0.00	0.00			0.00	0.00															
	612	614	0.56	0.80	1.25	3.32			0.00	0.00			0.00	0.00			0.00	0.00	12.19	69.30	93.88	109.99	160.71	230	675	675	CONC	0.15	84.5	325.5584	0.9098	1.5480	0.708
Contribution From PRIVATE STREET 4, Pipe 613 - 614						0.30				0.00				0.00				0.00	10.89														
Contribution From PRIVATE STREET 4, Pipe 616 - 614						0.31				0.00				0.00				0.00	10.45														
	614	617			0.00	3.94			0.00	0.00			0.00	0.00			0.00	0.00	13.74	64.91	87.85	102.91	150.31	256	675	675	CONC	0.20	2.5	375.9224	1.0505	0.0397	0.681
	617	620			0.00	3.94			0.00	0.00			0.00	0.00			0.00	0.00	13.78	64.80	87.71	102.74	150.07	256	675	675	CONC	0.20	3.5	375.9224	1.0505	0.0555	0.680
	620	220	0.08	0.80	0.18	4.12			0.00	0.00			0.00	0.00			0.00	0.00	13.84	64.66	87.51	102.50	149.72	266	675	675	CONC	0.20	22.5	375.9224	1.0505	0.3570	0.709
	220	221			0.00	4.12			0.00	0.00			0.00	0.00			0.00	0.00	14.19	63.74	86.25	101.02	147.55	263	750	750	CONC	0.15	10.5	431.1703	0.9760	0.1793	0.609
To STREET 7, Pipe 221 - 222						4.12				0.00				0.00				0.00	14.37														
STREET 7																																	
Contribution From SERVICE CONNECTIONS, Pipe 605 - 606						4.12				0.00				0.00				0.00	14.37														
Contribution From STREET 4, Pipe 218 - 221						0.45				0.00				0.00				0.00	10.92														
Contribution From STREET 4, Pipe 219 - 221						0.28				0.00				0.00				0.00	11.00														
	221	222	0.12	0.77	0.26	5.11			0.00	0.00			0.00	0.00			0.00	0.00	14.37	63.29	85.64	100.30	146.48	323	825	825	CONC	0.15	91.0	555.9418	1.0400	1.4583	0.581
			0.31	0.52	0.45	5.55			0.00	0.00			0.00	0.00			0.00	0.00															
	222	223	0.41	0.77	0.88	6.43			0.00	0.00			0.00	0.00			0.00	0.00	15.83	59.87	80.96	94.80	138.42	385	825	825	CONC	0.15	64.5	555.9418	1.0400	1.0337	0.693
	223	224			0.00	6.43			0.00	0.00			0.00	0.00			0.00	0.00	16.87	57.69	77.98	91.29	133.27	371	825	825	CONC	0.15	10.0	555.9418	1.0400	0.1603	0.667
To STREET 6, Pipe 224 - 228						6.43				0.00				0.00				0.00	17.03														
LANE 1																																	
	213	214	0.10	0.86	0.24	0.24			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	18	450	450	CONC	0.20	66.5	127.5033	0.8017	1.3825	0.144
	214	215	0.27	0.86	0.65	0.88			0.00	0.00			0.00	0.00			0.00	0.00	11.38	71.88	97.42	114.16	166.84	64	450	450	CONC	0.20	98.0	127.5033	0.8017	2.0374	0.499
	215	216			0.00	0.88			0.00	0.00			0.00	0.00			0.00	0.00	13.42	65.77	89.04	104.30	152.35	58	450	450	CONC	0.20	10.0	127.5033	0.8017	0.2079	0.456
			0.01	0.90	0.03	0.91			0.00	0.00			0.00	0.00			0.00	0.00															
			0.02	0.59	0.03	0.94			0.00	0.00			0.00	0.00			0.00	0.00															
	216	217	0.07	0.86	0.17	1.11			0.00	0.00			0.00	0.00			0.00	0.00	13.63	65.21	88.27	103.40	151.03	72	600	600	CONC	0.15	28.5	237.8056	0.8411	0.5648	0.304
To STREET 6, Pipe 217 - 224						1.11				0.00				0.00				0.00	14.19														
Contribution From STREET 6, Pipe 211 - 212						3.38				3.26				0.00				0.00	16.72														
	212	217			0.00	3.38			0.00	3.26			0.00	0.00			0.00	0.00	16.72	57.99	78.39	91.77	133.98	451	825	825	CONC	0.20	6.0	641.9463	1.2009	0.0833	0.703
To STREET 6, Pipe 217 - 224						3.38				3.26				0.00				0.00	16.80														
LANE 2																																	
	206	207	0.16	0.86	0.38	0.38			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	29	450	450	CONC	0.20	94.0	127.5033	0.8017	1.9542	0.230
	207	209	0.23	0.86	0.55	0.93			0.00	0.00			0.00	0.00			0.00	0.00	11.95	70.04	94.89	111.19	162.47	65	450	450	CONC	0.20	82.5	127.5033	0.8017	1.7151	0.512
To STREET 4, Pipe 209 - 210						0.93				0.00				0.00				0.00	13.67														

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed: V.W.
Checked: V.W.
Dwg. Reference:
PROJECT: **BCDC WEST PH5&6**
LOCATION: **City of Ottawa**
File Ref:
Date: 05 May 2026
Sheet No. SHEET 2 OF 4

LICENSED PROFESSIONAL ENGINEER
X. WEI
100531124
26-04-10
PROVINCE OF ONTARIO

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

	LOCATION		AREA (Ha)																FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year	10 Year	100 Year										
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	FLOW (min.)	Q/Q full
STREET 4																																	
			0.05	0.77	0.11	0.11			0.00	0.00			0.00	0.00			0.00	0.00															
			0.05	0.77	0.11	0.21			0.00	0.00			0.00	0.00			0.00	0.00															
			0.23	0.57	0.36	0.58			0.00	0.00			0.00	0.00			0.00	0.00															
	111	113	0.25	0.77	0.54	1.11			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	86	450	450	CONC	0.30	111.0	156.1591	0.9819	1.8842	0.548
To STREET 5, Pipe 113 - 114						1.11				0.00				0.00				0.00	11.88														
			0.02	0.80	0.03	0.03			0.00	0.00			0.00	0.00			0.00	0.00															
			0.07	0.80	0.16	0.19			0.00	0.00			0.00	0.00			0.00	0.00															
	218	221	0.12	0.77	0.26	0.45			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	34	300	300	PVC	0.35	44.5	57.2089	0.8093	0.9164	0.599
To STREET 7, Pipe 221 - 222						0.45				0.00				0.00				0.00	10.92														
			0.04	0.80	0.09	0.09			0.00	0.00			0.00	0.00			0.00	0.00															
	219	221	0.09	0.77	0.19	0.28			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	22	300	300	PVC	0.35	48.5	57.2089	0.8093	0.9988	0.378
To STREET 7, Pipe 221 - 222						0.28				0.00				0.00				0.00	11.00														
Contribution From LANE 2, Pipe 207 - 209						0.93				0.00				0.00				0.00	13.67														
	209	210	0.06	0.77	0.13	1.06			0.00	0.00			0.00	0.00			0.00	0.00	13.67	65.10	88.12	103.22	150.77	69	600	600	CONC	0.15	30.0	237.8056	0.8411	0.5945	0.290
To STREET 6, Pipe 210 - 211						1.06				0.00				0.00				0.00	14.26														
Contribution From STREET 3, Pipe 109 - 110						3.57				2.01				0.00				0.00	16.58														
			0.05	0.77	0.11	3.68			0.00	2.01			0.00	0.00			0.00	0.00															
	110	113	0.11	0.77	0.24	3.92			0.00	2.01			0.00	0.00			0.00	0.00	16.58	58.28	78.78	92.24	134.66	387	750	750	CONC	0.15	60.0	431.1703	0.9760	1.0246	0.897
To STREET 5, Pipe 113 - 114						3.92				2.01				0.00				0.00	17.60														
BLK 125 (FUT. DEVELOPMENT)																																	
	200	201			0.00	0.00	0.96	0.80	2.14	2.14			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	222	600	600	CONC	0.20	18.5	274.5943	0.9712	0.3175	0.810
To STREET 1, Pipe 201 - 203						0.00				2.14				0.00				0.00	10.32														
STREET 1																																	
					0.00	0.00	0.12	0.80	0.27	0.27			0.00	0.00			0.00	0.00															
					0.00	0.00	0.16	0.83	0.37	0.64			0.00	0.00			0.00	0.00															
	100	102			0.00	0.00	0.31	0.81	0.70	1.33			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	139	525	525	CONC	0.20	119.5	192.3297	0.8885	2.2417	0.723
To STREET 2, Pipe 102 - 103						0.00				1.33				0.00				0.00	12.24														
					0.00	0.00	0.06	0.90	0.15	0.15			0.00	0.00			0.00	0.00															
	101	102			0.00	0.00	0.15	0.81	0.34	0.49			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	51	450	450	CONC	0.20	21.5	127.5033	0.8017	0.4470	0.399
To STREET 2, Pipe 102 - 103						0.00				0.49				0.00				0.00	10.45														
	202	203			0.00	0.00	0.07	0.90	0.18	0.18			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	18	600	600	CONC	0.15	51.0	237.8056	0.8411	1.0106	0.077
To Unknown Road7 - 108, Pipe 203 - 204						0.00				0.18				0.00				0.00	11.01														
Contribution From BLK 125 (FUT. DEVELOPMENT), Pipe 20						0.00				2.14				0.00				0.00	10.32														
					0.00	0.00	0.05	0.83	0.12	2.25			0.00	0.00			0.00	0.00															
					0.00	0.00	0.07	0.80	0.16	2.41			0.00	0.00			0.00	0.00															
	201	203			0.00	0.00	0.27	0.90	0.68	3.08			0.00	0.00			0.00	0.00	10.32	75.61	102.55	120.20	175.71	316	675	675	CONC	0.20	54.5	375.9224	1.0505	0.8647	0.841
To STREET 1 TO STREET 8 STM SEWER, Pipe 203 - 204						0.00				3.08				0.00				0.00	11.18														
STREET 1 TO STREET 8 STM SEWER																																	
Contribution From STREET 1, Pipe 201 - 203						0.00				3.08				0.00				0.00	11.18														
Contribution From STREET 1, Pipe 202 - 203						0.00				0.18				0.00				0.00	11.01														
	203	204			0.00	0.00			0.00	3.26			0.00	0.00			0.00	0.00	11.18	72.55	98.34	115.25	168.43	320	750	750	CONC	0.15	25.5	431.1703	0.9760	0.4355	0.743
To STREET 8, Pipe 204 - 205						0.00				3.26				0.00				0.00	11.62														
STREET 8																																	
Contribution From STREET 1 TO STREET 8 STM SEWER, P						0.00				3.26				0.00				0.00	11.62														
			0.07	0.86	0.17	0.17			0.00	3.26			0.00	0.00			0.00	0.00															
			0.09	0.67	0.17	0.33			0.00	3.26			0.00	0.00			0.00	0.00															
			0.11	0.80	0.24	0.58			0.00	3.26			0.00	0.00			0.00	0.00															
	204	205	0.22	0.59	0.36	0.94			0.00	3.26			0.00	0.00			0.00	0.00	11.62	71.11	96.36	112.92	165.01	381	825	825	CONC	0.15	91.0	555.9418	1.0400	1.4583	0.685

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed: V.W.	PROJECT: BCDC WEST PH5&6
Checked: V.W.	LOCATION: City of Ottawa
Dwg. Reference:	File Ref: / Date: 05 May 2026 / Sheet No. SHEET 3 OF 4

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Manning 0.013

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Arterial Roads Return Frequency = 10 years

LICENSED PROFESSIONAL ENGINEER X. WEI 100531124 26-04-10 PROVINCE OF ONTARIO

LOCATION			AREA (Ha) 2 YEAR				5 YEAR				10 YEAR				100 YEAR				FLOW						SEWER DATA								
Location	From Node	To Node	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	Time of Conc. (min)	Intensity 2 Year (mm/h)	Intensity 5 Year (mm/h)	Intensity 10 Year (mm/h)	Intensity 100 Year (mm/h)	Peak Flow Q (l/s)	DIA. (mm) (actual)	DIA. (mm) (nominal)	TYPE	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME OF FLOW (min.)	RATIO Q/Q full
			0.02	0.80	0.04	0.98			0.00	3.26			0.00	0.00			0.00	0.00															
			0.06	0.67	0.11	1.10			0.00	3.26			0.00	0.00			0.00	0.00															
	205	210	0.12	0.59	0.20	1.29			0.00	3.26			0.00	0.00			0.00	0.00	13.08	66.72	90.34	105.83	154.60	381	825	825	CONC	0.15	77.0	555.9418	1.0400	1.2340	0.684
To STREET 6, Pipe 210 - 211						1.29				3.26				0.00				0.00	14.31														
STREET 6																																	
	225	226	0.12	0.77	0.26	0.26			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	20	375	375	PVC	0.30	65.5	96.0323	0.8695	1.2555	0.205
			0.23	0.50	0.32	0.58			0.00	0.00			0.00	0.00			0.00	0.00															
	226	227	0.27	0.77	0.58	1.15			0.00	0.00			0.00	0.00			0.00	0.00	11.26	72.30	98.00	114.85	167.84	83	375	375	PVC	0.35	66.0	103.7267	0.9392	1.1713	0.805
	227	228			0.00	1.15			0.00	0.00			0.00	0.00			0.00	0.00	12.43	68.59	92.91	108.86	159.05	79	600	600	CONC	0.15	11.0	237.8056	0.8411	0.2180	0.333
To STM OUTLET 2, Pipe 228 - 229						1.15				0.00				0.00				0.00	12.64														
Contribution From STREET 8, Pipe 205 - 210						1.29				3.26				0.00				0.00	14.31														
Contribution From STREET 4, Pipe 209 - 210						1.06				0.00				0.00				0.00	14.26														
			0.05	0.59	0.08	2.44			0.00	3.26			0.00	0.00			0.00	0.00															
	210	211	0.05	0.80	0.11	2.55			0.00	3.26			0.00	0.00			0.00	0.00	14.31	63.45	85.85	100.55	146.86	441	825	825	CONC	0.20	91.0	641.9463	1.2009	1.2630	0.687
			0.21	0.80	0.47	3.01			0.00	3.26			0.00	0.00			0.00	0.00															
	211	212	0.22	0.59	0.36	3.38			0.00	3.26			0.00	0.00			0.00	0.00	15.57	60.45	81.75	95.73	139.78	470	825	825	CONC	0.20	82.5	641.9463	1.2009	1.1450	0.733
To LANE 1, Pipe 212 - 217						3.38				3.26				0.00				0.00	16.72														
Contribution From LANE 1, Pipe 212 - 217						3.38				3.26				0.00				0.00	16.80														
Contribution From LANE 1, Pipe 216 - 217						1.11				0.00				0.00				0.00	14.19														
			0.04	0.52	0.06	4.54			0.00	3.26			0.00	0.00			0.00	0.00															
			0.04	0.59	0.07	4.61			0.00	3.26			0.00	0.00			0.00	0.00															
			0.04	0.77	0.09	4.69			0.00	3.26			0.00	0.00			0.00	0.00															
	217	224	0.05	0.80	0.11	4.81			0.00	3.26			0.00	0.00			0.00	0.00	16.80	57.82	78.16	91.50	133.58	532	900	900	CONC	0.15	62.5	701.1305	1.1021	0.9452	0.759
Contribution From STREET 7, Pipe 223 - 224						6.43				0.00				0.00				0.00	17.03														
			0.08	0.50	0.11	11.35			0.00	3.26			0.00	0.00			0.00	0.00															
	224	228	0.20	0.77	0.43	11.78			0.00	3.26			0.00	0.00			0.00	0.00	17.75	55.96	75.62	88.52	129.20	905	975	975	CONC	0.25	50.5	1120.5266	1.5008	0.5608	0.808
To STM OUTLET 2, Pipe 228 - 229						11.78				3.26				0.00				0.00	18.31														
STM OUTLET 2																																	
Contribution From STREET 6, Pipe 224 - 228						11.78				3.26				0.00				0.00	18.31														
Contribution From STREET 6, Pipe 227 - 228						1.15				0.00				0.00				0.00	12.64														
	228	229			0.00	12.93			0.00	3.26			0.00	0.00			0.00	0.00	18.31	54.92	74.20	86.85	126.76	952	975	975	CONC	0.30	4.5	1227.4754	1.6440	0.0456	0.775
	229	HW2			0.00	12.93			0.00	3.26			0.00	0.00			0.00	0.00	18.35	54.84	74.09	86.72	126.56	950	1050	1050	CONC	0.20	12.5	1221.2174	1.4103	0.1477	0.778
Borrisokane Road																																	
					0.00	0.00			0.00	0.00	0.06	0.66	0.11	0.11			0.00	0.00															
					0.00	0.00			0.00	0.00	0.08	0.90	0.20	0.31			0.00	0.00															
	8001	800			0.00	0.00			0.00	0.00	2.52	0.80	5.60	5.92			0.00	0.00	10.00	76.81	104.19	122.14	178.56	722	1200	1200	CONC	0.10	90.0	1232.8868	1.0901	1.3760	0.586
	800	801			0.00	0.00			0.00	0.00			0.00	5.92			0.00	0.00	11.38	71.90	97.45	114.20	166.89	675	1200	1200	CONC	0.10	68.5	1232.8868	1.0901	1.0473	0.548
					0.00	0.00			0.00	0.00	0.11	0.66	0.20	6.12			0.00	0.00															
					0.00	0.00			0.00	0.00	0.12	0.65	0.22	6.33			0.00	0.00															
	801	802			0.00	0.00			0.00	0.00	0.39	0.80	0.87	7.20			0.00	0.00	12.42	68.60	92.93	108.87	159.07	784	1200	1200	CONC	0.10	70.0	1232.8868	1.0901	1.0702	0.636
					0.00	0.00			0.00	0.00	0.03	0.80	0.07	7.27			0.00	0.00															
					0.00	0.00			0.00	0.00	0.05	0.66	0.09	7.36			0.00	0.00															
					0.00	0.00			0.00	0.00	0.10	0.77	0.21	7.57			0.00	0.00															
	802	803			0.00	0.00			0.00	0.00	0.26	0.80	0.58	8.15			0.00	0.00	13.49	65.57	88.76	103.98	151.88	848	1200	1200	CONC	0.10	70.0	1232.8868	1.0901	1.0702	0.687
					0.00	0.00			0.00	0.00	0.11	0.66	0.20	8.35			0.00	0.00															
	803	804			0.00	0.00			0.00	0.00	0.51	0.80	1.13	9.49			0.00	0.00	14.56	62.82	84.99	99.54	145.37	944	1200	1200	CONC	0.10	70.0	1232.8868	1.0901	1.0702	0.766
	804	805			0.00	0.00			0.00	0.00			0.00	9.49			0.00	0.00	15.63	60.31	81.56	95.51	139.45	906	1200	1200	CONC	0.10	70.0	1232.8868	1.0901	1.0702	0.735
To STM OUTLET 8, Pipe 805 - 806						0.00				0.00				9.49				0.00	16.70														
STM OUTLET 8																																	
Contribution From Borrisokane Road, Pipe 804 - 805						0.00				0.00				9.49				0.00	16.70														
					0.00	0.00			0.00	0.00	0.01	0.66	0.02	9.51			0.00	0.00															
	805	806			0.00	0.00			0.00	0.00	0.18	0.80	0.40	9.91			0.00	0.00	16.70	58.02	78.43	91.82	134.04	910	1200	1200	CONC	0.10	17.5	1232.8868	1.0901	0.2676	0.738
	806	HW8			0.00	0.00			0.00	0.00			0.00	9.91			0.00	0.00	16.97	57.47	77.68	90.95	132.76	901	1200	1200	CONC	0.10	18.5	1232.8868	1.0901	0.2828	0.731

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed: V.W.	PROJECT: BCDC WEST PH5&6		
Checked: V.W.	LOCATION: City of Ottawa		
Dwg. Reference:	File Ref:	Date: 05 May 2026	Sheet No. SHEET 4 OF 4

Project Name:	BCDC West
Project Number:	1527
Designed By:	LH
Checked By:	VM
Date	2026-05-04

David Schaeffer Engineering Limited
600 Alden Road, Suite 606
Markham, ON L3R 0E7

HGL Analysis Table

MH ID	HGL [1] (from PCSWMM Model)		MH RIM	Freeboard (RIM - HGL)	
	100-year	5-year		100-year	5-year
	(m)	(m)	(m)	(m)	(m)
MH-220	92.74	92.66	92.96	0.22	0.30
MH-602	93.14	92.96	93.22	0.08	0.26
MH-603	93.10	92.95	93.23	0.13	0.28
MH-604	93.10	92.94	93.80	0.70	0.86
MH-605	93.10	92.93	93.64	0.54	0.71
MH-606	93.08	92.92	93.24	0.16	0.32
MH-608	93.10	92.93	93.21	0.11	0.28
MH-612	93.00	92.86	93.05	0.05	0.19
MH-613	92.87	92.79	92.94	0.07	0.15
MH-614	92.90	92.79	92.97	0.07	0.18
MH-616	92.91	92.80	93.06	0.15	0.26
MH-617	92.97	92.92	92.99	0.02	0.07
MH-620	92.84	92.72	93.02	0.17	0.30
MH-221	92.72	92.65	93.00	0.28	0.35
			Min=	**0.02**	**0.07**

Project Name:	BCDC West
Project Number:	1226
Designed By:	LH
Checked By:	VM
Date	2026-05-04

DSEL
David Schaeffer Engineering Limited
600 Alden Road, Suite 606
Markham, ON L3R 0E7

Overland Flow Depth Analysis - 3hr Chicago Storm

Major System Node ID	Connected CB ID	Max Flow Depth			
		2-Year	5-Year	100-Year	100-Year+20%
		(m)	(m)	(m)	(m)
Streets Adjacent to Block 122 (2yr Catchbasins)					
LP035	CB_25	0.03	0.04	0.15	0.19
LP035	CB_26	0.03	0.04	0.15	0.19
LP016	CB_43 CB_44	0.02	0.03	0.11	0.14
LP015	CB_45 CB_46	0.03	0.03	0.11	0.14
LP010	CB_65 CB_66	0.04	0.12	0.20	0.25
LP009	CB_67 CB_68	0.02	0.08	0.16	0.22
LP038	CB_69 CB_70	0.02	0.08	0.19	0.25
LP036	CB_71 CB_72	0.03	0.07	0.19	0.22
LP013	CB_75 CB_76	0.04	0.08	0.18	0.23

Major System Node ID	Connected CB ID	Max Flow Depth			
		2-Year	5-Year	100-Year	100-Year+20%
		(m)	(m)	(m)	(m)
Block-122 Catch Basins					
J048	CB_1	0.01	0.04	0.07	0.09
LP020	CB_10 CB_11	0.02	0.02	0.13	0.18
LP021	CB_12 CB_13	0.02	0.03	0.18	0.22
LP017	CB_14 CB_15	0.02	0.02	0.12	0.20
LP016	CB_16 CB_17	0.02	0.02	0.10	0.15
LP015	CB_18 CB_19	0.03	0.04	0.16	0.19
LP010	CB_2	0.02	0.02	0.11	0.13
J027	CB_21 CB_22	0.01	0.02	0.04	0.08
LP005	CB_24 CB_25	0.04	0.05	0.21	0.26
LP007	CB_26 CB_27	0.02	0.03	0.17	0.20
LP009	CB_28	0.03	0.07	0.20	0.24
LP002	CB_29	0.04	0.05	0.12	0.16
LP010	CB_3	0.02	0.02	0.11	0.13
LP001	CB_30	0.04	0.05	0.12	0.15
J002	CB_31	0.02	0.02	0.03	0.06
LP003	CB_32 CB_33	0.02	0.03	0.14	0.19
J058	CB_34	0.01	0.02	0.02	0.07
LP013	CB_4 CB_5	0.02	0.02	0.06	0.11
J055	CB_6 CB_7	0.02	0.03	0.14	0.19
J053	CB_8	0.02	0.03	0.12	0.17
LP018	CB_9	0.04	0.08	0.17	0.22
	Max=	**0.04**	**0.08**	**0.21**	**0.26**

Project Name:	Conservancy West - Phase 6 Site Plan
Client:	Barrhaven Conservancy Development Corporation
Project Number:	21-1527
Date:	2026-05-04

StormTech Isolator Row Plus Models

Chamber Model	Chamber Storage	Chamber Footprint	Treatment Flowrate for >81% TSS Removal
SC-160LP	0.42 m^3	1.06 m^2	3.11 L/s
SC-310	0.88 m^3	1.64 m^2	4.53 L/s
DC-780	2.22 m^3	2.58 m^2	7.36 L/s
SC-800	2.29 m^3	2.54 m^2	7.1 L/s
MC-3500	4.96 m^3	3.99 m^2	11.32 L/s
MC-4500	4.60 m^3	2.80 m^2	7.93 L/s
MC-7200	7.57 m^3	4.65 m^2	12.74 L/s

Isolator Row PLUS removal efficiency is based on a verified ETV test report. For more information, including design manual, please refer to the ADS official website.

Treatment Required	
Tributary Area:	1.78 ha
Weighted Runoff Coefficient:	0.80
Flowrate Requiring Treatment 25mm Event from PCSWMM	**208.00 L/s**

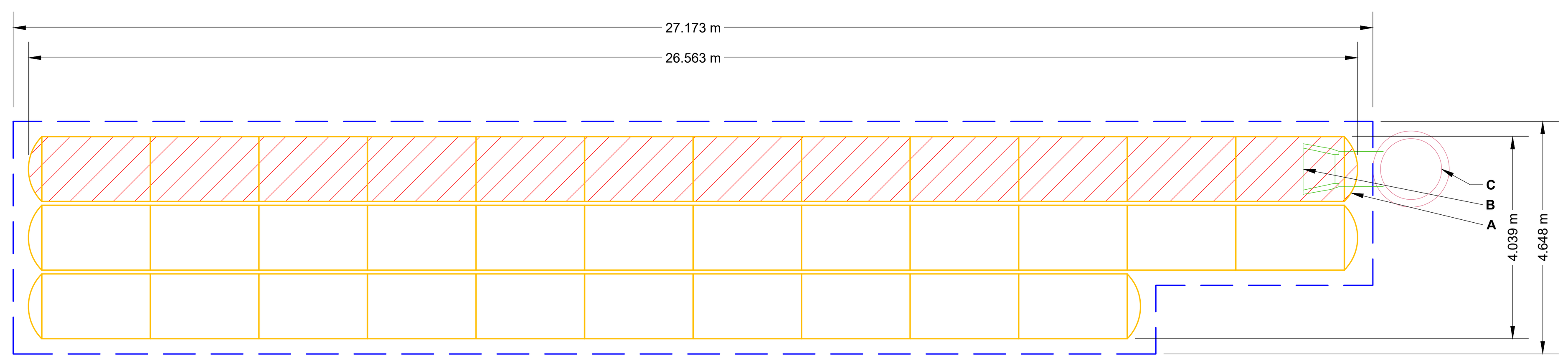
StormTech Isolator Row Sizing	
Chamber Model:	SC-800
Treatment Flowrate /Chamber:	7.10 L/s
Number Chambers Required:	30
Number Chambers Proposed:	**34**
Treatment Rate Provided:	**241.40 L/s**
TSS Removal Achieved:	**>81 %**

PROPOSED LAYOUT	
34	STORMTECH SC-800 CHAMBERS
6	STORMTECH SC-800 END CAPS
152	STONE ABOVE (mm)
152	STONE BELOW (mm)
40	STONE VOID
84.6	INSTALLED SYSTEM VOLUME (m³) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)
120.4	SYSTEM AREA (m²)
63.6	SYSTEM PERIMETER (m)

CONCEPTUAL ELEVATIONS	
MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	3.429
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	1.524
MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	1.372
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	1.372
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	1.372
TOP OF STONE:	1.143
TOP OF SC-800 CHAMBER:	0.991
600 mm ISOLATOR ROW PLUS INVERT:	0.211
BOTTOM OF SC-800 CHAMBER:	0.152
BOTTOM OF STONE:	0.000

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED EZ END CAP	A	600 mm BOTTOM PREFABRICATED EZ END CAP, PART#: SC800ECEZ / TYP OF ALL 600 mm BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS		
FLAMP	B	INSTALL FLAMP ON 600 mm ACCESS PIPE / PART#: SC80024RAMP		
CONCRETE STRUCTURE	C	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		



ISOLATOR ROW PLUS (SEE DETAIL)

NO WOVEN GEOTEXTILE

BED LIMITS

NOTES

- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- **NOT FOR CONSTRUCTION**: THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

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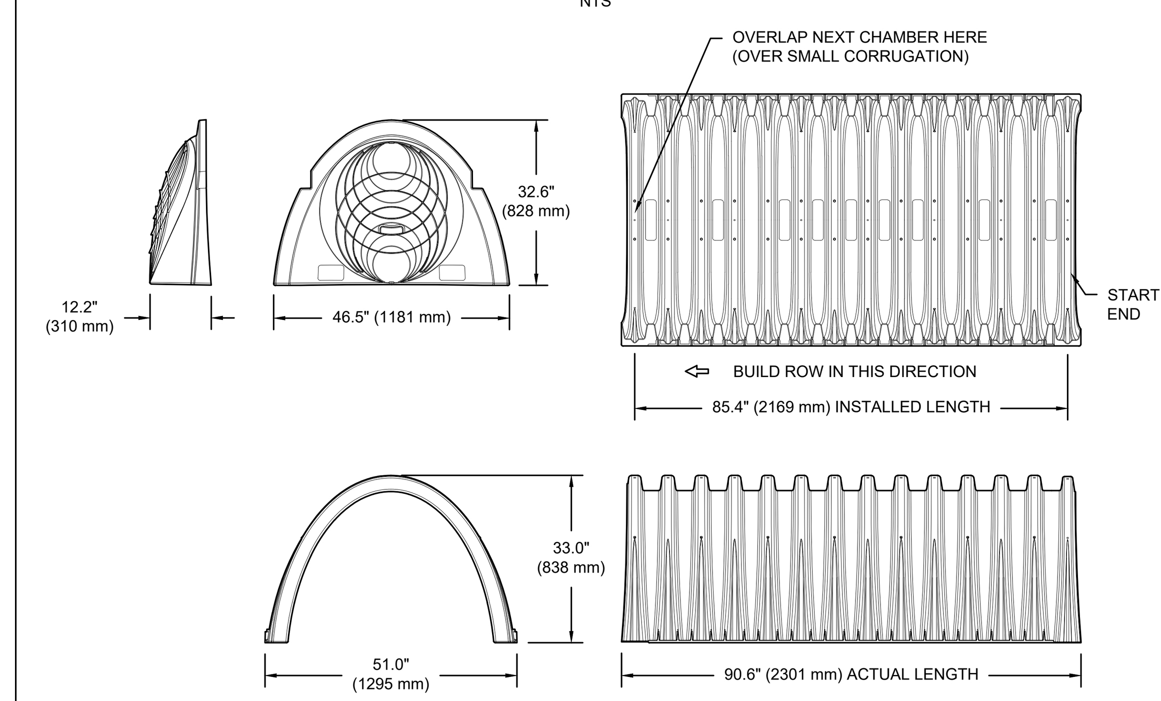
SC-800 TECHNICAL SPECIFICATION

NTS



NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	51.0" X 33.0" X 85.4"	(1295 mm X 838 mm X 2169 mm)
CHAMBER STORAGE	50.6 CUBIC FEET	(1.43 m³)
MINIMUM INSTALLED STORAGE*	78.4 CUBIC FEET	(2.22 m³)
WEIGHT	81.8 lbs.	(37.1 kg)

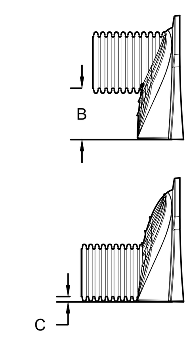
NOMINAL END CAP SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	46.5" X 32.6" X 10.5"	(1181 mm X 828 mm X 267 mm)
END CAP STORAGE	3.4 CUBIC FEET	(0.09 m³)
MINIMUM INSTALLED STORAGE**	14.7 CUBIC FEET	(0.42 m³)
WEIGHT	15.7 lbs.	(7.1 kg)

* ASSUMES 6" (150 mm) STONE ABOVE, BELOW, AND BETWEEN CHAMBERS, 3" (75 mm) BETWEEN CHAMBERS
**ASSUMES 6" (150 mm) STONE ABOVE AND BELOW END CAPS, 3" (150 mm) BETWEEN ROWS, 12" (300 mm) BEYOND END CAPS

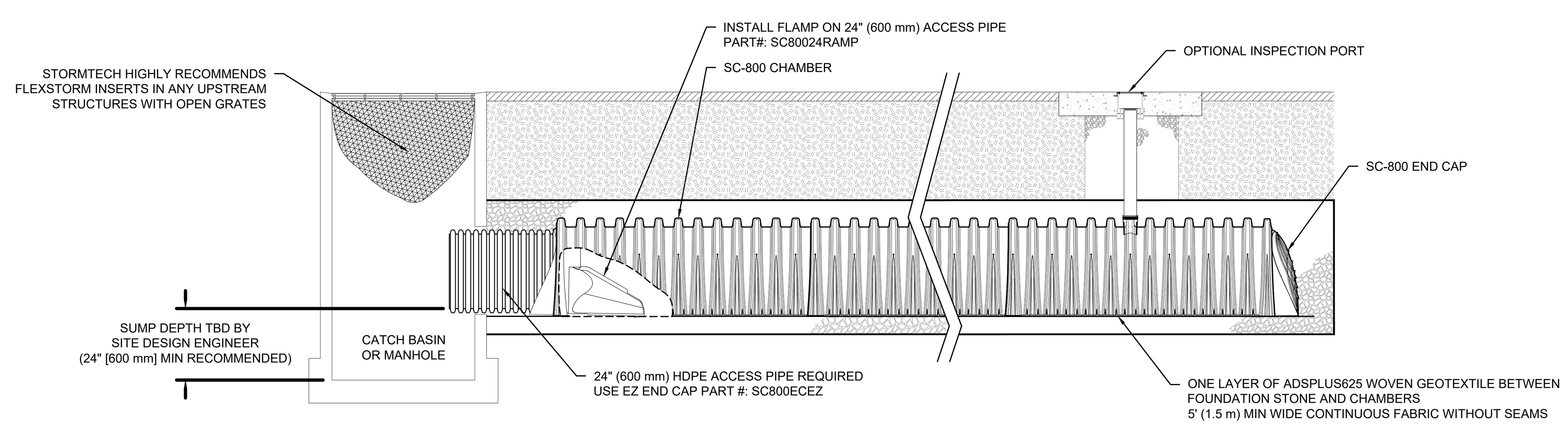
PRE-CORED HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "BPC"
PRE-CORED HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "TPC"

PART #	STUB	B	C
SC800EPE06TPC	6" (150 mm)	21.4" (544 mm)	---
SC800EPE06BPC		---	0.9" (23 mm)
SC800EPE08TPC	8" (200 mm)	19.2" (488 mm)	---
SC800EPE08BPC		---	1.0" (25 mm)
SC800EPE10TPC	10" (250 mm)	17.0" (432 mm)	---
SC800EPE10BPC		---	1.2" (30 mm)
SC800EPE12TPC	12" (300 mm)	14.4" (366 mm)	---
SC800EPE12BPC		---	1.6" (41 mm)
SC800EPE15TPC	15" (375 mm)	11.3" (287 mm)	---
SC800EPE15BPC		---	1.7" (43 mm)
SC800EPE18TPC	18" (450 mm)	8.0" (203 mm)	---
SC800EPE18BPC		---	2.0" (51 mm)
SC800EPE24BPC	24" (600 mm)	---	2.3" (58 mm)
SC800EPE	NONE	SOLID END CAP	



NOTE: ALL DIMENSIONS ARE NOMINAL

2 SC-800 TECHNICAL SPECIFICATION



SC-800 ISOLATOR ROW PLUS DETAIL

NTS

3 SC-800 ISOLATOR ROW PLUS DETAIL

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INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

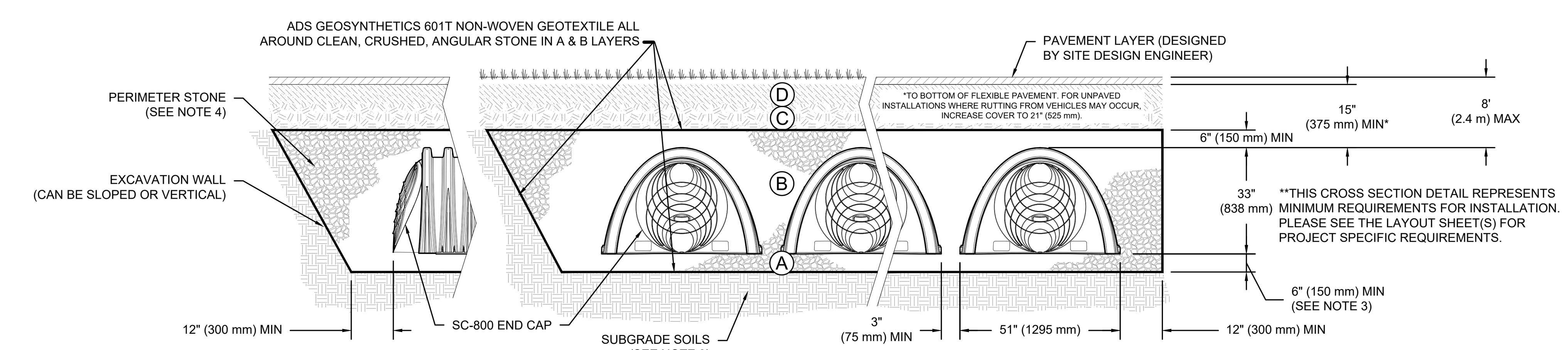
NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

ACCEPTABLE FILL MATERIALS: STORMTECH SC-800 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER.	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 15" (375 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 12" (300 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 6" (150 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS. ROLLER GROSS VEHICLE WEIGHT NOT TO EXCEED 12,000 lbs (53 kN). DYNAMIC FORCE NOT TO EXCEED 20,000 lbs (89 kN).
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE[5]	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE[5]	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 6" (150 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.
5. WHERE RECYCLED CONCRETE AGGREGATE IS USED IN LAYERS 'A' OR 'B' THE MATERIAL SHOULD ALSO MEET THE ACCEPTABILITY CRITERIA OUTLINED IN TECHNICAL NOTE 6.20 "RECYCLED CONCRETE STRUCTURAL BACKFILL".



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. SC-800 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS. REFERENCE STORMTECH DESIGN MANUAL FOR BEARING CAPACITY GUIDANCE.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 2".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 700 LBS/FT/%. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

1 SC-800 CROSS SECTION DETAIL

DATE: 05/01/2026
PROJECT #:
NOT TO SCALE
DRAWN: AS
CHECKED: N/A
REV:

CW
OTTAWA, AK, USA

StormTech® Chamber System

WWW.ADSPIPE.COM

ADS

Version 1.1

Project: **26-1527**

Chamber Model -	SC-800	
Units -	**Metric**	
Number of Chambers -	34	
Number of End Caps -	6	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	0.00	m
Amount of Stone Above Chambers -	152	mm
Amount of Stone Below Chambers -	152	mm

Area of System- 120.3547271 sq.meters Min. Area - 105.88 sq.meters

StormTech SC-800 Cumulative Storage Volumes

Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Single End Cap *(cubic meters)*	Incremental Chambers *(cubic meters)*	Incremental End Cap *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Ch, EC and Stone *(cubic meters)*	Cumulative System *(cubic*	Elevation *(meters)*
1143	0.000	0.000	0.00	0.00	1.22	1.22	84.62	1.14
1118	0.000	0.000	0.00	0.00	1.22	1.22	83.40	1.12
1092	0.000	0.000	0.00	0.00	1.22	1.22	82.17	1.09
1067	0.000	0.000	0.00	0.00	1.22	1.22	80.95	1.07
1041	0.000	0.000	0.00	0.00	1.22	1.22	79.73	1.04
1016	0.000	0.000	0.00	0.00	1.22	1.22	78.50	1.02
991	0.002	0.000	0.07	0.00	1.19	1.27	77.28	0.99
965	0.006	0.000	0.19	0.00	1.15	1.34	76.02	0.97
940	0.008	0.000	0.27	0.00	1.11	1.39	74.68	0.94
914	0.014	0.000	0.49	0.00	1.03	1.52	73.29	0.91
889	0.021	0.000	0.71	0.00	0.94	1.65	71.78	0.89
864	0.025	0.001	0.86	0.00	0.88	1.74	70.12	0.86
838	0.029	0.001	0.98	0.01	0.83	1.81	68.38	0.84
813	0.032	0.001	1.08	0.01	0.79	1.87	66.57	0.81
787	0.034	0.001	1.17	0.01	0.75	1.93	64.70	0.79
762	0.037	0.002	1.25	0.01	0.72	1.98	62.77	0.76
737	0.039	0.002	1.32	0.01	0.69	2.02	60.79	0.74
711	0.041	0.002	1.39	0.01	0.66	2.06	58.77	0.71
686	0.043	0.002	1.45	0.01	0.64	2.10	56.70	0.69
660	0.044	0.003	1.51	0.02	0.61	2.14	54.60	0.66
635	0.046	0.003	1.56	0.02	0.59	2.17	52.46	0.64
610	0.047	0.003	1.61	0.02	0.57	2.20	50.29	0.61
584	0.049	0.003	1.66	0.02	0.55	2.23	48.09	0.58
559	0.050	0.004	1.70	0.02	0.53	2.26	45.86	0.56
533	0.051	0.004	1.74	0.02	0.52	2.28	43.61	0.53
508	0.052	0.004	1.78	0.02	0.50	2.31	41.32	0.51
483	0.054	0.004	1.82	0.02	0.48	2.33	39.02	0.48
457	0.055	0.004	1.86	0.02	0.47	2.35	36.69	0.46
432	0.056	0.004	1.89	0.03	0.46	2.37	34.34	0.43
406	0.057	0.004	1.92	0.03	0.44	2.39	31.96	0.41
381	0.057	0.005	1.95	0.03	0.43	2.41	29.57	0.38
356	0.058	0.005	1.98	0.03	0.42	2.43	27.16	0.36
330	0.059	0.005	2.01	0.03	0.41	2.44	24.73	0.33
305	0.060	0.005	2.03	0.03	0.40	2.46	22.29	0.30
279	0.060	0.005	2.05	0.03	0.39	2.47	19.83	0.28
254	0.061	0.005	2.08	0.03	0.38	2.49	17.36	0.25
229	0.062	0.005	2.10	0.03	0.37	2.50	14.87	0.23
203	0.062	0.005	2.12	0.03	0.36	2.51	12.37	0.20
178	0.063	0.004	2.14	0.02	0.36	2.52	9.86	0.18
152	0.000	0.000	0.00	0.00	1.22	1.22	7.34	0.15
127	0.000	0.000	0.00	0.00	1.22	1.22	6.11	0.13
102	0.000	0.000	0.00	0.00	1.22	1.22	4.89	0.10
76	0.000	0.000	0.00	0.00	1.22	1.22	3.67	0.08
51	0.000	0.000	0.00	0.00	1.22	1.22	2.45	0.05
25	0.000	0.000	0.00	0.00	1.22	1.22	1.22	0.03

David Schaeffer Engineering Ltd.
120 Iber Road, Suite 103
Stittsville, ON K2S 1E9
613-836-0856
dsel.ca

APPENDIX E

Geotechnical

memorandum

re: **Geotechnical Review – Groundwater Infiltration**
Proposed Residential Development – Conservancy Lands East and West
Borrisokane Road – Ottawa, Ontario

to: Caivan Communities – **Hugo Lalonde** – hugo.lalonde@caivan.com

date: June 16, 2025

file: PG5036-MEMO.42 Revision 1

Further to your request and authorization, Paterson Group (Paterson) prepared the current memorandum to provide a geotechnical review and recommendations with respect to management of groundwater infiltration into the sump pits of townhouse blocks and back-to-back style residential dwellings. This memorandum should be read in conjunction with the Sump Pump Feasibility Report (Paterson Group Report PG5036-LET.01 Revision 3 dated September 5, 2022).

Geotechnical Review & Recommendations

The subject residential development consists of single-family homes, townhouse blocks and back-to-back style residential buildings. Buildings which include a basement level will use sump pump(s) to provide an outlet for stormwater and spring melt water collected from the perimeter foundation drainage system.

Based on the geotechnical investigation completed by others, the subsurface profile at the subject site generally consists of topsoil underlain by a very stiff to stiff, brown silty clay crust, becoming firm to stiff and grey in colour by approximate depths of 2.5 to 3.0 m below the existing ground surface. The silty clay deposit generally extended to the maximum depth of the boreholes. The long-term groundwater elevation at the subject site is expected at an approximate geodetic elevation ranging from 88.3 to 90.0 m.

Hydraulic conductivity (slug) testing was completed by Paterson and by others at select monitoring wells installed during the geotechnical investigation, by others. Based on the results of the slug testing, the silty clay within the subject site has a hydraulic conductivity ranging from 5.0×10^{-8} and 2.0×10^{-5} m/sec.

It is understood that the proposed townhouse blocks may consist of up to 12 units, with an approximate building footprint of 720 m^2. From the hydraulic conductivity of the in-situ soils and the sizing of the building footprint, sump pumps for the proposed townhouse blocks should be sized to handle an approximate volume of up to 200,000 L/day.

As such, it is recommended that the proposed townhouse blocks be outfitted with a minimum of 4 sump pumps to effectively drain this volume of water. The location(s) of the sump pump(s) should be evenly distributed across each building footprint.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
June 16, 2025
K. A. PICKARD
100531344
PROVINCE OF ONTARIO

Kevin A. Pickard, P.Eng. Scott S. Dennis, P.Eng.

Geotechnical Investigation

Proposed Residential Development

Conservancy Lands West
Ottawa, Ontario

Prepared for Caivan Communities

Report PG5036-2 Revision 3, dated March 14, 2024

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Caivan Communities to prepare a geotechnical report for the proposed residential development to be located at the Conservancy Lands West, along Borrisokane Road in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2). The objective of the geotechnical investigation was to:

- ❑ Review available subsurface soil and groundwater information prepared by others.
- ❑ Provide geotechnical recommendations pertaining to the design of the proposed development including construction considerations which may affect its design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. The report contains the geotechnical findings and includes recommendations pertaining to the design and construction of the subject development as understood at the time of writing this report.

2.0 Proposed Development

It is understood that the proposed residential development will consist of single-family dwellings and townhouses with associated driveways, local roadways, landscaping areas, and park lands.

It is further anticipated that the proposed development will be serviced by future municipal water, sanitary and storm services.

3.0 Method of Investigation

3.1 Field Investigation

A geotechnical investigation was previously completed by others at the subject site during the periods of January 31 through March 31, 2017, and November 5 through 9, 2018. The geotechnical investigation consisted of 47 boreholes advanced to a maximum depth of 9.1 m below the existing ground surface. The locations of the boreholes are shown on Drawing PG5036-4 - Test Hole Location Plan included in Appendix 2.

The boreholes were advanced using a track-mounted auger drill rig operated by a two-person crew. The drilling procedure consisted of augering to the required depths and sampling the overburden soils.

Reference should be made to the Soil Profile and Test Data sheets, prepared by others, which are presented in Appendix 1 for specific details of the soil profile encountered at the test hole locations.

Groundwater

Groundwater monitoring wells and standpipes were installed in 37 boreholes by others to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. All groundwater observations by others are noted on the Soil Profile and Test Data sheets presented in Appendix 1.

3.2 Field Survey

The ground surface elevations at the borehole locations were surveyed by others and are understood to be referenced to a geodetic datum. The locations of the boreholes and the ground surface elevation for each borehole location are presented on Drawing PG5036-4 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

A total of 14 Shelby tube samples collected from the boreholes during the geotechnical investigation were submitted for unidimensional consolidation testing by others. The results of the consolidation testing are summarized in Section 5.3.

A total of 47 representative soil samples were submitted for Atterberg limit testing by others from the geotechnical investigation. The results of the Atterberg testing are presented in Section 4.2 and are discussed in Section 6.7.

4.0 Observations

4.1 Surface Conditions

Generally, the subject site consists of agricultural fields and is bordered by Highway 416 to the west, a railroad to the northwest, a stormwater retention pond to the northeast, vacant City Lands to the southeast, and the Jock River to the southwest. Foster Drain runs in a north-south direction across the east portion of the site. The existing ground surface across the site is relatively level at approximate geodetic elevation 91 to 92 m.

4.2 Subsurface Profile

Overburden

The subsurface profile encountered at the borehole locations generally consisted of an approximate 50 to 360 mm thick layer of topsoil underlain by a silty clay deposit.

The silty clay deposit was generally observed to have a very stiff to stiff, brown silty clay crust, becoming a firm to stiff, grey silty clay at approximate depths of 2.5 to 3 m below the existing ground surface. The silty clay deposit generally extended beyond the bottom of the boreholes at depths of up to 9 m.

However, near the western boundary of the site, a glacial till deposit was encountered underlying the silty clay at depths varying from 1.5 to 7.5 m below the existing ground surface. The glacial till was generally observed to consist of a loose to compact, grey silty clay to silty sand with some gravel, cobbles and boulders.

Laboratory Testing

Atterberg limit testing, as well as associated moisture content testing, was completed by others on recovered silty clay samples at selected locations throughout the subject site.

The results of the Atterberg limit tests are presented in Table 1 on the following page.

Table 1 - Atterberg Limits Results

Borehole Number	Depth (m)	LL (%)	PL (%)	PI (%)	w (%)
BH 17-01	1.5	42	15	28	32
BH 17-02	0.8	53	16	37	35
BH 17-03	0.8	67	22	44	43
BH 17-04	0.8	68	23	45	33
BH 17-05	0.8	42	19	22	31
BH 17-06	0.8	62	22	41	40
BH 17-07	0.8	50	16	34	30
BH 17-08	0.8	45	19	26	35
BH 17-10	1.5	27	17	10	27
BH 17-09	1.5	43	19	24	35
BH 17-16	0.8	66	22	44	42
BH 17-17	1.5	42	17	25	34
BH 17-18	1.5	38	15	23	37
BH 17-19	0.8	67	21	46	41
BH 17-20	0.6	52	17	35	32
BH 17-21	0.8	40	20	20	33
BH 17-22	0.8	35	20	15	32
BH 17-23	1.5	44	16	28	37
BH 17-24	0.8	56	17	39	46
BH 17-25	1.4	30	17	13	33
BH 17-26	0.8	60	18	42	37
BH 17-27	0.8	61	21	40	44
BH 17-28	0.8	54	21	33	38
BH 17-29	0.8	37	19	18	31
BH 17-30	0.6	43	16	27	32
BH 17-31	0.8	53	16	46	40
BH 17-32	0.8	43	16	27	32
BH 17-33	0.8	58	17	41	36
BH 17-34	0.8	59	17	42	39
BH 17-35	0.6	47	20	27	36
BH 17-36	0.8	53	17	36	35

Table 1 - Atterberg Limits Results

Borehole Number	Depth (m)	LL (%)	PL (%)	PI (%)	w (%)
BH 17-37	0.8	36	19	17	33
BH 17-38	0.5	46	16	30	32
BH 18-01	0.8	51	21	30	59
BH 18-02	1.5	36	16	20	45
BH 18-03	0.7	66	26	40	50
BH 18-04	1.5	35	17	18	37
BH 18-05	0.8	56	23	33	39
BH 18-06	0.8	64	26	28	46
BH 18-07	0.8	42	21	21	30
BH 18-08	1.5	54	21	33	45
BH 18-09	0.8	55	22	33	40
BH 18-10	1.5	35	16	19	33
BH 18-11	0.8	30	19	11	29
BH 18-12	1.5	47	20	27	37
BH 18-13	0.8	31	18	13	30
BH 18-14	1.5	38	18	20	33

Notes: LL: Liquid Limit; PL: Plastic Limit; PI: Plasticity Index; w: water content;

The results of the shrinkage limit test indicate a shrinkage limit of 17.7% and a shrinkage ratio of 1.85.

Bedrock

Based on available geological mapping, bedrock in the area consists of interbedded limestone and dolomite of the Gull River formation with overburden drift thicknesses ranging between 5 and 15 m.

4.3 Groundwater

Groundwater levels (GWL) were measured by others in 37 boreholes following completion of the geotechnical investigation. The measured GWL readings are presented in Table 2 on the following page. It should be noted that surface water can become trapped within a backfilled borehole, which can lead to higher than normal groundwater level readings. It should be noted that long-term groundwater levels within a silty clay deposit can also be estimated based on the observed colour, moisture levels and consistency of the recovered soil samples.

Based on these observations, the long-term groundwater level is expected between a 2 to 3 m depth.

However, it should be noted that the groundwater levels can fluctuate periodically throughout the year and higher levels could be encountered at the time of construction.

Table 2 – Summary of Groundwater Level Readings

Borehole Number	Ground Elevation (m)	Measured Groundwater Level (m)		Recording Date
		Depth	Elevation	
BH 17-01	91.76	0.69	91.07	February 21, 2017
BH 17-05	91.12	1.22	89.90	February 21, 2017
BH 17-09	90.87	0.81	90.06	February 21, 2017
BH 17-16	91.27	0.93	90.34	April 13, 2017
BH 17-17A	91.82	0.61	91.21	March 31, 2017
BH 17-18A	91.40	0.45	90.95	March 31, 2017
BH 17-19	91.24	1.35	89.89	April 13, 2017
BH 17-20A	91.03	0.66	90.37	March 31, 2017
BH 17-22	91.36	0.37	90.99	April 13, 2017
BH 17-23	91.41	0.06	91.36	April 13, 2017
BH 17-24	90.90	0.31	90.59	April 13, 2017
BH 17-25A	91.09	0.01	91.08	March 31, 2017
BH 17-26	91.54	0.26	91.28	March 31, 2017
BH 17-28A	91.10	0.32	90.78	March 31, 2017
BH 17-30	90.92	0.46	90.46	April 13, 2017
BH 17-32A	91.05	0.42	90.63	March 31, 2017
BH 17-33	91.53	0.45	91.08	April 13, 2017
BH 17-35	91.04	0.54	90.50	April 13, 2017
BH 17-36A	91.35	0.62	90.73	March 31, 2017
BH 17-38A	91.24	0.61	90.63	March 31, 2017
BH 18-01	92.12	-0.19	92.31	April 30, 2019
BH 18-02	91.65	0.46	91.19	April 30, 2019
BH 18-03	91.32	0.22	91.09	April 30, 2019
BH 18-04A	91.28	0.06	91.22	April 30, 2019

Table 2 – Summary of Groundwater Level Readings				
Borehole Number	**Ground Elevation (m)**	**Measured Groundwater Level (m)**		**Recording Date**
		Depth	**Elevation**	
BH 18-04B	91.28	0.22	91.06	April 30, 2019
BH 18-05	91.29	0.19	91.10	April 30, 2019
BH 18-06	91.25	0.18	91.07	April 30, 2019
BH 18-07A	91.43	0.51	90.92	April 30, 2019
BH 18-07B	91.43	0.25	91.18	April 30, 2019
BH 18-8	91.48	0.32	91.16	April 30, 2019
BH 18-9	91.12	0.07	91.05	April 30, 2019
BH 18-10	91.24	0.18	91.06	April 30, 2019
BH 18-11	91.26	0.05	91.21	April 30, 2019
BH 18-12A	91.14	0.08	91.06	April 30, 2019
BH 18-12B	91.14	0.04	91.10	April 30, 2019
BH 18-13	91.07	0.49	90.57	April 30, 2019
BH 18-14	91.38	0.37	91.01	April 30, 2019
Notes: Borehole elevations are referenced to a geodetic datum.				

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed residential development. It is expected that the proposed residential buildings will be founded on conventional shallow footings placed on an undisturbed, stiff to firm silty clay bearing surface or an engineered fill pad over an approved subgrade soil.

Due to the presence of a silty clay deposit, permissible grade raise restrictions are recommended for this site.

A construction setback defined as the Limit of Hazard Lands has been defined for the slope face along the adjacent segment of the Jock River, as presented on Drawing PG5036-4 - Test Hole Location Plan. This is discussed further in Section 6.8.

The above and other considerations are discussed in the following paragraphs.

5.2 Site Grading and Preparation

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

It is anticipated that the existing fill, free of deleterious materials and topsoil can be left in place below the proposed park blocks. However, it is recommended that the existing fill layer be thoroughly proof-rolled under dry conditions and in above freezing temperatures, using several passes of a vibratory drum roller and approved by the geotechnical consultant at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with approved fill material, such as OPSS Granular B, Type II.

Fill Placement

Fill used for grading beneath the building areas, including the park blocks, should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. Consideration could be given to using an alternative granular fill provided that the geotechnical engineer provides fill placement recommendations for the selected material. Granular material should be tested and approved prior to delivery to the site.

The fill should be placed in loose lifts of 300 mm thick or less and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of the Standard Proctor Maximum Dry Density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of the SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Bearing Resistance Values

Strip footings, up to 2 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **150 kPa**. Strip footings, up to 2 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, firm silty clay bearing surface can be designed using a bearing resistance value at SLS of **60 kPa** and a factored bearing resistance value at ULS of **90 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

Footings placed over an engineered pad, consisting of a Granular A or Granular B Type II or approved granular fill alternative placed in maximum 300 mm loose lifts and compacted to 98% of its SPMDD, can be designed using a bearing resistance value at SLS of 100 kPa and a factored bearing resistance value at ULS of 200 kPa.

Bearing resistance values for footing design should be determined on a per lot basis at the time of construction. The bearing resistance values are provided on the assumption that the footings will be placed on undisturbed soil bearing surfaces. An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Park Block Structures

Thickened edge concrete slabs or footings supported on the proof-rolled and approved existing fill can be designed using a bearing resistance value at serviceability limit states (SLS) for **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **180 kPa**, provided that the bearing surface is inspected and approved by the geotechnical consultant at the time of construction. The total and differential settlements for the proposed structures are 25 and 20 mm, respectively.

Where the existing fill material is encountered at the foundation subgrade, the existing fill shall be proof-rolled under dry conditions and above freezing temperatures, using a vibratory drum roller making several passes and approved by the geotechnical consultant at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with approved fill material, such as OPSS Granular B, Type II.

The bearing medium under thickened edge concrete slab supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to silty clay and engineered fill above the groundwater table when a plane extending horizontally and vertically from the underside of the foundation at a minimum of 1.5H:1V passing through in situ soil of the same or higher bearing capacity as the bearing medium soil.

Consideration can be given to slab-on-grade construction within the park blocks. With the removal of fill, containing significant amounts of deleterious or organic materials, the existing fill or native soil subgrade approved by the geotechnical consultant at the time of excavation will be considered an acceptable subgrade surface on which to commence backfilling for slab-on-grade construction. Where the subgrade consists of existing fill, a vibratory drum roller should complete several passes over the subgrade surface as a proof-rolling program. Any poor performing areas should be removed and reinstated with an engineered fill such as OPSS Granular B Type II.

It is recommended the upper 400 mm of sub-floor fill consist of OPSS Granular A crushed stone. All backfill material required to raise grade within the footprint of settlement sensitive structures should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to the in-situ bearing medium soils above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise Recommendations

Consideration must be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For dwellings, a minimum value of 50% of the live load is recommended by Paterson.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics of the silty clay. These characteristics are estimated in the laboratory by conducting unidimensional consolidation tests on undisturbed soil samples collected using Shelby tubes in conjunction with a piston sampler. Twelve (12) site specific consolidation tests were conducted by others as part of the geotechnical investigation at the subject site. The results of the consolidation testing are presented in Table 3 below.

Table 3 - Summary of Consolidation Test Results

Borehole Number	Sample	Depth (m)	p'_c (kPa)	p'_o (kPa)	C_{cr}	C_c
BH 17-01	3	3.60	110.0	35.0	0.055	0.760
BH 17-05	5	5.00	85.0	50.0	0.055	0.800
BH 17-07A	1	6.50	115.0	55.0	0.005	1.540
BH 17-08	5	6.50	90.0	55.0	0.009	0.970
BH 17-16	7	8.10	115.0	65.0	0.006	1.470
BH 17-17	4	4.90	105.0	45.0	0.011	1.070
BH 17-19	4	5.00	90.0	50.0	0.004	1.100
BH 17-21	5	6.50	110.0	60.0	0.007	1.330
BH 17-33	6	8.00	85.0	60.0	0.007	2.280
BH 17-35	5	6.40	110.0	50.0	0.004	1.160

Table 3 - Summary of Consolidation Test Results						
Borehole Number	**Sample**	**Depth (m)**	**p'_c (kPa)**	**p'_o (kPa)**	**C_{cr}**	**C_c**
BH 18-03	5	3.40	58.0	35.0	0.011	0.540
BH 18-07	5	5.00	115.0	42.0	0.004	1.110

The value for p'_c is the preconsolidation pressure and p'_o is the effective overburden pressure of the test sample. The difference between these values is the available preconsolidation. The increase in stress on the soil due to the cumulative effects of the fill surcharge, the footing pressures, the slab loadings and the lowering of the groundwater should not exceed the available preconsolidation if unacceptable settlements are to be avoided.

The values for C_{cr} and C_c are the recompression and compression indices, respectively. These soil parameters are a measure of the compressibility due to stress increases below and above the preconsolidation pressures. The higher values for the C_c, as compared to the C_{cr}, illustrate the increased settlement potential above, as compared to below, the preconsolidation pressure.

The values of p'_c, p'_o, C_{cr} and C_c are determined using standard engineering testing procedures and are estimates only. Natural variations within the soil deposit will affect the results. The p'_o parameter is directly influenced by the groundwater level. Groundwater levels were measured during the site investigation. Groundwater levels vary seasonally which has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Unacceptable settlements could be induced by a significant lowering of the groundwater level. The p'_o values for the consolidation tests carried out for the present investigation are based on the long term groundwater level observed at each borehole location. The groundwater level is based on the colour and undrained shear strength profile of the silty clay.

The total and differential settlements will be dependent on characteristics of the proposed buildings. For design purposes, the total and differential settlements are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 1 m was assumed.

The potential post construction total and differential settlements are dependent on the position of the long term groundwater level when buildings are situated over deposits of compressible silty clay. Efforts can be made to reduce the impacts of the proposed development on the long term groundwater level by placing clay dykes in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge or limiting planting of trees to areas away from the buildings. However, it is not economically possible to control the groundwater level.

To reduce potential long term liabilities, consideration should be given to accounting for a larger groundwater lowering and to provide means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the dwellings, etc). Buildings on silty clay deposits increases the likelihood of movements and therefore of cracking.
The use of steel reinforcement in foundations placed at key structural locations will tend to reduce foundation cracking compared to unreinforced foundations.

Based on the consolidation testing results and undrained shear strength values at the borehole locations and our experience with local Ottawa clays, we have determined our permissible grade raise recommendations for the current phase of the proposed development. Our permissible grade raise recommendations are presented in Drawing PG5036-5 - Permissible Grade Raise Plan in Appendix 2.

Based on the above discussion, several options could be considered to accommodate proposed grade raises with respect to our permissible grade raise recommendations, such as the use of lightweight fill, which allow for raising the grade without adding a significant load to the underlying soils. Alternatively, it is possible to preload or surcharge the subject site in localized areas provided sufficient time is available to achieve the desired settlements.

5.4 Test Fill Pile Settlement Monitoring Program

Between January 30, 2020 and February 11, 2020, a test fill pile settlement monitoring program consisting of two (2) test fill piles (Piles D and DD) was initiated. The test fill piles were strategically placed across the subject site to provide additional information regarding our permissible grade raise recommendations for the area. The test fill piles consisted of a 30 m x 30 m pile, ranging in height from 2.5 to 3.1 m at the time of construction. Two (2) settlement plates were installed in each of the two (2) test fill piles. An initial baseline survey was conducted on each settlement plate at the time of installation to accurately monitor settlement contributed by the test fill piles.

The results of the monitoring program indicate that up to 37 mm of settlement at Test Fill Pile D and DD have occurred since the initial baseline survey. The monitoring results to date are considered to have confirmed that our original permissible grade raise recommendations for the site.

The test fill piles are outlined in Drawing PG5036-4 - Test Hole Location Plan in Appendix 2. The periodic readings, including most recent results, from our test fill pile settlement monitoring program are presented in Figure 6 - Test Fill Pile Settlement Monitoring Program in Appendix 2.

5.5 Design for Earthquakes

The results of seismic shear wave velocity testing performed by others indicated an average shear wave velocity, V_{s30}, at this site of 211 m/s and 176 m/s. A **Site Class D** is therefore applicable for design across the majority of the site. However, a **Site Class E** is applicable for an area within the northeast portion of the site, as shown on Drawing PG5036-4 in Appendix 2. The soils underlying the subject site are not susceptible to liquefaction.

Reference should be made to the latest revision of the Ontario Building Code (OBC) 2012 for a full discussion of the earthquake design requirements.

5.6 Basement Slab / Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill from within the footprint of the proposed buildings, the native soil surface or approved fill subgrade will be considered an acceptable subgrade on which to commence backfilling for floor slab construction.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

For structures with slab-on-grade construction, the upper 200 mm of sub-slab fill is recommended to consist of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

For structures with basement slabs, it is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone.

5.7 Pavement Design

For design purposes, the pavement structure presented in the following tables is recommended for the design of park block pathways, access pathways, car only parking areas, local roadways and arterial roadways with bus traffic.

Table 4 - Recommended Pavement Structure – Park Block Pathways	
Thickness (mm)	**Material Description**
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 5 - Recommended Pavement Structure – Driveways / Car Only Parking Areas / Park Block Parking Areas and Access Pathways	
Thickness (mm)	**Material Description**
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 6 - Recommended Pavement Structure - Local Roads	
Thickness (mm)	**Material Description**
40	**Wear Course** - Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 7 - Recommended Pavement Structure - Roadways with Bus Traffic	
Thickness (mm)	**Material Description**
40	**Wear Course** - Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
600	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for driveways and local roadways and PG 64-34 asphalt cement should be used for roadways with bus traffic. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on maintaining the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing load carrying capacity.

Due to the low permeability of the subgrade materials consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines. Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

A perimeter foundation drainage system is recommended for each proposed structure. The system should consist of a 100 to 150 mm diameter, geotextile-wrapped, perforated, corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone which is placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided in this regard.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings, such as structures within the park blocks.

It is recommended that Paterson review the proposed frost protection for each structure at the time of detailed design.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavations to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level.

The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

The pipe bedding for sewer and water pipes placed on a relatively dry, undisturbed subgrade surface should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extend at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

Generally, it should be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay material will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

To reduce long-term lowering of the groundwater at this site, clay seals should be provided within the service trenches excavated through the silty clay deposit. The seals should be at least 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. The seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches excavated through the silty clay deposit.

6.5 Groundwater Control

Due to the relatively impervious nature of the silty clay materials, it is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment, Conservation, and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

The subsurface conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur. Precautions should be taken if winter construction is considered for this project.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters, tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be constructed in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Landscaping Considerations

Tree Planting Restrictions - Area 1 - Low to Medium Sensitivity Area

A low to medium sensitivity clay soil was encountered between the anticipated design underside of footing elevations and 3.5 m below finished grade as per City Guidelines in the areas outlined in Drawing PG5036-6 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg limits test results, the modified plasticity index does not exceed 40% in these areas. The following tree planting setbacks are recommended for the low to medium sensitivity area. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to **4.5 m** for small (mature height up to 7.5 m) and medium size trees (mature tree height 7.5 to 14 m), provided that the conditions noted below are met.

- ❑ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan.

- ❑ A small tree must be provided with a minimum of 25 m^3 of available soils volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

- ❑ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.

- ❑ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- ❑ Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Tree Planting Restrictions - Area 2 - High Sensitivity Area

High sensitivity clay soils were encountered between the anticipated design underside of footing elevations and 3.5 m below finished grade as per City Guidelines at the areas outlined in PG5036-6 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg limits test results, the modified plasticity index generally exceeds 40% in these areas. The following tree planting setbacks are recommended for these high sensitivity areas. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits are 7.5 m for small (mature height up to 7.5 m) and medium size trees (mature tree height 7.5 to 14 m), provided that the following conditions are met:

- ❑ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan.

- ❑ A small tree must be provided with a minimum of 25 m^3 of available soils volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

- ❑ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.

- ❑ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- ❑ Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Aboveground Swimming Pools

The in-situ soils are considered to be acceptable for in-ground swimming pools. Above ground swimming pools must be placed at least 5 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer’s recommendations.

Aboveground Hot Tubs

Additional grading around hot tubs should not exceed permissible grade raises. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer’s specifications.

Decks and Building Additions

Additional grading around proposed decks or additions should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

6.8 Slope Stability Assessment

A slope stability analysis was carried out to determine the required construction setback from the top of the bank. Two (2) slope cross-sections were studied as the worst case scenarios.

Erosional and access allowances were also considered in the determination of limits of hazard lands and are discussed in the following sections. The cross-section locations and the proposed limit of hazard lands are shown on Drawing PG5036-4 - Test Hole Location Plan attached to the current report.

Slope Stability Assessment

The analyses of the stability of the slopes were carried out using SLIDE, a computer program which permits a two-dimensional slope stability analysis using several methods including the Bishop's method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favouring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsoil and groundwater conditions, a factor of safety greater than one is usually required to ascertain that the risks of failure are acceptable.

A minimum factor of safety of 1.5 is generally recommended for conditions where the failure of the slope would endanger permanent structures.

The cross-sections were analyzed based on our review of the available topographic mapping. The slope stability analysis was completed at each slope cross-section under worst-case-scenario by assigning cohesive soils under fully saturated conditions. Subsoil conditions at the cross-sections were inferred based on nearby boreholes and general knowledge of the area's geology.

The effective strength soil parameters used for static analysis were chosen based on the subsoil information recovered during the geotechnical investigation. The effective strength soil parameters used for static analysis are presented in Table 8 below.

Table 8 - Effective Soil and Material Parameters (Static Analysis)

Soil Layer	Unit Weight (kN/m^3)	Friction Angle (degrees)	Undrained Shear Strength (kPa)
Brown Silty Clay Crust	17	33	5
Grey Silty Clay	16	33	10
Glacial Till	20	33	0

The total strength parameters for seismic analysis were chosen based on the in situ, undrained shear strengths recovered within the open boreholes completed at the time of the geotechnical investigation and based on our general knowledge of the geology in the area. The strength parameters used for seismic analysis at the slope cross-sections are presented in Table 9 on the following page.

Table 9 - Total Stress Soil and Material Parameters (Seismic Analysis)			
Soil Layer	**Unit Weight (kN/m^3)**	**Friction Angle (degrees)**	**Undrained Shear Strength (kPa)**
Brown Silty Clay Crust	17	-	150
Grey Silty Clay	16	-	25 to 40
Glacial Till	20	33	0

Static Loading Analysis

The results for the slope stability analyses under static conditions at Sections A and B are shown on Figures 2 and 4, attached to the present report. The factor of safety was found to be greater than 1.5 at Sections A and B. Based on these results, the slopes are considered to be stable under static loading.

Seismic Loading Analysis

An analysis considering seismic loading was also completed. A horizontal acceleration of 0.16 g was considered for all slopes. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

The results of the slope stability analyses under seismic conditions are shown on Figures 3 and 5 in Appendix 2. The results indicate that the factors of safety are greater than 1.1 under seismic conditions. Based on these results, the slopes are considered to be stable under seismic loading. Therefore, when considering seismic loading, no geotechnical setback from the top of the slope is required to achieve a factor of safety of 1.1 for the limit of the hazard lands.

Geotechnical Setback - Limit of Hazard Lands

Based on site reconnaissance completed by others, signs of active erosion were noted along portions of the slope. A 5 m toe erosion allowance is deemed appropriate for this slope based on the cohesive nature of the soils, the observed erosion areas and the current watercourse depth and width. It is considered that a toe erosion allowance of 5 m and an erosion access allowance of 6 m is required from the top of stable slope (ie.- slope with factor of safety greater than 1.5).

The limit of hazard lands, which include these allowances, is indicated on Drawing PG5036-4 - Test Hole Location Plan attached to the present report.

It is recommended that any existing vegetation on the slope faces not be removed as it contributes to the stability of the slope and reduces erosion.

6.9 Corrosion Potential and Sulphate

Four (4) soil sample was submitted for analytical testing. The analytical test results of the soil sample indicate that the sulphate content is less than 0.01%. These results along with the chloride and pH value are indicative that Type 10 Portland cement would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a moderate to aggressive corrosive environment.

7.0 Recommendations

It is recommended that the following be completed once the master plan and site development are determined:

- ❑ Review detailed grading plan(s) from a geotechnical perspective.
- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❑ Observation of all subgrades and subdrains prior to placing backfilling materials.
- ❑ Observation of proof-rolling operations for subgrade within park blocks.
- ❑ Field density tests to ensure that the specified level of compaction has been achieved.
- ❑ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with Paterson’s recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should also be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and the test hole logs are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Caivan Communities or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
March 14, 2024
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Kevin A. Pickard, EIT

David J. Gilbert, P.Eng.

Report Distribution:

- ❑ Caivan Communities (email copy)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS BY OTHERS

SYMBOLS AND TERMS BY OTHERS

SEISMIC SITE CLASS TESTING RESULTS BY OTHERS

SHRINKAGE LIMIT RESULTS BY OTHERS

RECORD OF BOREHOLE: 17-01

PROJECT: 1771847
SHEET 1 OF 1

LOCATION: N 5013143.8 ;E 361309.9
BORING DATE: February 2, 2017
DATUM: CGVD28

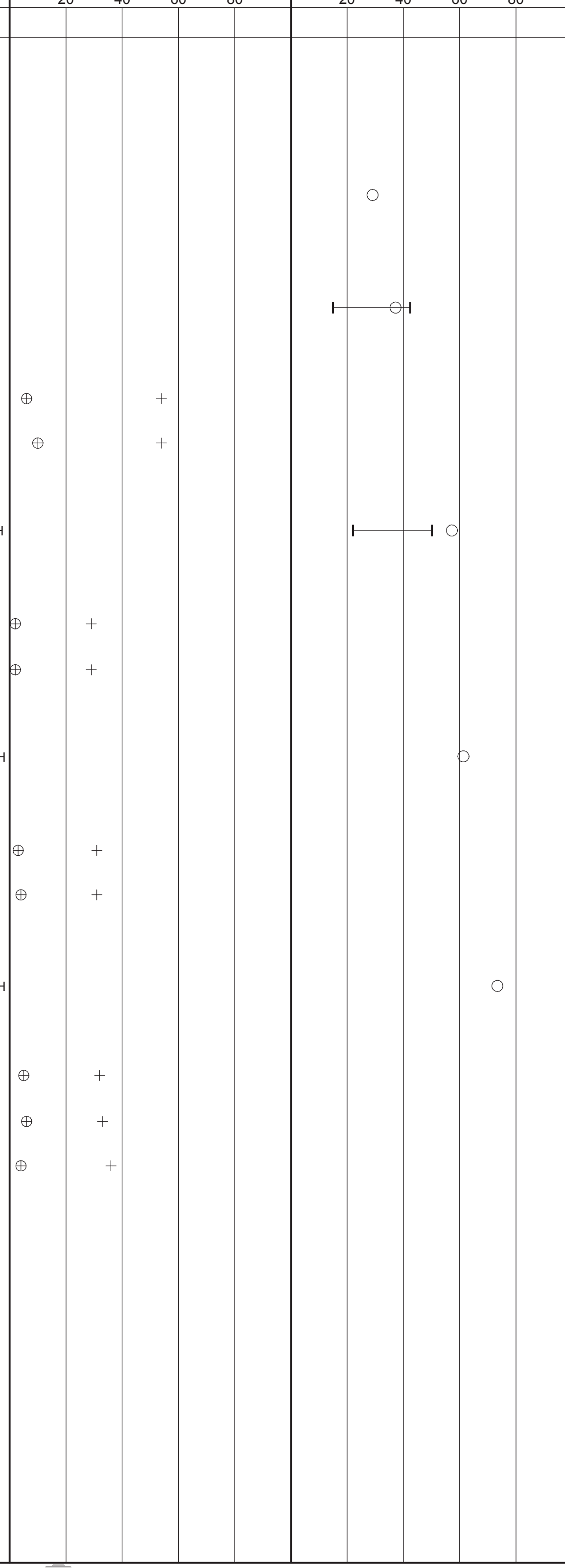
SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

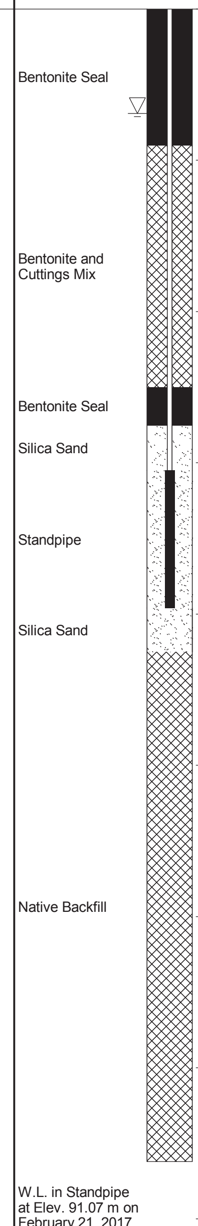
DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)
	GROUND SURFACE	91.76
0	TOPSOIL - (SM) SILTY SAND; dark brown; moist	0.00
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silty sand layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.16
2.74	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, firm	89.02 / 2.74
7.62	End of Borehole	84.14 / 7.62

SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	3	
2	SS	1	
3	TP	PH	C
4	SS	WH	
5	SS	WH	

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80)
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl (20, 40, 60, 80)



PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE 1 : 50

Golder Associates

LOGGED: DG
CHECKED: SD

PROJECT: 1771847

RECORD OF BOREHOLE: 17-02

SHEET 1 OF 1

LOCATION: N 5013269.0 ;E 361573.3

BORING DATE: February 1, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	91.75
TOPSOIL - (SM) SILTY SAND; dark brown; moist	0.07
(CL/CI/CH) SILTY CLAY to CLAY, some sand; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	89.01 / 2.74
(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, stiff to firm	84.13 / 7.62
End of Borehole	

SAMPLE NUMBER	TYPE	BLOWS/0.30m
1	SS	8
2	SS	4
3	SS	2
4	SS	WH
5	SS	WH
6	SS	WH

Column headings: DEPTH SCALE METRES; BORING METHOD; SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)); SAMPLES (NUMBER, TYPE, BLOWS/0.30m); DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20, 40, 60, 80); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-03

PROJECT: 1771847 — SHEET 1 OF 1

LOCATION: N 5012851.9 ;E 361409.3 — BORING DATE: February 1, 2017 — DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm — PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

Soil Profile

Description	Elev. (m)	Depth (m)
GROUND SURFACE	91.20	
TOPSOIL - (SM) sandy SILT; dark brown; moist	91.20	0.00
(CL/CI/CH) SILTY CLAY to CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		0.13
(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm	88.46	2.74
End of Borehole	83.58	7.62

Samples

Number	Type	Blows/0.30m
1	SS	3
2	SS	WH
3	SS	WH
4	SS	WH
5	SS	WR

Column headings: DEPTH SCALE METRES; BORING METHOD; SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)); SAMPLES (NUMBER, TYPE, BLOWS/0.30m); DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (20, 40, 60, 80); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: DG

CHECKED: SD

RECORD OF BOREHOLE: 17-04

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5013010.7 ;E 361684.6

BORING DATE: February 1, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH (m)	DESCRIPTION	ELEV. (m)
	GROUND SURFACE	91.21
0.00	TOPSOIL - (SM) SILTY SAND; dark brown; moist	
0.10	(CL/CI/CH) SILTY CLAY to CLAY, some sand; grey brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm	
2.74	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, firm	88.47
7.62	End of Borehole	83.59

SAMPLE NUMBER	TYPE	BLOWS/0.30m
1	SS	5
2	SS	WH
3	SS	WH
4	SS	WH
5	TP	PH

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl (20 40 60 80)

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

LOGGED: DG

CHECKED: SD

Golder Associates

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-05

PROJECT: 1771847
SHEET 1 OF 1

LOCATION: N 5012743.9 ;E 361739.5
BORING DATE: February 1, 2017
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	91.12					
0	TOPSOIL - (SM) SILTY SAND; dark brown; moist	0.00					Bentonite Seal
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.10					
1			1	SS	3		
			2	SS	2		Bentonite and Cuttings Mix
	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm	88.53 / 2.59	3	SS	1		
3			4	SS	WH		Bentonite Seal
4							Silica Sand
5			5	TP	PH	C	Standpipe
							Silica Sand
6			6	SS	WH		Native Backfill
7	End of Borehole	83.50 / 7.62					W.L. in Standpipe at Elev. 89.90 m on February 21, 2017

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl ; 20 40 60 80

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: DG
CHECKED: SD

RECORD OF BOREHOLE: 17-06

PROJECT: 1771847 | SHEET 1 OF 1

LOCATION: N 5013111.2 ;E 361966.0 | BORING DATE: January 31, 2017 | DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm | PENETRATION TEST HAMMER, 64kg; DROP, 760mm

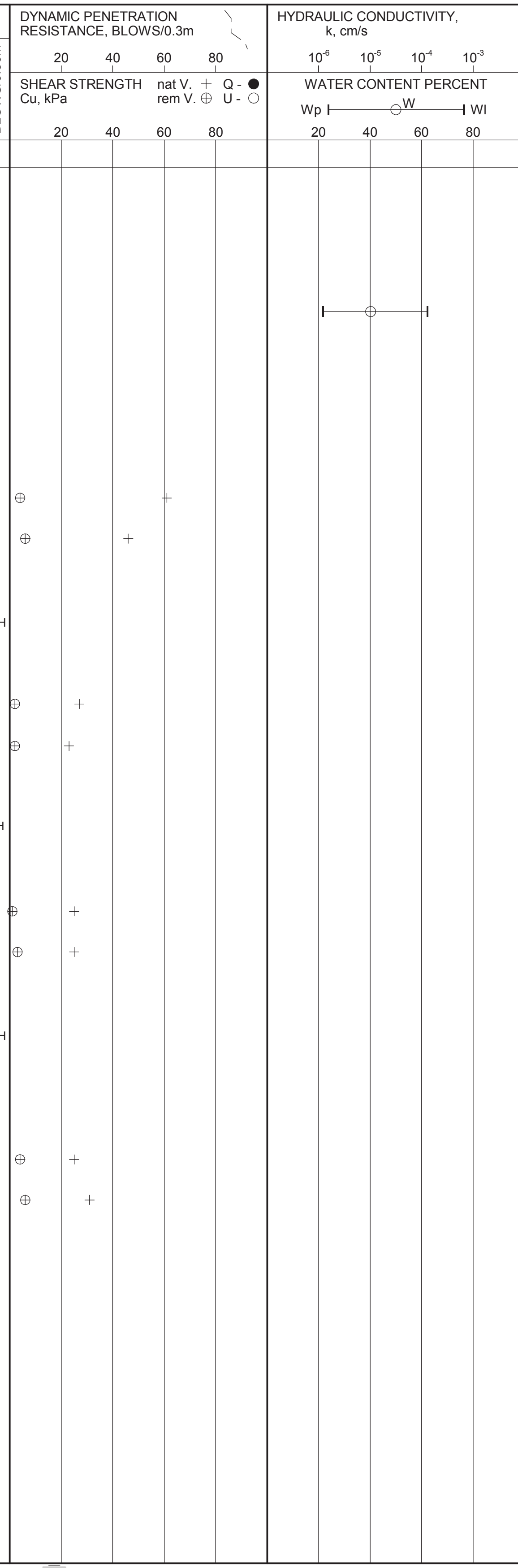
BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	91.22
TOPSOIL - (SM) SILTY SAND; dark brown; moist	0.00
(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm	0.08
(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm	88.48 / 2.74
End of Borehole	83.60 / 7.62

SAMPLES

NUMBER	TYPE	BLOWS/0.30m
1	SS	4
2	SS	1
3	SS	WH
4	TP	PH
5	SS	WH



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

LOGGED: DG

CHECKED: SD

Golder Associates

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-07

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5013270.1 ;E 362250.9

BORING DATE: January 31, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m
		GROUND SURFACE		91.56			
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; dark brown; moist		0.00			
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silty sand layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm		0.10			
1					1	SS	4
2					2	SS	1
		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm		88.82 / 2.74			
3					3	SS	WH
5					4	SS	WH
6					5	SS	WH
		End of Borehole		83.94 / 7.62			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ●; rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl (20 40 60 80)

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: DG

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-07A

PROJECT: 1771847 | SHEET 1 OF 1

LOCATION: 2 m North of 17-07 | BORING DATE: January 31, 2017 | DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm | PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.56							
0	Power Auger 200 mm Diam. (Hollow Stem)	For stratigraphy refer to RECORD OF BOREHOLE 17-07		0.00							
6		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm	hatched	85.46 6.10	1	TP	PH		Wp ~20, Wl ~46, W ~65	C	
		End of Borehole		84.90 6.66							

DEPTH SCALE 1 : 50 | Golder Associates | LOGGED: DG | CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-08

PROJECT: 1771847 | SHEET 1 OF 1

LOCATION: N 5012981.2 ;E 362191.5 | BORING DATE: February 3, 2017 | DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm | PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	91.15
TOPSOIL - (SM) SILTY SAND; dark brown; moist	0.00
(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.10
(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm	88.41 / 2.74
End of Borehole	83.53 / 7.62

SAMPLE NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	3	
2	SS	1	
3	SS	WH	
4	SS	WH	
5	TP	PH	C

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl — 20 40 60 80

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: DG

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-09

PROJECT: 1771847 | SHEET 1 OF 1

LOCATION: N 5012670.0 ;E 362072.9 | BORING DATE: February 3, 2017 | DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm | PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	90.87				
0	TOPSOIL - (SM) SILTY SAND; dark brown; moist	0.00				Bentonite Seal
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.13				
1			1	SS	1	
			2	SS	2	
2						Bentonite and Cuttings Mix
	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm	88.13 / 2.74				
3			3	SS	WH	Bentonite Seal
4						Silica Sand
			4	TP	PH	Standpipe
5						Silica Sand
6			5	SS	WH	Native Backfill
7						
	End of Borehole	83.25 / 7.62				W.L. in Standpipe at Elev. 90.06 m on February 21, 2017
8						
9						
10						

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ W ⊣ Wl ; 20 40 60 80

ADDITIONAL LAB. TESTING

STRATA PLOT

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: DG

CHECKED: SD

PROJECT: 1771847

RECORD OF BOREHOLE: 17-10

SHEET 1 OF 1

LOCATION: N 5012858.2 ;E 362391.4

BORING DATE: February 15, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH Cu, kPa (nat V. + / rem V. ⊕)	WATER CONTENT PERCENT (Wp / W / Wl)
	GROUND SURFACE	91.21					
0	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00					
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm	0.15	1	GRAB	-		
1			2	SS	3		
			3	SS	1		Wp–W plotted (~20)
2			4	SS	WH		
3	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft fo firm	88.31 / 2.90					
			5	SS	WH		
4						⊕ / +	
						⊕ / +	
5			6	SS	WH		
						⊕ / +	
6						⊕ / +	
			7	SS	WH		
7						⊕ / +	
						⊕ / +	
	End of Borehole	83.59 / 7.62				⊕ / +	
8							
9							
10							

Other columns: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SD

PROJECT: 1771847

RECORD OF BOREHOLE: 17-16

SHEET 1 OF 1

LOCATION: N 5012987.6 ;E 361366.8

BORING DATE: March 31, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Column headings: DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)) | SAMPLES (NUMBER, TYPE, BLOWS/0.30m) | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20, 40, 60, 80) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

Depth (m)	Description	Elev. / Depth (m)	Sample No.	Type	Blows/0.30m	Add. Lab Testing	Piezometer / Standpipe
	GROUND SURFACE	91.27					
0	TOPSOIL - (SM) SILTY SAND; brown, contains rootlets; moist	0.00					
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silty sand layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.15	1	GRAB	-		Bentonite Seal
1			2	SS	4		
2			3	SS	1		
	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm	88.83 / 2.44					
3			4	SS	WH		Cuttings
5			5	SS	WH		
6			6	SS	WH		Bentonite Seal
							Silica Sand
7							Standpipe
8			7	TP	PH	C	W.L. in Standpipe at Elev. 90.34 m on April 13, 2017
9	End of Borehole	82.13 / 9.14					
10							

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SN

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-17

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5013210.1 ;E 361450.6

BORING DATE: March 23 & 24, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Column headings: DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)) | SAMPLES (NUMBER, TYPE, BLOWS/0.30m) | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (20, 40, 60, 80) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT (Wp ⊢ W ⊣ Wl) (20, 40, 60, 80) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

ELEV. / DEPTH (m)	DESCRIPTION
91.82	GROUND SURFACE
0.00	TOPSOIL - (ML) sandy SILT; dark brown; moist
0.09	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff
89.08 / 2.74	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm
82.68 / 9.14	End of Borehole

NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	4	
2	SS	3	
3	SS	1	
4	TP	PH	C
5	SS	WH	
6	SS	WH	

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

PROJECT: 1771847

RECORD OF BOREHOLE: 17-17A

SHEET 1 OF 1

LOCATION: Adjacent to BH 17-17

BORING DATE: March 24, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.82							
0	Power Auger 200 mm Diam. (Hollow Stem)	Refer to Borehole 17-17 for Stratigraphy		0.00							Bentonite Seal; Silica Sand; 51 mm Diam. PVC #10 Slot Screen; Silica Sand
3		End of Borehole		88.77 3.05							WL in Screen at Elev. 91.21 m on March 31, 2017

Depth scale marks: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-18

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5013064.6 ;E 361497.9

BORING DATE: March 23, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m
		GROUND SURFACE	91.40			
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00			
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm	0.10			
1				1	SS	6
2				2	SS	WH
		(CI/CH) SILTY CLAY to CLAY; grey, contains silt seams; cohesive, w>PL, soft to firm	88.66 2.74			
3				3	SS	WH
5				4	SS	WH
6				5	SS	WH
7		End of Borehole	83.78 7.62			
8						
9						
10						

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp —○W— Wl : 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM/SM

CHECKED: SD

RECORD OF BOREHOLE: 17-18A

PROJECT: 1771847
SHEET 1 OF 1

LOCATION: Adjacent to BH 17-18
BORING DATE: March 23, 2017
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.40							
0	Power Auger 200 mm Diam. (Hollow Stem)	Refer to Borehole 17-18 for Stratigraphy		0.00							Bentonite Seal
1											Silica Sand
2											51 mm Diam. PVC #10 Slot Screen
3		End of Borehole		88.35 / 3.05							Silica Sand
											WL in Screen at Elev. 90.95 m on March 31, 2017
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KM/SM
CHECKED: SD

RECORD OF BOREHOLE: 17-19

PROJECT: 1771847 — SHEET 1 OF 1

LOCATION: N 5012932.6 ;E 361556.3 — BORING DATE: March 30, 2017 — DATUM: CGVD28

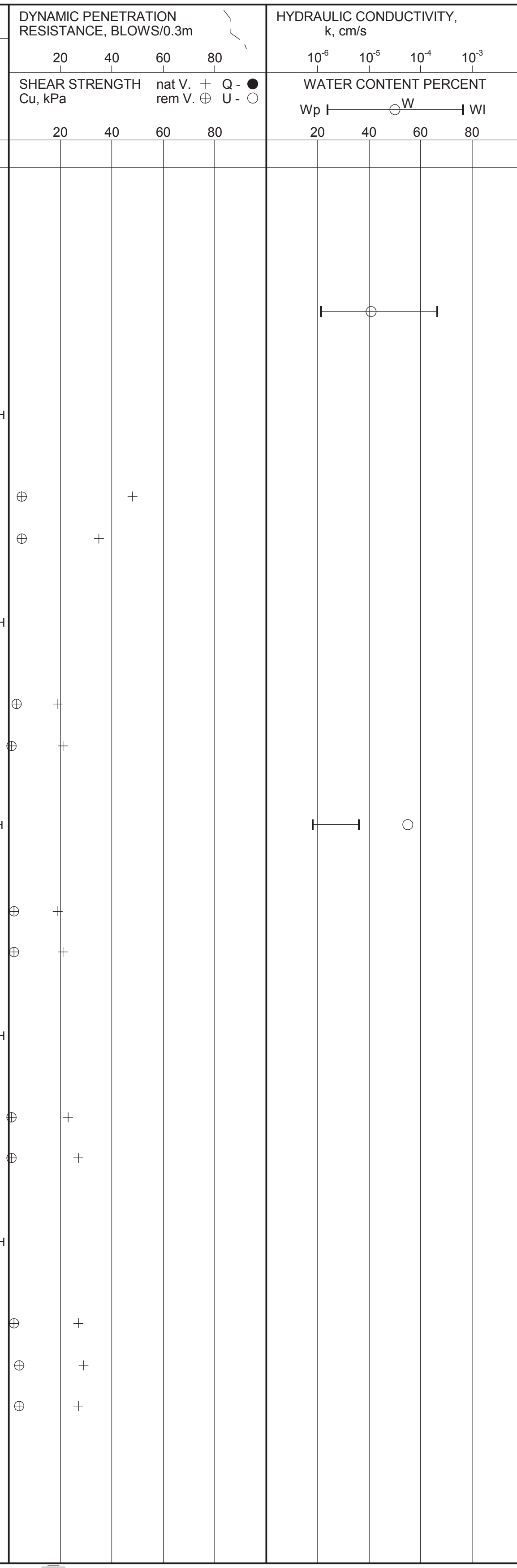
SAMPLER HAMMER, 64kg; DROP, 760mm — PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

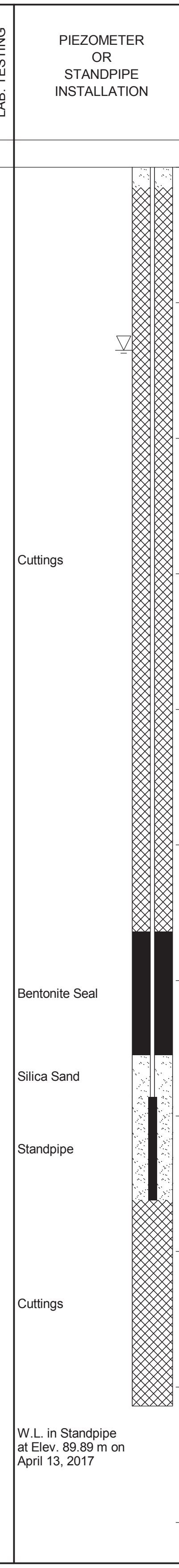
Depth (m)	Description	Elev. / Depth (m)
	GROUND SURFACE	91.24
0.00	TOPSOIL - (SM) SILTY SAND; dark brown; moist	0.00
0.15	(CL/CI/CH) SILTY CLAY to CLAY; brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm	0.15
2.74	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm	88.50 / 2.74
9.14	End of Borehole	82.10 / 9.14

Samples

Number	Type	Blows/0.30m	Additional Lab. Testing
1	SS	2	
2	SS	WH	
3	SS	WH	
4	TP	PH	C
5	SS	WH	
6	SS	WH	



Piezometer or Standpipe Installation



DEPTH SCALE 1 : 50

Golder Associates

LOGGED: SM

CHECKED: SD

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PROJECT: 1771847

RECORD OF BOREHOLE: 17-20

SHEET 1 OF 1

LOCATION: N 5012801.4 ;E 361573.1

BORING DATE: March 20, 2017

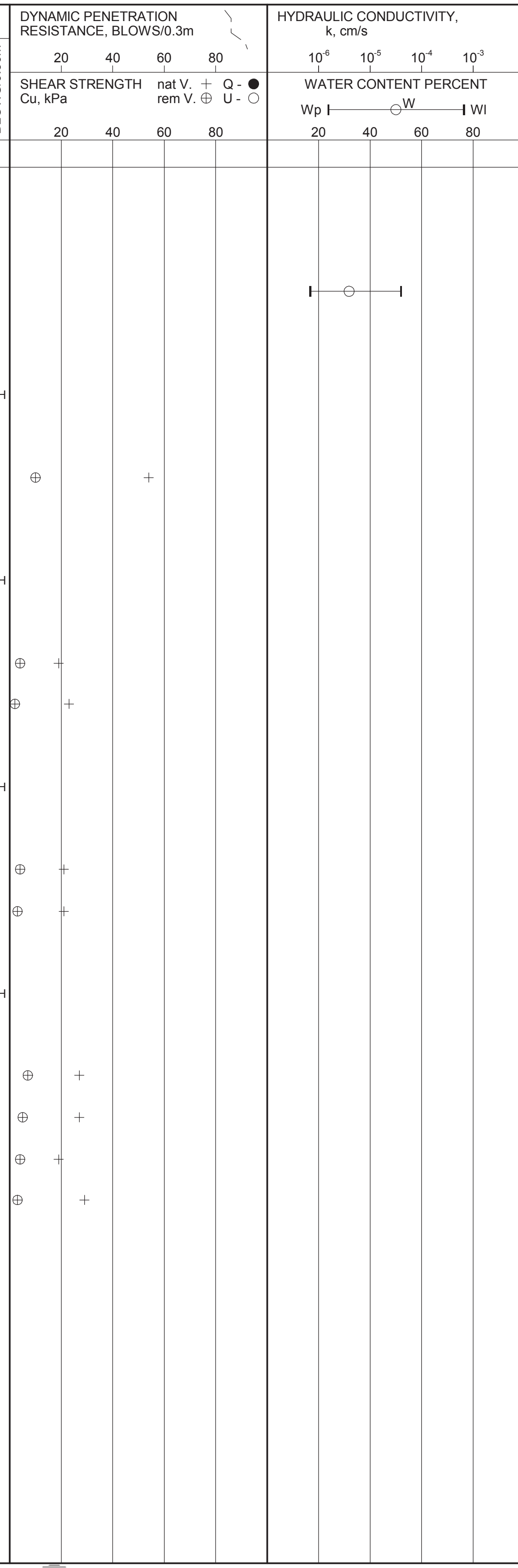
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m
0	GROUND SURFACE	91.03			
	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00			
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.10			
1			1	SS	4
			2	SS	WH
2	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains sandy silt seams; cohesive, w>PL, soft to firm	88.74 / 2.29			
3			3	SS	WH
4			4	SS	WH
6			5	SS	WH
	End of Borehole	83.41 / 7.62			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-20A

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: Adjacent to BH 17-20

BORING DATE: March 20, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ⊖W ⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.03							
0	Power Auger 200 mm Diam. (Hollow Stem)	Refer to Borehole 17-20 for Stratigraphy		0.00							Bentonite Seal ▽
1											Silica Sand
2											51 mm Diam. PVC #10 Slot Screen
3		End of Borehole		87.98 3.05							Silica Sand WL in Screen at Elev. 90.37 m on March 31, 2017
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-21

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5012670.3 ;E 361616.6

BORING DATE: March 29, 2017

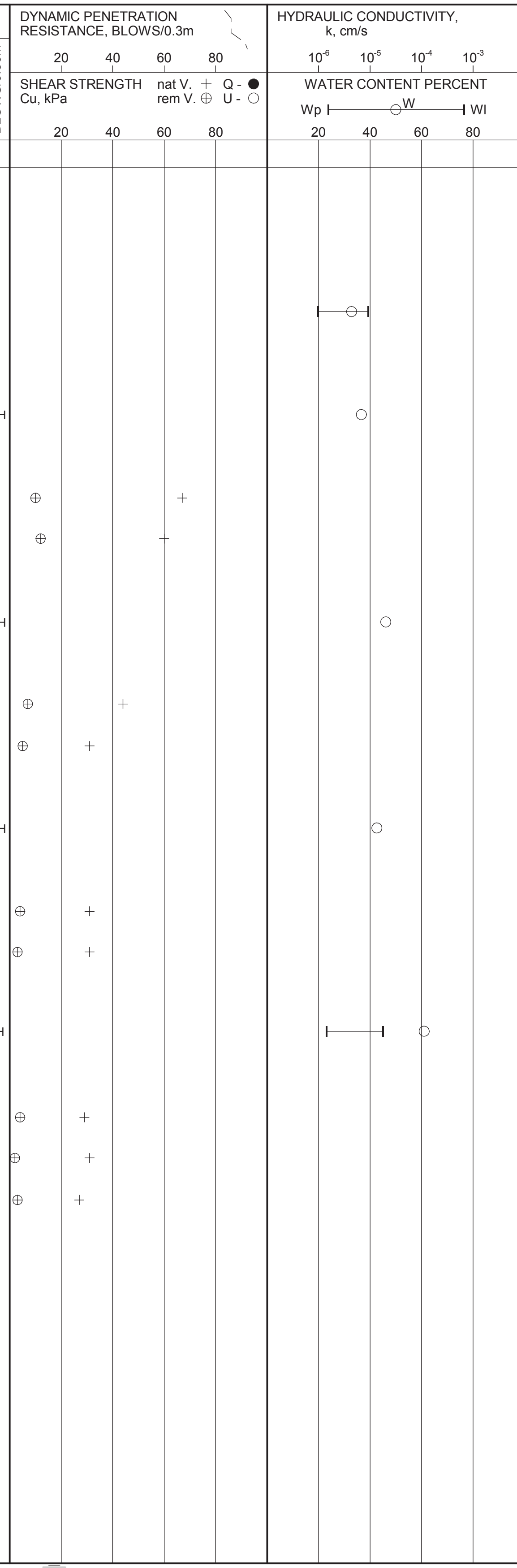
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
	GROUND SURFACE	91.24				
0	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00				
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.10				
1			1	SS	4	
2			2	SS	WH	
3	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, firm	88.19 / 3.05	3	SS	WH	
5			4	SS	WH	
6			5	TP	PH	C
7.62	End of Borehole	83.62 / 7.62				



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-22

PROJECT: 1771847 — SHEET 1 OF 1

LOCATION: N 5012555.0 ;E 361697.8 — BORING DATE: March 29, 2017 — DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm — PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

Depth (m)	Description	Elev. / Depth (m)	Sample No.	Type	Blows/0.30m	Piezometer or Standpipe Installation
	GROUND SURFACE	91.36				
0	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00				
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silty sand layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.09				Cuttings
1			1	SS	2	
2			2	SS	2	
3	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, firm	88.31 / 3.05	3	SS	WH	
5			4	SS	WH	
6			5	SS	WH	Bentonite Seal
7						Silica Sand; Standpipe
8			6	TP	PH	Cuttings
9	End of Borehole	82.22 / 9.14				

Dynamic Penetration Resistance, Blows/0.3m: 20, 40, 60, 80

Shear Strength Cu, kPa: nat V. +, Q - ●, rem V. ⊕, U - ○ (20, 40, 60, 80)

Hydraulic Conductivity, k, cm/s: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}

Water Content Percent: Wp —○W— Wl (20, 40, 60, 80)

Additional Lab. Testing

W.L. in Standpipe at Elev. 90.99 m on April 13, 2017

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-23

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5013132.3 ;E 361640.7

BORING DATE: March 30, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE | SAMPLES | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) | SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}) | WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20, 40, 60, 80) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	91.41
TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00
(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silt seams (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	91.23 / 0.18
(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, firm	88.67 / 2.74
End of Borehole	82.27 / 9.14

NUMBER	TYPE	BLOWS/0.30m
1	SS	9
2	SS	1
3	SS	WH
4	SS	WH
5	SS	WH
6	SS	WH

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Cuttings

Bentonite Seal

Silica Sand

Standpipe

Cuttings

W.L. in Standpipe at Elev. 91.36 m on April 13, 2017

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-24

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5012870.0 ;E 361739.6

BORING DATE: March 29, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH (m)	SOIL PROFILE - DESCRIPTION	ELEV. (m) / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	90.90				
0	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00				
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt seams (WEATHERED CRUST); cohesive, w>PL, stiff to firm	0.11				
1			1	SS	2	
			2	SS	1	
	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm	88.16 / 2.74				Cuttings
3			3	SS	WH	
4–5			4	TP	PH	
6			5	SS	WH	Bentonite Seal
7						Silica Sand; Standpipe
8			6	SS	WH	Cuttings
9	End of Borehole	81.76 / 9.14				

W.L. in Standpipe at Elev. 90.59 m on April 13, 2017

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp W Wl ; 20 40 60 80

ADDITIONAL LAB. TESTING

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

PROJECT: 1771847

RECORD OF BOREHOLE: 17-25

SHEET 1 OF 1

LOCATION: N 5012633.8 ;E 361839.8

BORING DATE: March 24, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.09							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (ML) sandy SILT; dark brown; moist		0.00							
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		0.08							
1					1	SS	4				
					2	SS	2				
2											
3		(CI/CH) SILTY CLAY to CLAY; grey, contains silt seams; cohesive, w>PL, firm		88.19 2.90	3	SS	WH				
4											
5					4	SS	WH				
6					5	SS	WH				
7											
		End of Borehole		83.47 7.62							
8											
9											
10											

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM/KM

CHECKED: SD

RECORD OF BOREHOLE: 17-25A

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: Adjacent to BH 17-25

BORING DATE: March 24, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.09							
0	Power Auger 200 mm Diam. (Hollow Stem)	Refer to Borehole 17-25 for Stratigraphy		0.00							Bentonite Seal
1											Silica Sand
2											51 mm Diam. PVC #10 Slot Screen
3		End of Borehole		88.04 3.05							Silica Sand
											WL in Screen at Elev. 91.08 m on March 31, 2017
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM/KM

CHECKED: SD

RECORD OF BOREHOLE: 17-26

PROJECT: 1771847 | SHEET 1 OF 1

LOCATION: N 5013197.9 ;E 361757.1 | BORING DATE: March 23, 2017 | DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm | PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	91.54				
TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00				
(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt seams (WEATHERED CRUST); cohesive, w>PL, very stiff to firm	0.09	1	SS	12	Bentonite Seal
		2	SS	6	Silica Sand
		3	SS	1	51 mm Diam. PVC #10 Slot Screen
(CI/CH) SILTY CLAY to CLAY; grey, contains silt seams; cohesive, w>PL, firm	88.95 / 2.59	4	SS	WH	Silica Sand
(SM) gravelly SILTY SAND; grey, contains cobbles and boulders (GLACIAL TILL); non-cohesive, wet, loose to compact	87.12 / 4.42	5	SS	7	Cuttings
		6	SS	10	
		7	SS	6	
End of Borehole	84.99 / 6.55				WL in Screen at Elev. 91.28 m on March 31, 2017

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl (20 40 60 80)

ADDITIONAL LAB. TESTING

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM/SM

CHECKED: SD

RECORD OF BOREHOLE: 17-27

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5013051.5 ;E 361831.3

BORING DATE: March 28, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	91.21
TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00
(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, stiff to firm	0.09
(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm	88.47 / 2.74
End of Borehole	82.07 / 9.14

SAMPLES

NUMBER	TYPE	BLOWS/0.30m
1	SS	2
2	SS	WH
3	SS	WH
4	SS	1
5	TP	PH
6	SS	WH

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp —○W— Wl : 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 – 10

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

PROJECT: 1771847

RECORD OF BOREHOLE: 17-28

SHEET 1 OF 1

LOCATION: N 5012922.4 ;E 361888.7

BORING DATE: March 20, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m
		GROUND SURFACE	91.10			
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00			
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.10	1	SS	13
1				2	SS	5
2				3	SS	WH
		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm	88.36 2.74			
3				4	SS	WH
5				5	SS	WH
6				6	SS	WH
		End of Borehole	83.48 7.62			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp —○W— Wl ; 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

PROJECT: 1771847

RECORD OF BOREHOLE: 17-28A

SHEET 1 OF 1

LOCATION: Adjacent to BH 17-28

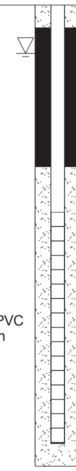
BORING DATE: March 20, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.10							
0	Power Auger 200 mm Diam. (Hollow Stem)	Refer to Borehole 17-28 for Stratigraphy		0.00							Bentonite Seal
1											Silica Sand
2											51 mm Diam. PVC #10 Slot Screen
3		End of Borehole		88.05 / 3.05							Silica Sand; WL in Screen at Elev. 90.78 m on March 31, 2017
4											
5											
6											
7											
8											
9											
10											



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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-29

PROJECT: 1771847
SHEET 1 OF 1

LOCATION: N 5012811.0 ;E 361925.0
BORING DATE: March 28, 2017
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m
	GROUND SURFACE	92.08			
0	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00			
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.08			
1			1	SS	3
2			2	SS	2
	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm	89.34 / 2.74			
3			3	SS	WH
5			4	SS	WH
6			5	SS	WH
	End of Borehole	84.46 / 7.62			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl — 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM
CHECKED: SD

RECORD OF BOREHOLE: 17-30

PROJECT: 1771847

LOCATION: N 5012708.4 ;E 361971.8

SAMPLER HAMMER, 64kg; DROP, 760mm

BORING DATE: March 29, 2017

SHEET 1 OF 1

DATUM: CGVD28

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	90.92
TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00
(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.09
(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm	88.02 / 2.90
End of Borehole	81.78 / 9.14

SAMPLES

NUMBER	TYPE	BLOWS/0.30m
1	SS	4
2	SS	3
3	SS	WH
4	SS	WH
5	SS	WH
6	SS	WH

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ W ⊣ Wl : 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

- Cuttings
- Bentonite Seal
- Silica Sand
- Standpipe
- Cuttings

W.L. in Standpipe at Elev. 90.46 m on April 13, 2017

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

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RECORD OF BOREHOLE: 17-31

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5012999.3 ;E 362038.6

BORING DATE: March 27, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Column headings: DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)) | SAMPLES (NUMBER, TYPE, BLOWS/0.30m) | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20, 40, 60, 80) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

Description	Elev. / Depth (m)
GROUND SURFACE	91.20
TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00
(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silty sand layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm	0.09
(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt layers; cohesive, w>PL, soft to firm	88.46 / 2.74
End of Borehole	83.58 / 7.62

Number	Type	Blows/0.30m
1	SS	7
2	SS	3
3	TP	PH
4	SS	WH
5	SS	WH

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

PROJECT: 1771847

RECORD OF BOREHOLE: 17-32

SHEET 1 OF 1

LOCATION: N 5012872.7 ;E 362097.3

BORING DATE: March 17, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

ELEV. / DEPTH (m)	DESCRIPTION (SOIL PROFILE)
91.05	GROUND SURFACE
0.00	TOPSOIL - (ML) sandy SILT; brown; moist
0.12	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff
88.31 / 2.74	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, firm to soft
83.43 / 7.62	End of Borehole

SAMPLES

NUMBER	TYPE	BLOWS/0.30m
1	SS	5
2	SS	1
3	SS	WH
4	SS	WH
5	SS	WH

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl ; 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-32A

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: Adjacent to BH 17-32

BORING DATE: March 17, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.05							
0	Power Auger 200 mm Diam. (Hollow Stem)	Refer to Borehole 17-32 for Stratigraphy		0.00							Bentonite Seal; Silica Sand; 51 mm Diam. PVC #10 Slot Screen; Silica Sand
3		End of Borehole		88.00 3.05							WL in Screen at Elev. 90.63 m on March 31, 2017

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 17-33

PROJECT: 1771847
SHEET 1 OF 1

LOCATION: N 5013212.1 ;E 362096.4
BORING DATE: March 28, 2017
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	91.53					
0	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00					
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.12					
1			1	SS	3		
2			2	SS	WH		
3	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm	88.48 / 3.05					Cuttings
			3	SS	WH		
5			4	SS	WH		
6			5	SS	WH		Bentonite Seal
7							Silica Sand; Standpipe
8			6	TP	PH	C	Cuttings
9	End of Borehole	82.39 / 9.14					

W.L. in Standpipe at Elev. 91.08 m on April 13, 2017

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl (20 40 60 80)

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KM
CHECKED: SD

PROJECT: 1771847

RECORD OF BOREHOLE: 17-34

SHEET 1 OF 1

LOCATION: N 5013095.4 ;E 362152.5

BORING DATE: March 27, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ├─○W─┤ Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.25							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (ML) sandy SILT; dark brown; moist		0.00							
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		0.11							
1					1	SS	5		Wp ≈ 18, W ≈ 40, Wl ≈ 60		
2					2	SS	2				
								⊕ ≈ 10, + ≈ 71			
								⊕ ≈ 13, + ≈ 58			
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm		88.20 / 3.05	3	SS	WH				
4								⊕ ≈ 2, + ≈ 35			
								⊕ ≈ 3, + ≈ 29			
5					4	SS	WH				
								⊕ ≈ 4, + ≈ 23			
6								⊕ ≈ 4, + ≈ 19			
					5	SS	WH				
7								⊕ ≈ 2, + ≈ 25			
								⊕ ≈ 2, + ≈ 23			
		End of Borehole		83.63 / 7.62				⊕ ≈ 2, + ≈ 21			
8											
9											
10											

DEPTH SCALE 1 : 50	Golder Associates	LOGGED: KM CHECKED: SD

RECORD OF BOREHOLE: 17-35

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5012859.6 ;E 362245.8

BORING DATE: March 28, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ : 20, 40, 60, 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 20, 40, 60, 80

SOIL PROFILE

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	91.04
TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00
(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, stiff to firm	0.11
(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm	88.45 / 2.59
End of Borehole	81.90 / 9.14

SAMPLES

NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	2	
2	SS	WH	
3	SS	WH	
4	SS	WH	
5	TP	PH	C
6	SS	WH	

PIEZOMETER OR STANDPIPE INSTALLATION

Cuttings

Bentonite Seal

Silica Sand

Standpipe

Cuttings

W.L. in Standpipe at Elev. 90.50 m on April 13, 2017

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-36

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5013155.1 ;E 362292.3

BORING DATE: March 17, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH Cu, kPa (nat V. + / rem V. ⊕)	WATER CONTENT PERCENT
		GROUND SURFACE	91.35					
0	Power Auger 200 mm Diam. Hollow Stem	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00					
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.11					
1				1	SS	5		Wp–W–Wl
				2	SS	WH		
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm	88.30 / 3.05					
				3	SS	WH		
				4	SS	WH		
				5	SS	WH		
		End of Borehole	83.73 / 7.62					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

SHEAR STRENGTH nat V. + Q - ● rem V. ⊕ U - ○

WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl: 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-36A

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: Adjacent to BH 17-36

BORING DATE: March 17, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.35							
0	Power Auger 200 mm Diam. (Hollow Stem)	Refer to Borehole 17-36 for Stratigraphy		0.00							Bentonite Seal; Silica Sand; 51 mm Diam. PVC #10 Slot Screen; Silica Sand
3		End of Borehole		88.30 3.05							WL in Screen at Elev. 90.73 m on March 31, 2017

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-37

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: N 5013047.0 ;E 362327.9

BORING DATE: March 24, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m
	GROUND SURFACE	91.08			
0	TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00			
	(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.10			
1			1	SS	5
2			2	SS	3
	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm	88.34 / 2.74			
3			3	SS	WH
5			4	SS	WH
6			5	SS	WH
8			6	SS	WH
9	End of Borehole	81.94 / 9.14			
10					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl (20 40 60 80)

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

RECORD OF BOREHOLE: 17-38

PROJECT: 1771847
SHEET 1 OF 1

LOCATION: N 5012944.6 ;E 362382.6
BORING DATE: March 20, 2017
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		91.24			
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (ML) sandy SILT; dark brown; moist		0.00			
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		0.13	1	SS	6
1					2	SS	2
2							
		(CI/CH) SILTY CLAY to CLAY; grey with black mottling, contains sandy silt seams; cohesive, w>PL, soft to stiff		88.50 2.74	3	SS	WH
4					4	SS	WH
6					5	SS	WH
		End of Borehole		83.62 7.62			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl — 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KM
CHECKED: SD

RECORD OF BOREHOLE: 17-38A

PROJECT: 1771847

SHEET 1 OF 1

LOCATION: Adjacent to BH 17-38

BORING DATE: March 20, 2017

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ W ⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.24							
0	Power Auger 200 mm Diam. (Hollow Stem)	Refer to Borehole 17-38 for Stratigraphy		0.00							Bentonite Seal
1											Silica Sand
2											51 mm Diam. PVC #10 Slot Screen
3				88.19							Silica Sand
		End of Borehole		3.05							WL in Screen at Elev. 90.63 m on March 31, 2017
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KM

CHECKED: SD

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

RECORD OF BOREHOLE: 18-01

PROJECT: 18108333-2000 | SHEET 1 OF 1

LOCATION: N 5012964.6 ;E 361071.4 | BORING DATE: November 5, 2018 | DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm | PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

Description	Elev. / Depth (m)
GROUND SURFACE	92.12
TOPSOIL - (CI/CH) SILTY CLAY, trace sand; dark brown	92.12 / 0.00
(CI/CH) SILTY CLAY to CLAY, trace sand; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	91.94 / 0.18
(CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm	91.05 / 1.07
(ML) gravelly sandy SILT; grey (GLACIAL TILL); non-cohesive, wet, compact to loose	90.60 / 1.52
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, compact to loose	89.99 / 2.13
(SW) SAND, trace gravel; non-cohesive, wet, dense	89.07 / 3.05
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, dense to very dense	88.77 / 3.35
End of Borehole	86.56 / 5.56

Samples

Number	Type	Blows/0.30m
1	SS	8
2	SS	1
3	SS	10
4	SS	10
5	SS	33
6	SS	31
7	SS	34
8	SS	>50

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-8} 10^{-6} 10^{-4} 10^{-2}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 20 40 60 80

ADDITIONAL LAB. TESTING: MH (Sample 6)

Piezometer or Standpipe Installation

- Bentonite Seal
- Silica Sand
- PVC #10 Slot Screen
- Cave
- WL in screen at Elev. 92.31 m on April 30, 2019

DEPTH SCALE 1 : 50

GOLDER

LOGGED: RI

CHECKED:

RECORD OF BOREHOLE: 18-02

PROJECT: 18108333-2000 | SHEET 1 OF 1

LOCATION: N 5013068.6 ;E 361173.1 | BORING DATE: November 6, 2018 | DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm | PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

ELEV. / DEPTH (m)	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
91.65	GROUND SURFACE					
0.00	TOPSOIL - (CI/CH) SILTY CLAY					
0.15	(CI/CH) SILTY CLAY to CLAY to CLAY; brown (WEATHERED CRUST); cohesive, w>PL	1	SS	8		Native Backfill
		2	SS	7		Bentonite Seal
		3	SS	2	MH	Silica Sand
89.52 / 2.13	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, firm	4	SS	WH		38 mm Diam. PVC #10 Slot
		5	ST	PM		Cave
		6	SS	WH		
84.03 / 7.62	End of Borehole					WL in screen at Elev. 91.19 m on April 30, 2019

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-8} 10^{-6} 10^{-4} 10^{-2}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl (20 40 60 80)

DRAFT

DEPTH SCALE 1 : 50

GOLDER

LOGGED: RA

CHECKED:

PROJECT: 18108333-2000

RECORD OF BOREHOLE: 18-03

SHEET 1 OF 1

LOCATION: N 5012861.1 ;E 361112.0

BORING DATE: November 6, 2018

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH / DYNAMIC PENETRATION	WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	91.32							
0	Power Auger, 200 mm Diam. (Hollow Stem)	TOPSOIL - (CI/CH) SILTY CLAY to CLAY, trace to some sand	0.00							
		(CI/CH) SILTY CLAY to CLAY, trace sand; grey brown, contains silty sand seams (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	91.07 / 0.25	1	SS	5				Bentonite Seal
1				2	SS	2		Wp–W–Wl	MH	Silica Sand
				3	SS	4				
2		(CI/C) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm to soft	89.03 / 2.29							38 mm Diam. PVC #10 Slot Screen
				4	SS	WH				
3				5	TP	PH		Wp–W–Wl	C	Silica Sand
4							⊕ + ; ⊕ +			
5		(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, very loose to loose	86.37 / 4.95	6	SS	3				Cave
				7	SS	6				
6				8	SS	1				
7				9	SS	5				
		End of Borehole	83.85 / 7.47							
8										WL in screen at Elev. 91.09 m on April 30, 2019
9										
10										

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-8} 10^{-6} 10^{-4} 10^{-2}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 20 40 60 80

DRAFT

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DEPTH SCALE

1 : 50

GOLDER

LOGGED: RI

CHECKED:

PROJECT: 18108333-2000

RECORD OF BOREHOLE: 18-04

SHEET 1 OF 1

LOCATION: N 5012942.7 ;E 361222.8

BORING DATE: November 7, 2018

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	91.28				
0	TOPSOIL - (CL/CI) SILTY CLAY; brown	0.00				Native Backfill
	(CI/CH) SILTY CLAY to CLAY; grey (WEATHERED CRUST); cohesive, w>PL, stiff to very stiff	0.15	1	SS	7	Bentonite Seal
1			2	SS	2	Silica Sand
			3	SS	1	
2	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, soft to firm	89.15 / 2.13				38 mm Diam. PVC #10 Slot Screen 'B'
3			4	SS	WH	
5			5	SS	WH	Native Backfill
6			6	SS	WH	
7						Bentonite Seal
						Silica Sand
8			7	SS	WH	38 mm Diam. PVC #10 Slot Screen 'A'
9	End of Borehole	82.14 / 9.14				

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ●; rem V. ⊕ U - ○: 20, 40, 60, 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-8}, 10^{-6}, 10^{-4}, 10^{-2}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl: 20, 40, 60, 80

ADDITIONAL LAB. TESTING

WL in screen 'A' at Elev. 91.22 m on April 30, 2019
WL in screen 'B' at Elev. 91.06 m on April 30, 2019

DEPTH SCALE
1 : 50

GOLDER

LOGGED: RA
CHECKED:

RECORD OF BOREHOLE: 18-05

PROJECT: 18108333-2000

SHEET 1 OF 1

LOCATION: N 5012741.6 ;E 361151.9

BORING DATE: November 7, 2018

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	91.29
TOPSOIL - (CI/CH) SILTY CLAY to CLAY, trace sand; dark brown	0.00
(SM/ML) SILTY SAND to sandy SILT; grey brown; non-cohesive, moist to wet, loose	91.04 / 0.25
(CI/CH) SILTY CLAY to CLAY, trace sand; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	90.38 / 0.91
(CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm	89.16 / 2.13
End of Borehole	83.67 / 7.62

SAMPLE NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	7	
2	SS	3	MH
3	SS	WH	
4	SS	PM	
5	SS	PM	
6	SS	PM	

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-8} 10^{-6} 10^{-4} 10^{-2}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl; 20 40 60 80

PIEZOMETER OR STANDPIPE INSTALLATION:

- Bentonite Seal
- Silica Sand
- 38 mm Diam. PVC #10 Slot Screen
- Cave
- WL in screen at Elev. 91.10 m on April 30, 2019

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE 1 : 50

GOLDER

LOGGED: RA

CHECKED:

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RECORD OF BOREHOLE: 18-06

PROJECT: 18108333-2000

LOCATION: N 5012825.6 ;E 361270.4

BORING DATE: November 7, 2018

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE | SAMPLES | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) | SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (20, 40, 60, 80) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-8}, 10^{-6}, 10^{-4}, 10^{-2}) | WATER CONTENT PERCENT (Wp —○W— Wl) (20, 40, 60, 80) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	91.25
TOPSOIL - (CL/CU) SILTY CLAY; brown	0.00
(CI/CH) SILTY CLAY to CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, stiff to firm	0.15
(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, soft	88.96 / 2.29
End of Borehole	83.63 / 7.62

NUMBER	TYPE	BLOWS/0.30m
1	SS	3
2	SS	6
3	SS	4
4	ST	PM
5	SS	WH
6	SS	WH
7	SS	WH

Piezometer or standpipe installation:

- Native Backfill
- Bentonite Seal
- Silica Sand
- 38 mm Diam. PVC #10 Slot Screen
- Cave
- WL in screen at Elev. 91.07 m on April 30, 2019

DRAFT

DEPTH SCALE

1 : 50

GOLDER

LOGGED: RA

CHECKED:

MIS-BHS 001 18108333.GPJ GAL-MIS.GDT 19-5-10 ZS

PROJECT: 18108333-2000

RECORD OF BOREHOLE: 18-07

SHEET 1 OF 1

LOCATION: N 5012600.1 ;E 361205.1

BORING DATE: November 7, 2018

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

Soil Profile

ELEV. / DEPTH (m)	DESCRIPTION
91.43	GROUND SURFACE
0.00	TOPSOIL - (CI/CH) SILTY CLAY to CLAY, trace to some sand
91.13 / 0.30	(CI/CH) SILTY CLAY to CLAY, trace to some sand; grey brown, contain silty sand seams (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff
88.38 / 3.05	(CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm
83.81 / 7.62	(SM) gravelly SILTY SAND: grey (GLACIAL TILL); non-cohesive, wet, compact to loose
82.28 / 9.15	End of Borehole

Samples

NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	5	
2	SS	2	
3	SS	WH	
4	SS	WH	
5	TP	PM	C
6	SS	PM	
7	SS	11	
8	SS	5	

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-8} 10^{-6} 10^{-4} 10^{-2}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl (20 40 60 80)

Piezometer or Standpipe Installation

- Bentonite Seal
- Silica Sand
- 38 mm Diam. PVC #10 Slot Screen 'B'
- Native Backfill
- Bentonite Seal
- Silica Sand
- 38 mm Diam. PVC #10 Slot Screen 'A'

WL in screen 'A' at Elev. 90.92 m on April 30, 2019
WL in screen 'B' at Elev. 91.18 m on April 30, 2019

DEPTH SCALE 1 : 50

GOLDER

LOGGED: RI

CHECKED:

PROJECT: 18108333-2000

RECORD OF BOREHOLE: 18-08

SHEET 1 OF 1

LOCATION: N 5012701.2 ;E 361309.6

BORING DATE: November 8, 2018

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	91.48				
0	Power Auger, 200 mm Diam. (Hollow Stem)	TOPSOIL - (CI/CH) SILTY CLAY to CLAY, some sand; dark brown	0.00				
		(CI/CH) SILTY CLAY to CLAY, trace to some sand; grey brown, contains silty sand seams (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	91.12 / 0.36	1	SS	3	Bentonite Seal
1				2	SS	2	Silica Sand
2				3	SS	2	38 mm Diam. PVC #10 Slot Screen
		(CI/CH) SILTY CLAY to CLAY, trace sand; grey, contains silty sand seams; cohesive, w>PL, firm	89.35 / 2.13				
3				4	SS	WH	Silica Sand
4							
5				5	SS	PM	Cave
		(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, very loose to loose	85.99 / 5.49				
6				6	SS	2	
7				7	SS	9	
		End of Borehole	84.01 / 7.47				WL in screen at Elev. 91.16 m on April 30, 2019
8							
9							
10							

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-8} 10^{-6} 10^{-4} 10^{-2}

WATER CONTENT PERCENT: Wp — W — Wl — 20 40 60 80

ADDITIONAL LAB. TESTING

DRAFT

DEPTH SCALE 1 : 50

GOLDER

LOGGED: RI

CHECKED:

RECORD OF BOREHOLE: 18-09

PROJECT: 18108333-2000
SHEET 1 OF 1

LOCATION: N 5012730.1 ;E 361453.5
BORING DATE: November 8, 2018
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	91.12				
0	Power Auger, 200 mm Diam. (Hollow Stem)	TOPSOIL - (CL/CI) SILTY CLAY; brown	0.00				
		(CI/CH) SILTY CLAY to CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	90.92 / 0.20	1	SS	8	Native Backfill
1				2	SS	4	Bentontie Seal
							Silica Sand
2				3	SS	1	38 mm Diam. PVC #10 Slot Screen
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, soft to firm	88.69 / 2.43				
3				4	SS	WH	
5				5	SS	WH	Cave
6				6	ST	PM	
7		End of Borehole	83.50 / 7.62				
8							WL in screen at Elev. 91.05 m on April 30, 2019
9							
10							

DEPTH SCALE
1 : 50

GOLDER

LOGGED: RA
CHECKED:

PROJECT: 18108333-2000

RECORD OF BOREHOLE: 18-10

SHEET 1 OF 1

LOCATION: N 5012493.1 ;E 361243.6

BORING DATE: November 7, 2018

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	91.24				
0	TOPSOIL - (CI/CH) SILTY CLAY to CLAY, trace to some sand; dark brown	0.00				
	(CI/CH) SILTY CLAY to CLAY, trace to some sand; grey brown (WEATHERED CRUST); cohesive, w>PL, stiff to firm	91.01 / 0.23	1	SS	4	Bentonite Seal
1			2	SS	1	Silica Sand
2			3	SS	WH	
	(CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm	89.11 / 2.13				38 mm Diam. PVC #10 Slot Screen
3–4			4	SS	PM	
5			5	SS	PM	Cave
6			6	SS	PM	
7	End of Borehole	83.62 / 7.62				
8						WL in screen at Elev. 91.06 m on April 30, 2019

Column headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa — nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-8}, 10^{-6}, 10^{-4}, 10^{-2}); WATER CONTENT PERCENT Wp —○W— Wl (20, 40, 60, 80); ADDITIONAL LAB. TESTING

DRAFT

MIS-BHS 001 18108333.GPJ GAL-MIS.GDT 19-5-10 ZS

DEPTH SCALE

1 : 50

GOLDER

LOGGED: RI

CHECKED:

PROJECT: 18108333-2000

RECORD OF BOREHOLE: 18-11

SHEET 1 OF 1

LOCATION: N 5012581.7 ;E 361340.0

BORING DATE: November 8, 2018

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

ELEV. / DEPTH (m)	SOIL PROFILE – DESCRIPTION
91.26	GROUND SURFACE
0.00	TOPSOIL - (CI/CH) SILTY CLAY to CLAY, some sand; dark brown
90.96 / 0.30	(CI/CH) SILTY CLAY to CLAY, trace to some sand; grey brown, contains silty sand seams (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff
88.21 / 3.05	(CI/CH) SILTY CLAY to CLAY, trace sand; grey, contains silty sand seams; cohesive, w>PL, firm
87.91 / 3.35	(CI/CH) SILTY CLAY to CLAY, some gravel; grey; cohesive, w>PL, firm
87.60 / 3.66	(CI/CH) SILTY CLAY to CLAY, trace sand; grey, contains silty sand seams; cohesive, w>PL, firm
83.64 / 7.62	End of Borehole

SAMPLE NUMBER	TYPE	BLOWS/0.30m
1	SS	4
2	SS	2
3	SS	1
4	SS	12
5	SS	WH
6	SS	WH
7	SS	PM

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ●; rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-8} 10^{-6} 10^{-4} 10^{-2}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl (20 40 60 80)

ADDITIONAL LAB. TESTING: MH (Sample 2)

PIEZOMETER OR STANDPIPE INSTALLATION:

- Bentonite Seal
- Silica Sand
- 38 mm Diam. PVC #10 Slot Screen
- Silica Sand
- Cave

WL in screen at Elev. 91.21 m on April 30, 2019

DRAFT

DEPTH SCALE 1 : 50

GOLDER

LOGGED: RI

CHECKED:

PROJECT: 18108333-2000

RECORD OF BOREHOLE: 18-12

SHEET 1 OF 1

LOCATION: N 5012613.5 ;E 361486.7

BORING DATE: November 8, 2018

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Column headings: DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)) | SAMPLES (NUMBER, TYPE, BLOWS/0.30m) | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (20, 40, 60, 80) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-8}, 10^{-6}, 10^{-4}, 10^{-2}); WATER CONTENT PERCENT (Wp, W, Wl) (20, 40, 60, 80) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

Description	Elev. / Depth (m)
GROUND SURFACE	91.14
TOPSOIL - (CL/CI) SILTY CLAY; brown	0.00 / 90.96
(CI/CH) SILTY CLAY to CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.18
(CI/CH) SILTY CLAY; grey; cohesive, w>PL< firm	88.09 / 3.05
End of Borehole	82.00 / 9.14

Sample Number	Type	Blows/0.30m
1	SS	8
2	SS	4
3	SS	3
4	SS	WH
5	SS	WH
6	SS	WH
7	SS	WH

Piezometer or standpipe installation:
- Native Backfill
- Bentontie Seal
- Silica Sand
- 38 mm Diam. PVC #10 Slot Screen 'A'
- Native Backfill
- Bentontie Seal
- Silica Sand
- 38 mm Diam. PVC #10 Slot Screen 'B'

WL in screen 'A' at Elev. 91.06 m on April 30, 2019
WL in screen 'B' at Elev. 91.10 m on April 30, 2019

MIS-BHS 001 18108333.GPJ GAL-MIS.GDT 19-5-10 ZS

DEPTH SCALE
1 : 50

GOLDER

LOGGED: RA
CHECKED:

RECORD OF BOREHOLE: 18-13

PROJECT: 18108333-2000 | SHEET 1 OF 1

LOCATION: N 5012467.9 ;E 361426.7 | BORING DATE: November 8, 2018 | DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm | PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	91.07				
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (CI/CH) SILTY CLAY to CLAY, some sand; dark brown	0.00				
		(CI/CH) SILTY CLAY to CLAY, trace to some sand; grey brown, contains silty sand seams (WEATHERED CRUST); cohesive, w>PL, stiff	90.79 / 0.28	1	SS	3	Bentonite Seal
1				2	SS	3	Silica Sand
2				3	SS	WH	38 mm Diam. PVC #10 Slot Screen
		(CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm	88.78 / 2.29				
3				4	TP	PM	
5				5	SS	PM	Cave
6				6	SS	PM	
7.62		End of Borehole	83.45 / 7.62				
8							WL in screen at Elev. 90.57 m on April 30, 2019

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ ; 20, 40, 60, 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-8}, 10^{-6}, 10^{-4}, 10^{-2}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl ; 20, 40, 60, 80

ADDITIONAL LAB. TESTING

DRAFT

MIS-BHS 001 18108333.GPJ GAL-MIS.GDT 19-5-10 ZS

DEPTH SCALE 1 : 50

GOLDER

LOGGED: RI

CHECKED:

RECORD OF BOREHOLE: 18-14

PROJECT: 18108333-2000 | SHEET 1 OF 1

LOCATION: N 5012533.4 ;E 361557.7 | BORING DATE: November 9, 2018 | DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm | PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Column headings: DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)) | SAMPLES (NUMBER, TYPE, BLOWS/0.30m) | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) | SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (20, 40, 60, 80) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-8}, 10^{-6}, 10^{-4}, 10^{-2}) | WATER CONTENT PERCENT (Wp ⊢—○W—⊣ Wl) (20, 40, 60, 80) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	91.38
TOPSOIL - (CL/CI) SILTY CLAY; dark brown	0.00
(CI/CH) SILTY CLAY to CLAY; brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.15
(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, firm	88.33 / 3.05
(ML) gravelly sandy SILT; grey (GLACIAL TILL); non-cohesive, wet, very loose to compact	85.28 / 6.10
End of Borehole	83.91 / 7.47

NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	6	
2	SS	3	
3	SS	2	MH
4	SS	WH	
5	SS	WH	
6	SS	WH	MH
7	SS	11	

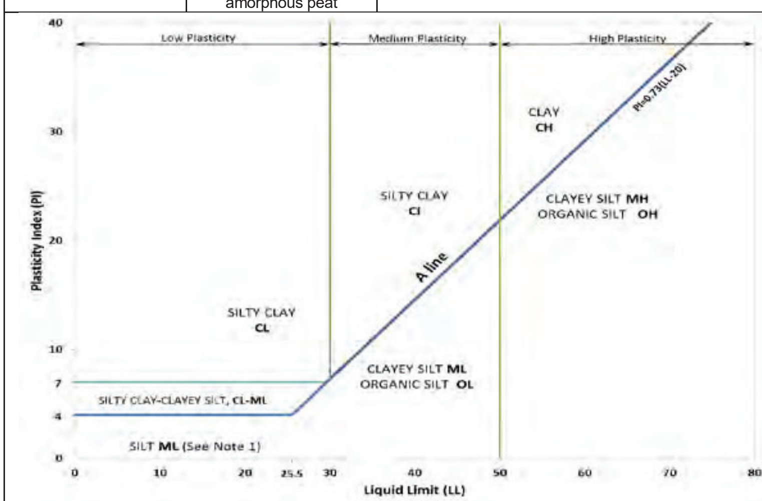
Piezometer or standpipe installation:
- Native Backfill
- Bentonite Seal
- Silica Sand
- 38 mm Diam. PVC #10 Slot Screen
- Cave
- WL in screen at Elev. 91.01 m on April 30, 2019

DEPTH SCALE 1 : 50 | GOLDER | LOGGED: RA | CHECKED:

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators: Dilatancy	Field Indicators: Dry Strength	Field Indicators: Shine Test	Field Indicators: Thread Diameter	Field Indicators: Toughness (of 3 mm thread)	Organic Content	USCS Group Symbol	Primary Name
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.
Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.
For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.
For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.
A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)
An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.
2. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\ \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma$ - u)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c′	effective cohesion
c_u, s_u	undrained shear strength (ϕ = 0 analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

GOLDER

TECHNICAL MEMORANDUM

DATE July 16, 2018 **Project No.** 18100364/2000

TO Andrew Finnson, CAIVAN Communities

CC

FROM Stephane Sol, Christopher Phillips **EMAIL** ssol@golder.com; cphillips@golder.com

NBCC SEISMIC SITE CLASS TESTING RESULTS
BORRISOKANE RD, OTTAWA, ONTARIO

This technical memorandum presents the results of four Multichannel Analysis of Surface Waves (MASW) tests performed for the National Building Code of Canada (NBCC 2015). The seismic testing was carried out near Cedarview Rd/Borrisokane Rd in Ottawa, Ontario and location of each MASW line is shown on Figure 1. The geophysical testing was performed by Golder Associates Ltd. (Golder) personnel on May 16 and 17 and June 26, 2018.

Figure 1: MASW Location Site Map (MASW Lines in red)

Methodology

The MASW method measures variations in surface-wave velocity with increasing distance and wavelength and can be used to infer the rock/soil types, stratigraphy and soil conditions.

A typical MASW survey requires a seismic source, to generate surface waves, and a minimum of two geophone receivers, to measure the ground response at some distance from the source. Surface waves are a special type of seismic wave whose propagation is confined to the near surface medium.

The depth of penetration of a surface wave into a medium is directly proportional to its wavelength. In a non-homogeneous medium, surface waves are dispersive, i.e., each wavelength has a characteristic velocity owing to the subsurface heterogeneities within the depth interval that particular wavelength of surface wave propagates through. The relationship between surface-wave velocity and wavelength is used to obtain the shear-wave velocity and attenuation profile of the medium with increasing depth.

The seismic source used can be either active or passive, depending on the application and location of the survey. Examples of active sources include explosives, weight-drops, sledge hammer and vibrating pads. Examples of passive sources are road traffic, micro-tremors, and water-wave action (in near-shore environments).

The geophone receivers measure the wave-train associated with the surface wave travelling from a seismic source at different distances from the source.

The participation of surface waves with different wavelengths can be determined from the wave-train by transforming the wave-train results into the frequency domain. The surface-wave velocity profile with respect to wavelength (called the 'dispersion curve') is determined by the delay in wave propagation measured between the geophone receivers. The dispersion curve is then matched to a theoretical dispersion curve using an iterative forward-modelling procedure. The result is a shear-wave velocity profile of the tested medium with depth, which can be used to estimate the dynamic shear-modulus of the medium as a function of depth.

Field Work

The MASW field work was conducted on May 16 and 17 and June 26, 2018, by personnel from the Golder Mississauga and Ottawa office. For the three MASW lines, a series of 24 low frequency (4.5 Hz) geophones were laid out at 3 metre intervals. Both active and passive readings were recorded along the MASW line. For the active investigation, a seismic drop of 45 kg and a 9.9 kg sledge hammer were used as seismic sources. Active seismic records were collected with seismic sources located 5, 10, and 15 metres from and collinear to the geophone array. Examples of active seismic record collected along each MASW line are shown on Figures 2, 3, 4, and 5 below.

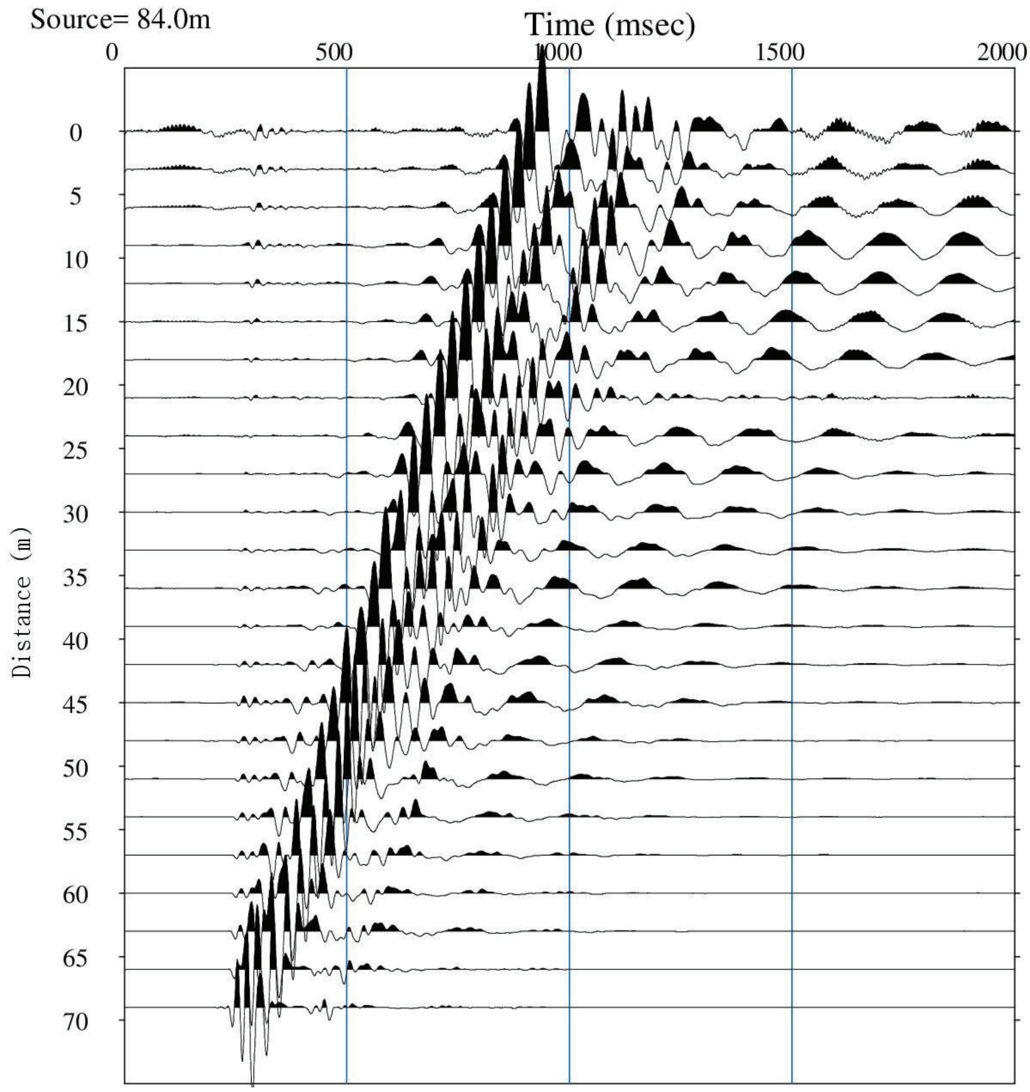


Figure 2: Typical seismic record collected at the site of the MASW Line 1.

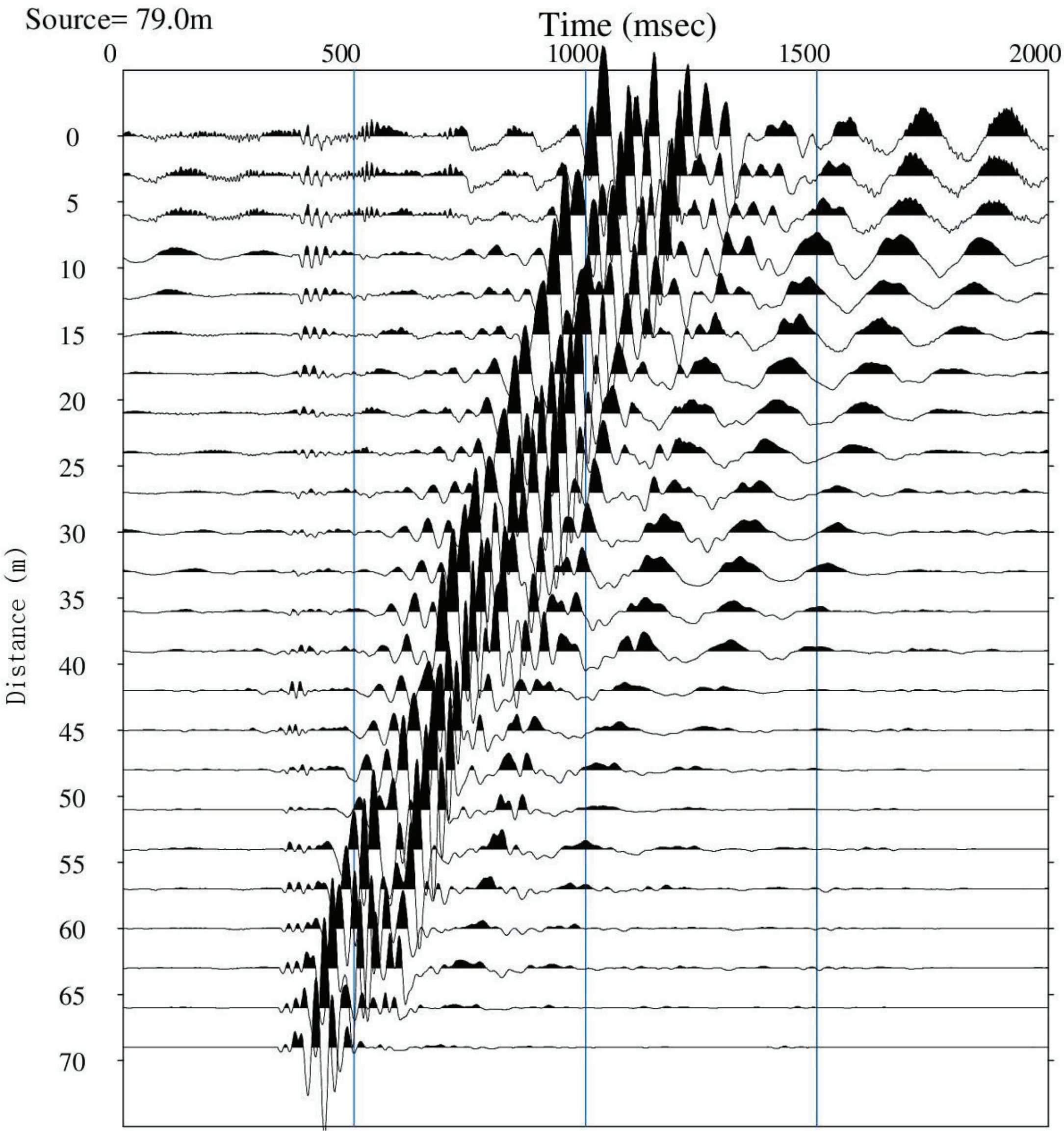


Figure 3: Typical seismic record collected at the site of the MASW Line 2.

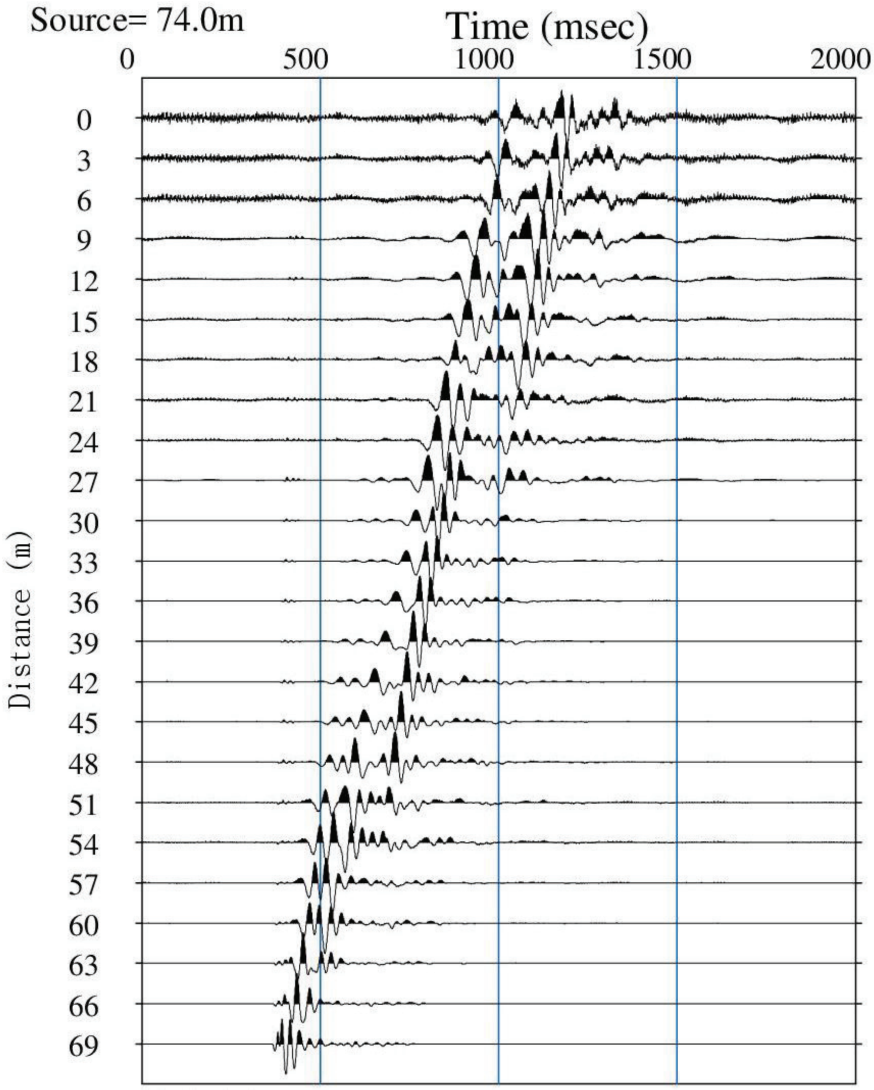


Figure 4: Typical seismic record collected at the site of the MASW Line 3.

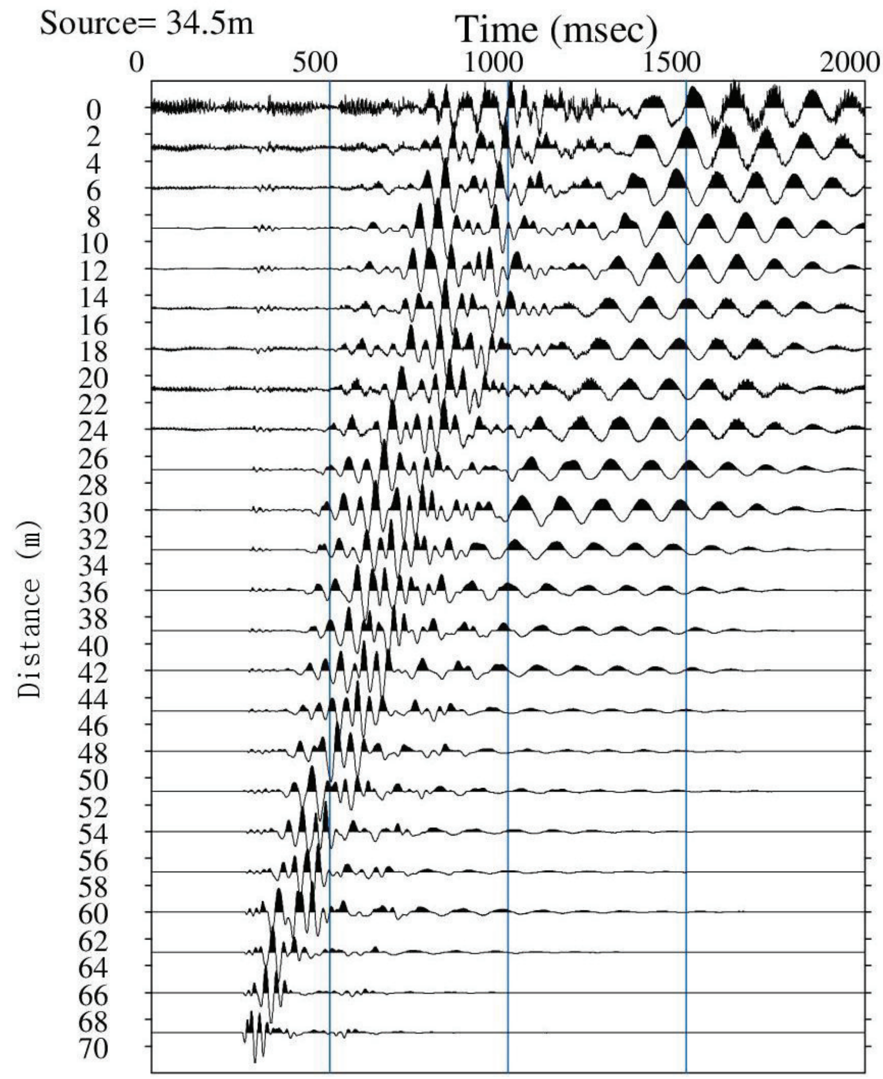


Figure 5: Typical seismic record collected at the site of the MASW Line 4.

Data Processing

Processing of the MASW test results consisted of the following main steps:

1) Transformation of the time domain data into the frequency domain using a Fast-Fourier Transform (FFT) for each source location;
2) Calculation of the phase for each frequency component;
3) Linear regression to calculate phase velocity for each frequency component;
4) Filtering of the calculated phase velocities based on the Pearson correlation coefficient (r2) between the data and the linear regression best fit line used to calculate phase velocity;
5) Generation of the dispersion curve by combining calculated phase velocities for each shot location of a single MASW test; and,

6) Generation of the stiffness profile, through forward iterative modelling and matching of model data to the field collected dispersion curve.

Processing of the MASW data was completed using the SeisImager/SW software package (Geometrics Inc.). The calculated phase velocities for a seismic shot point were combined and the dispersion curve generated by choosing the minimum phase velocity calculated for each frequency component as shown on Figures 6, 7, 8 and 9 for MASW Lines 1, 2, 3, and 4, respectively. Shear wave velocity profiles were generated through inverse modelling to best fit the calculated dispersion curves. The active survey of MASW Lines provided a dispersion curve with a suitable frequency range as summarized in Table 1, below.

Table 1: Summary of Dispersion Curves with Suitable Frequency Ranges

MASW Line	Minimum Frequency (Hz)	Maximum Frequency (Hz)
MASW Line 1	3	38
MASW Line 2	4	26
MASW Line 3	3	35
MASW Line 4	4	22

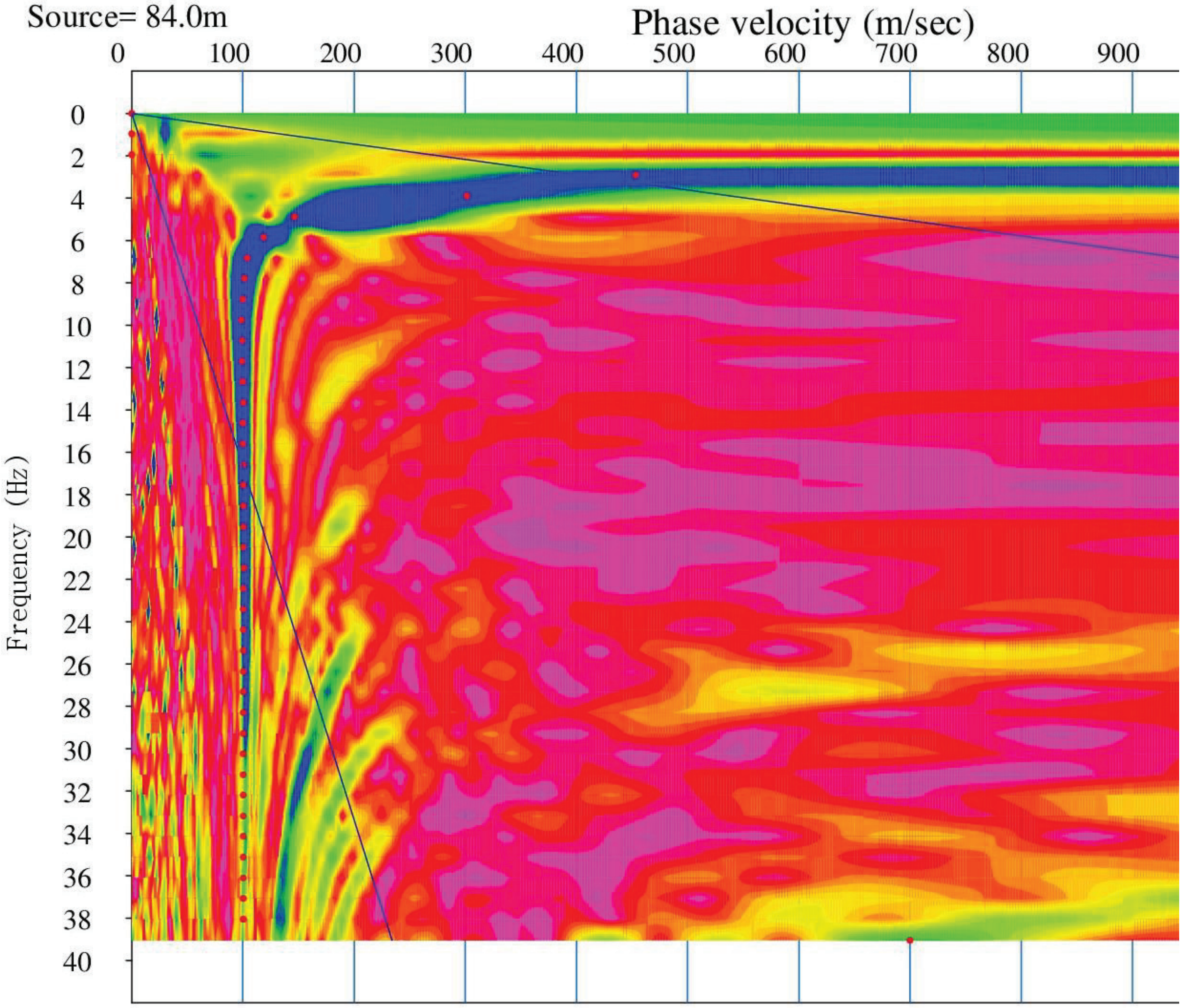


Figure 6: Active MASW Dispersion Curve Picks (red dots) along the MASW Line 1

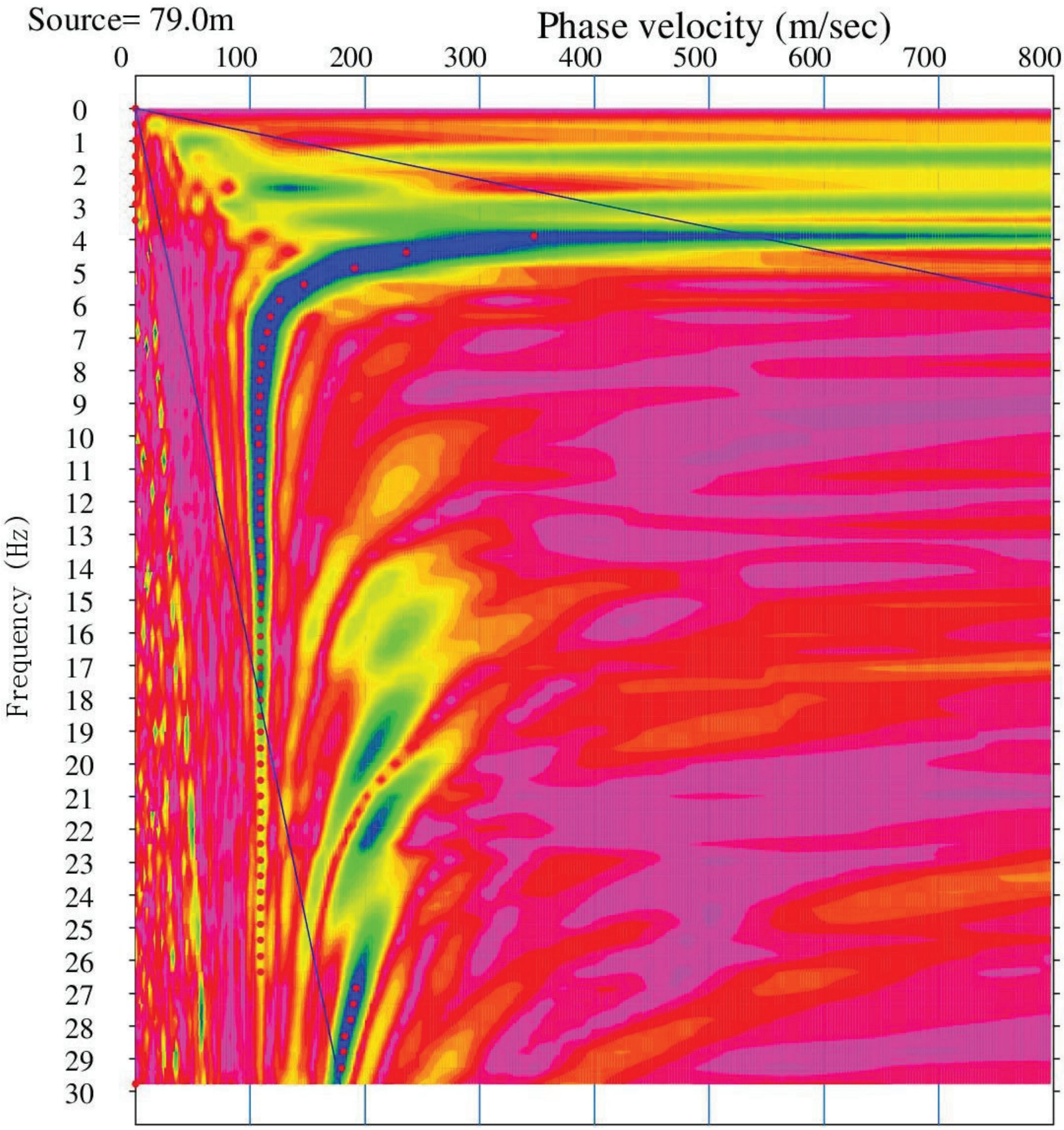


Figure 7: Active MASW Dispersion Curve Picks (red dots) along the MASW Line 2

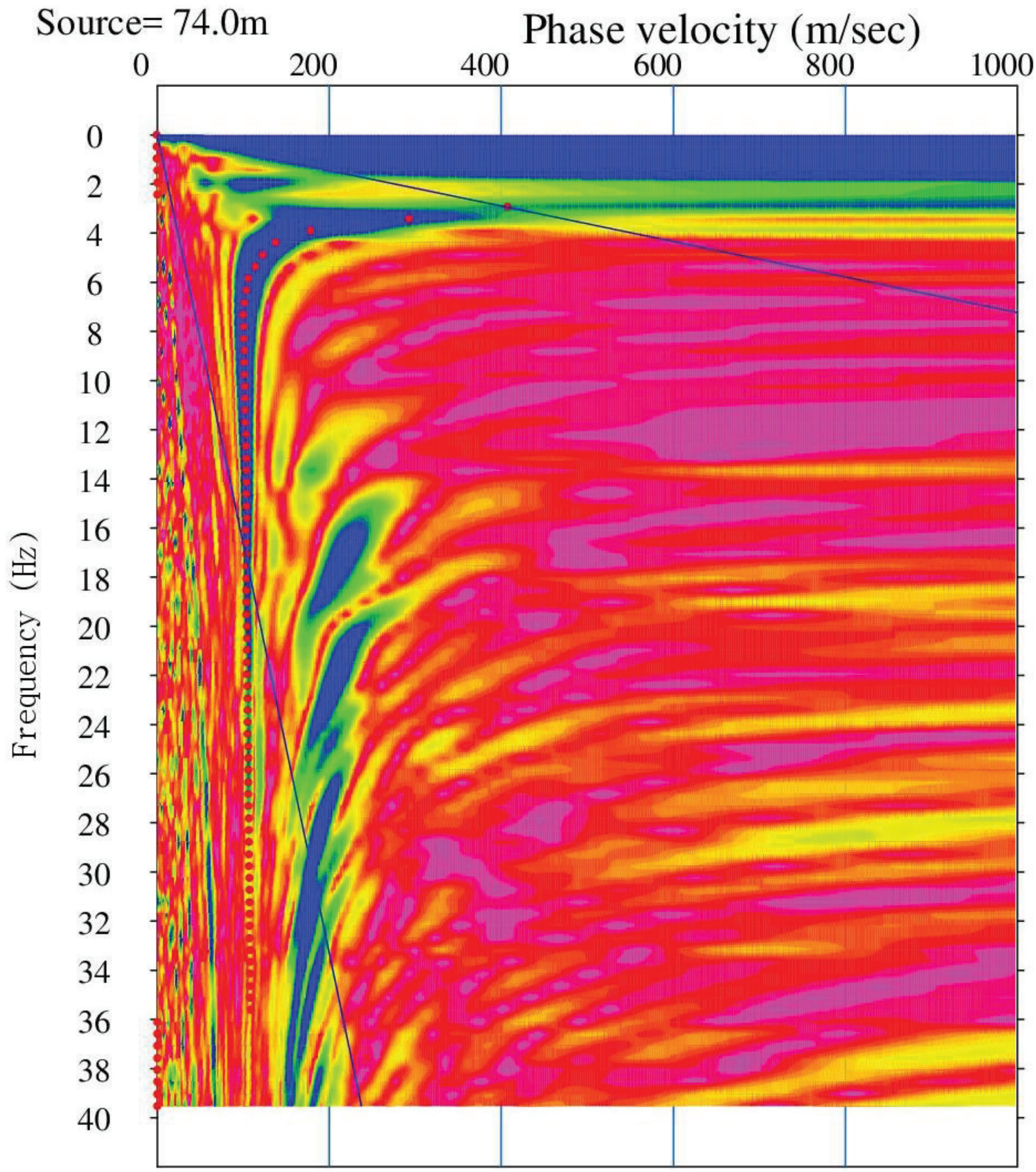


Figure 8: Active MASW Dispersion Curve Picks (red dots) along the MASW Line 3

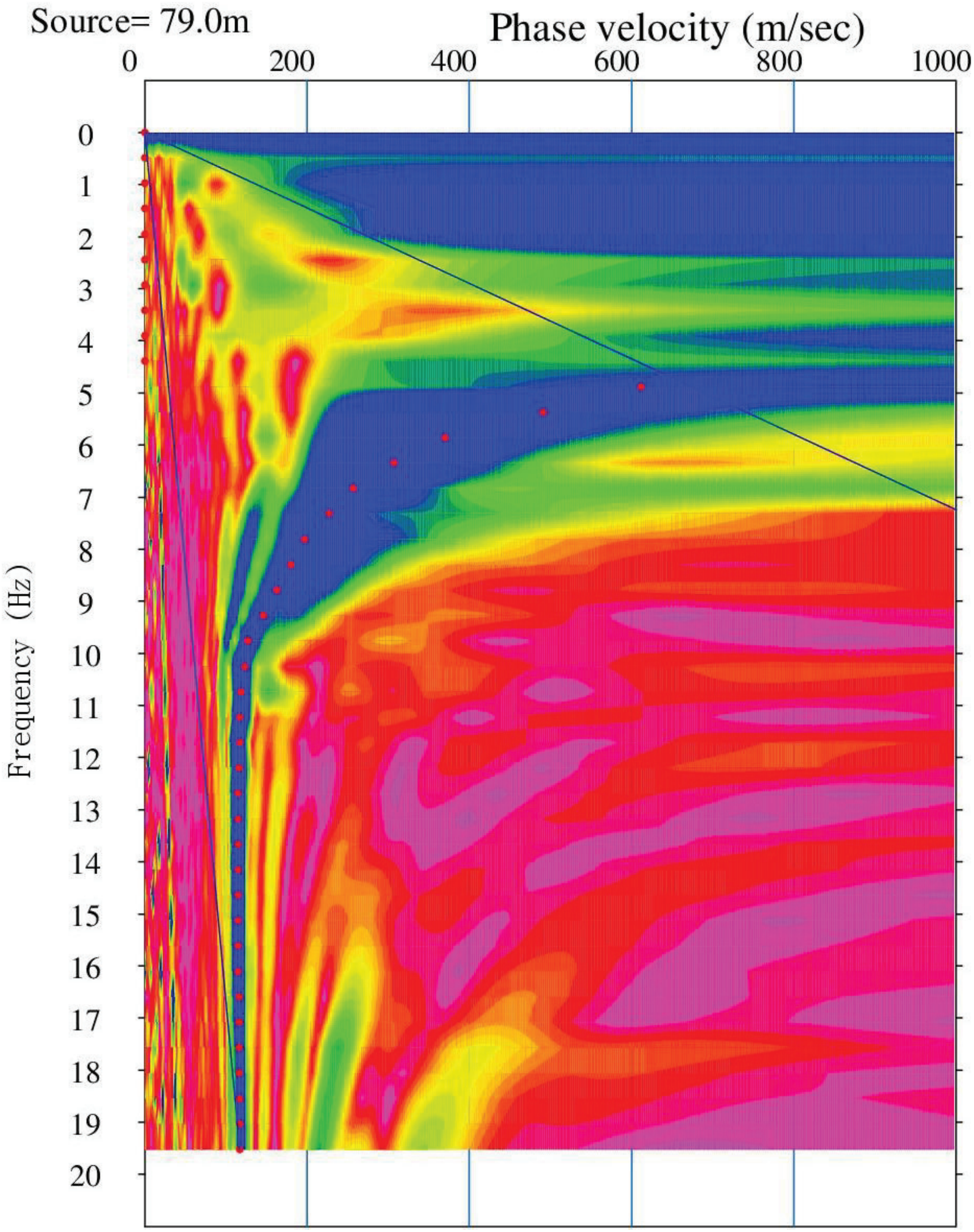


Figure 9: Active MASW Dispersion Curve Picks (red dots) along the MASW Line 4

Results

The MASW test results are presented in Figures 10, 11, 12, and 13 for MASW Lines 1, 2, 3, and 4, respectively. These results present the calculated shear wave velocity profiles derived from the field testing along each MASW line. The field collected dispersion curves are compared with the model generated dispersion curves on Figures 14, 15, 16 and 17 for MASW Lines 1, 2, 3, and 4, respectively. There is a satisfactory correlation between the field collected and model calculated dispersion curves, with a root mean squared error of less than 3% along each MASW line.

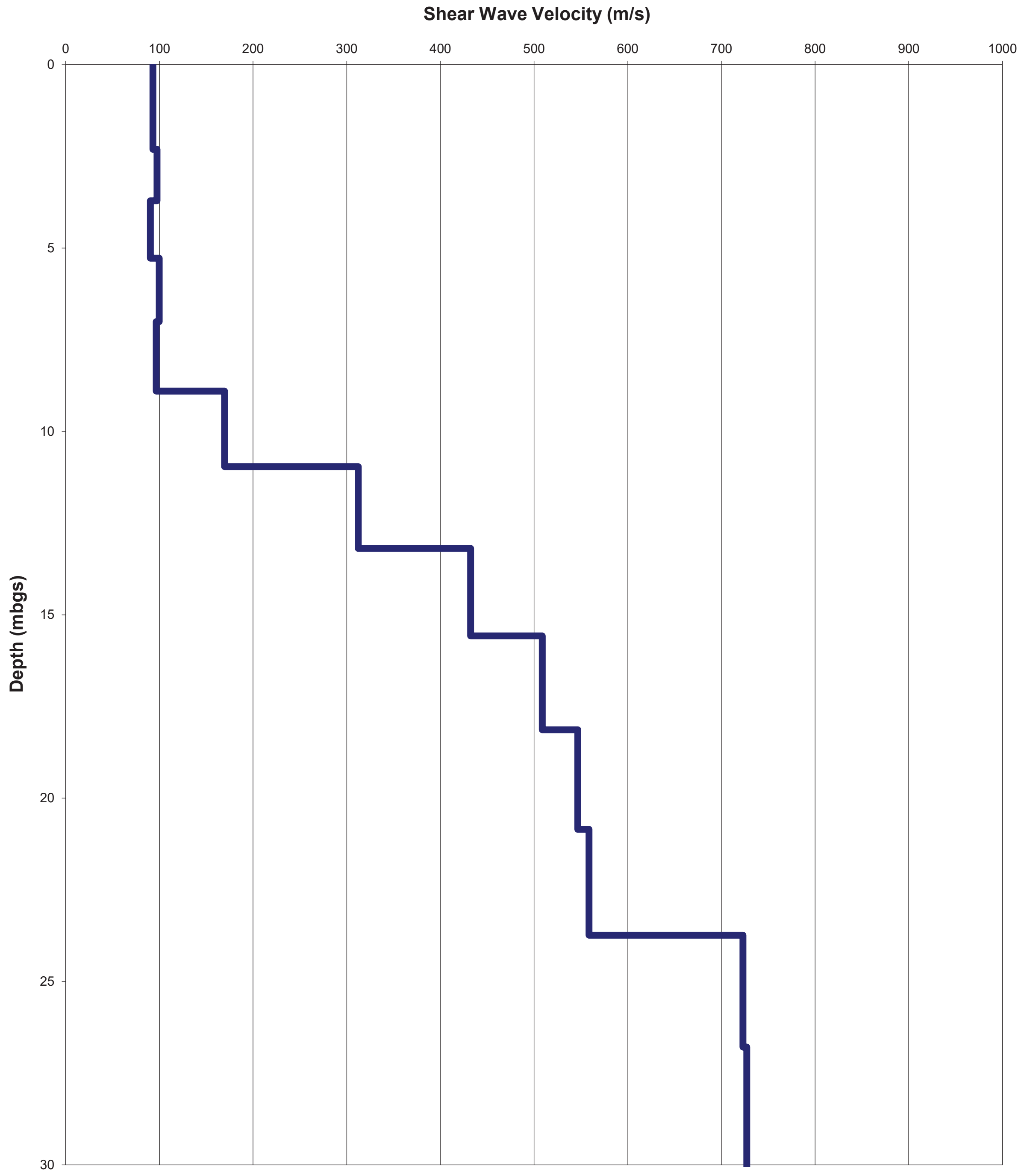


Figure 10: MASW Modelled Shear-Wave Velocity Depth profile along the MASW Line 1

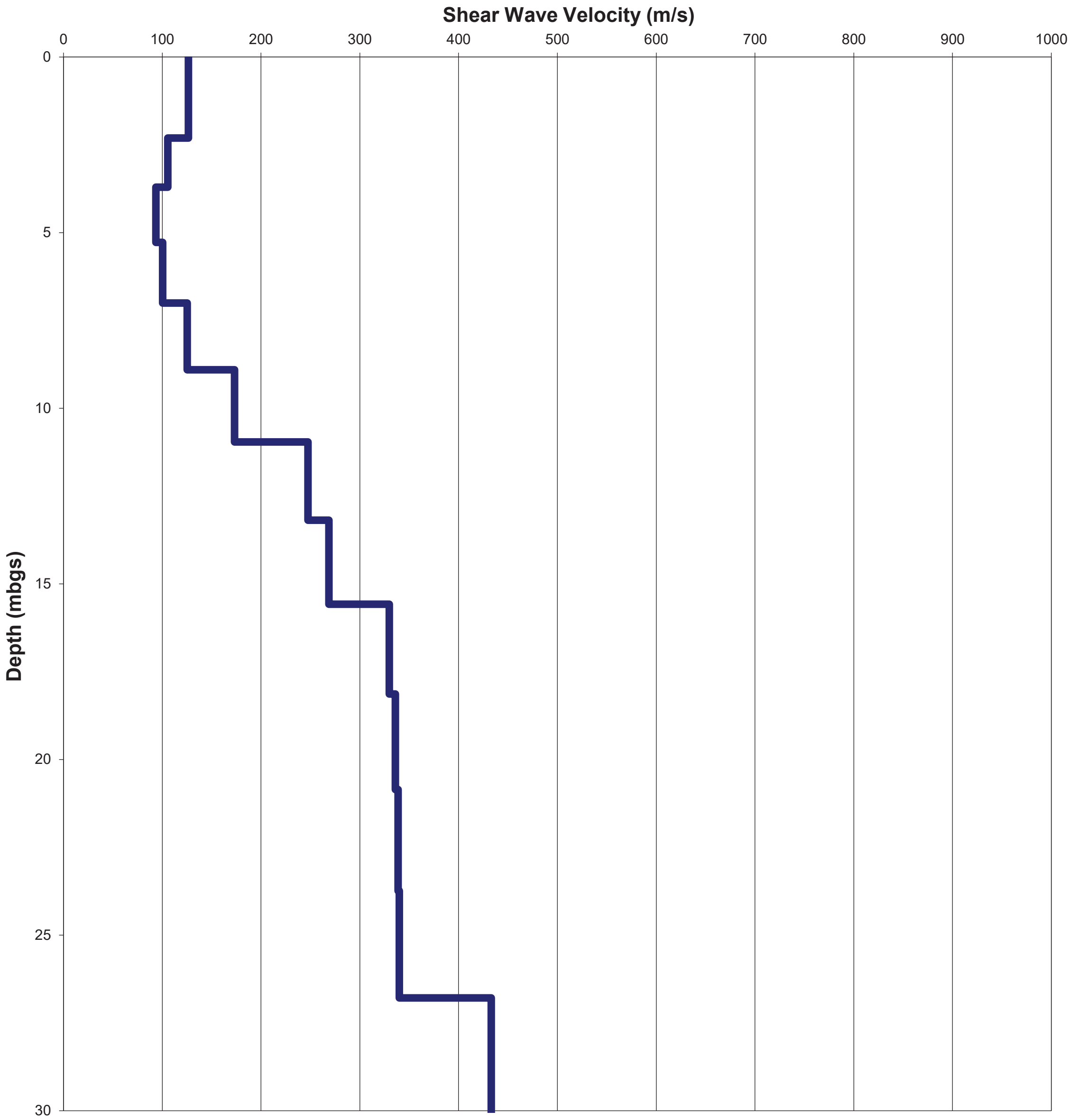


Figure 11: MASW Modelled Shear-Wave Velocity Depth profile along the MASW Line 2

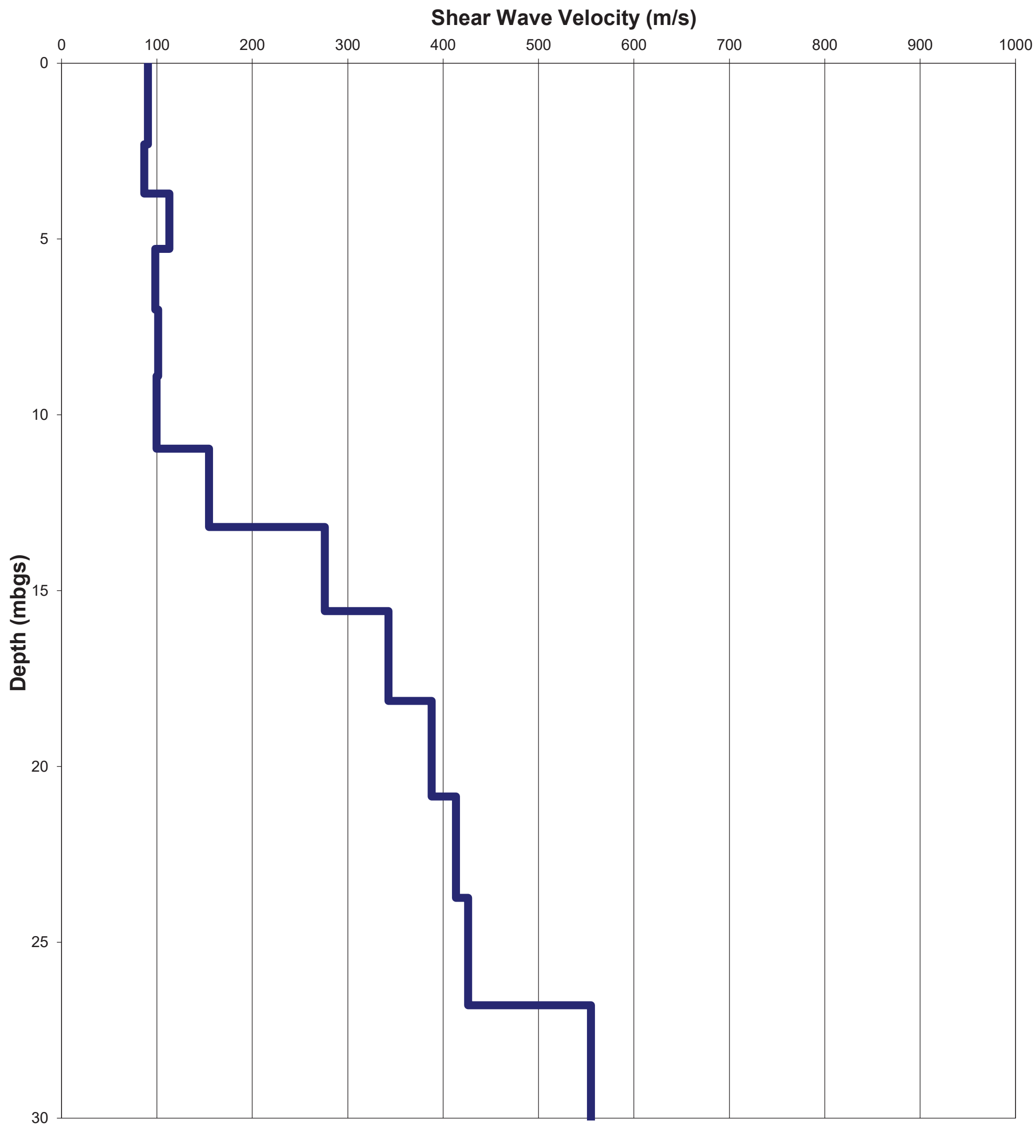


Figure 12: MASW Modelled Shear-Wave Velocity Depth profile along the MASW Line 3

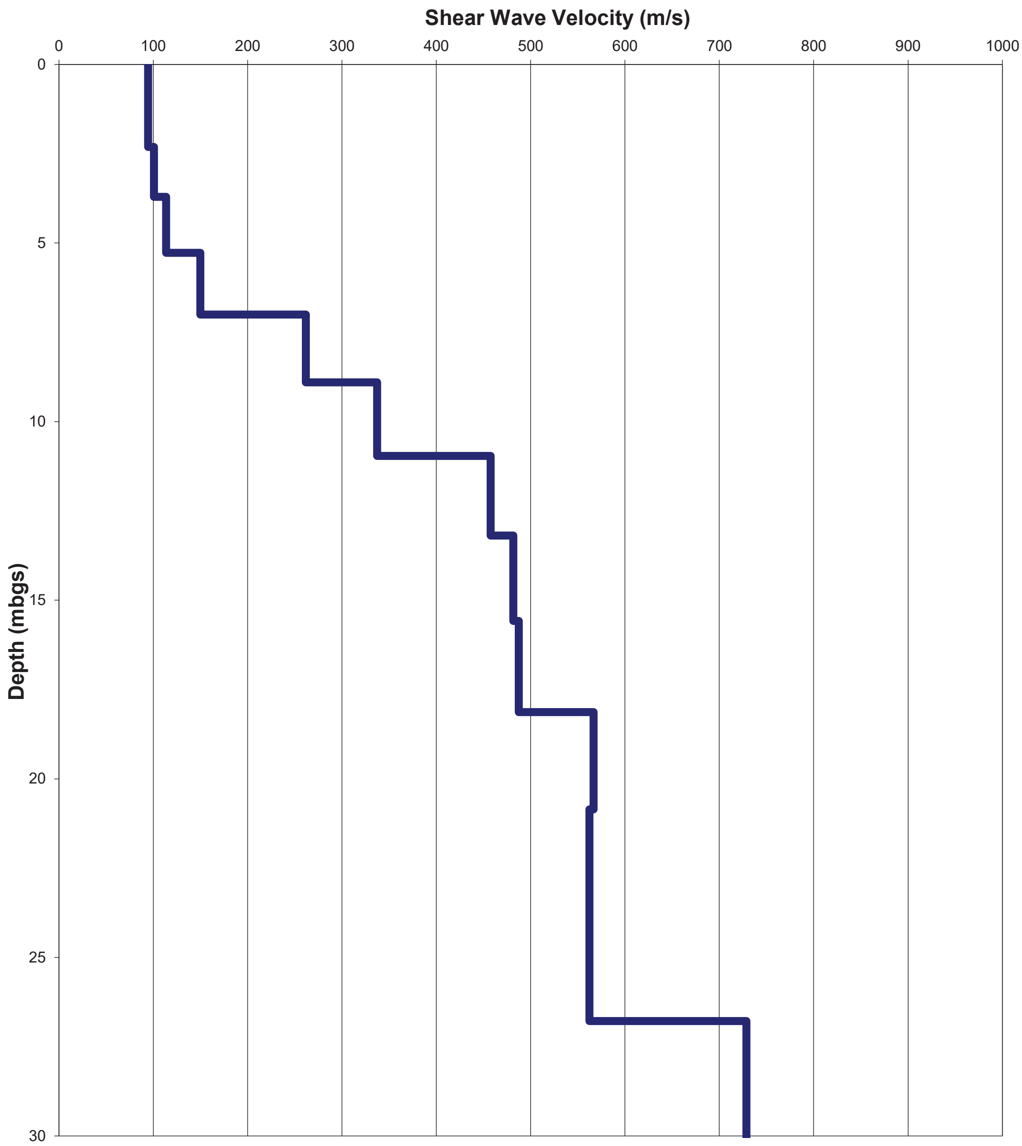


Figure 13: MASW Modelled Shear-Wave Velocity Depth profile along the MASW Line 4

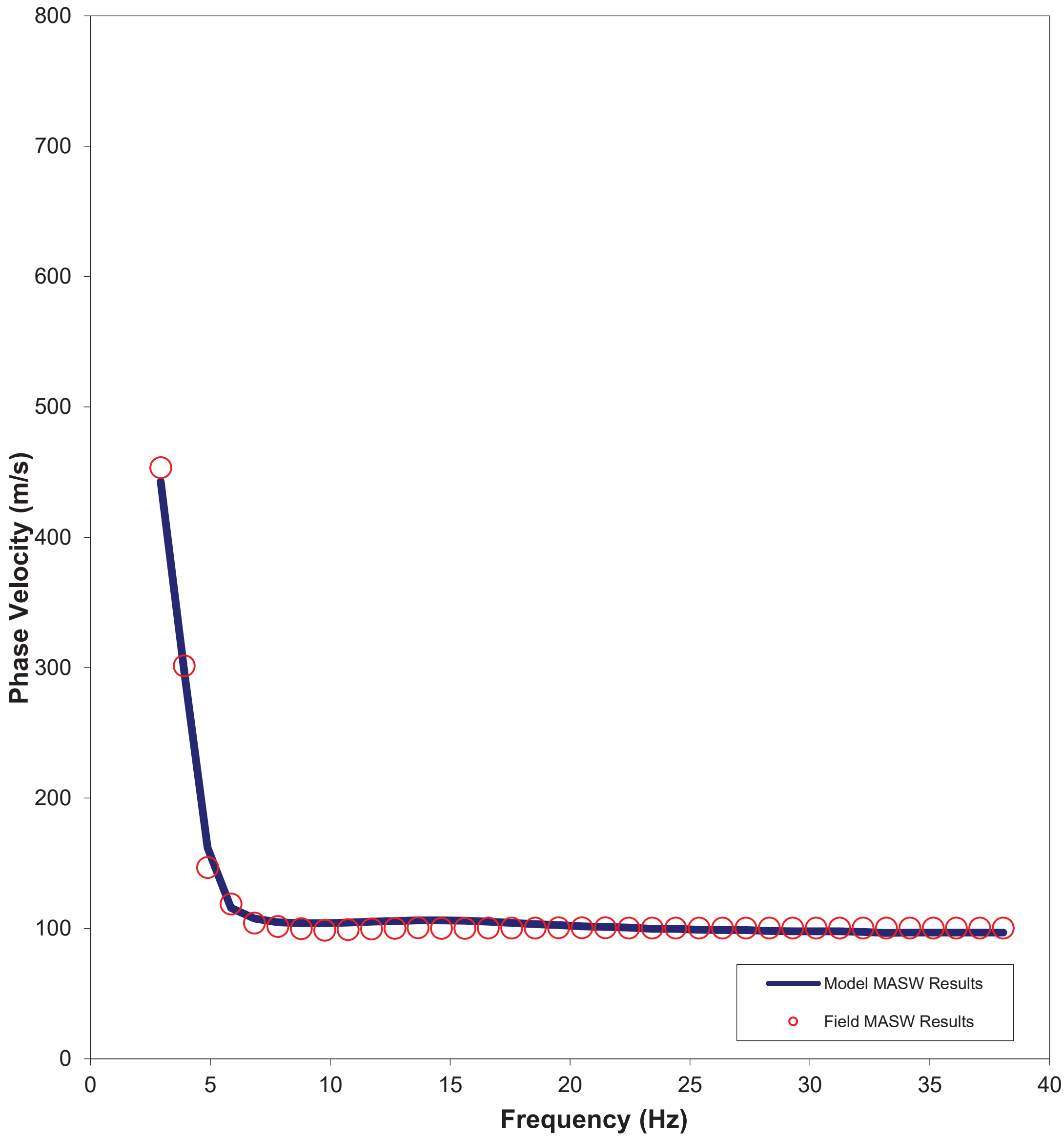


Figure 14: Comparison of Field (red dots) vs. Modelled Data (blue line) along the MASW Line 1

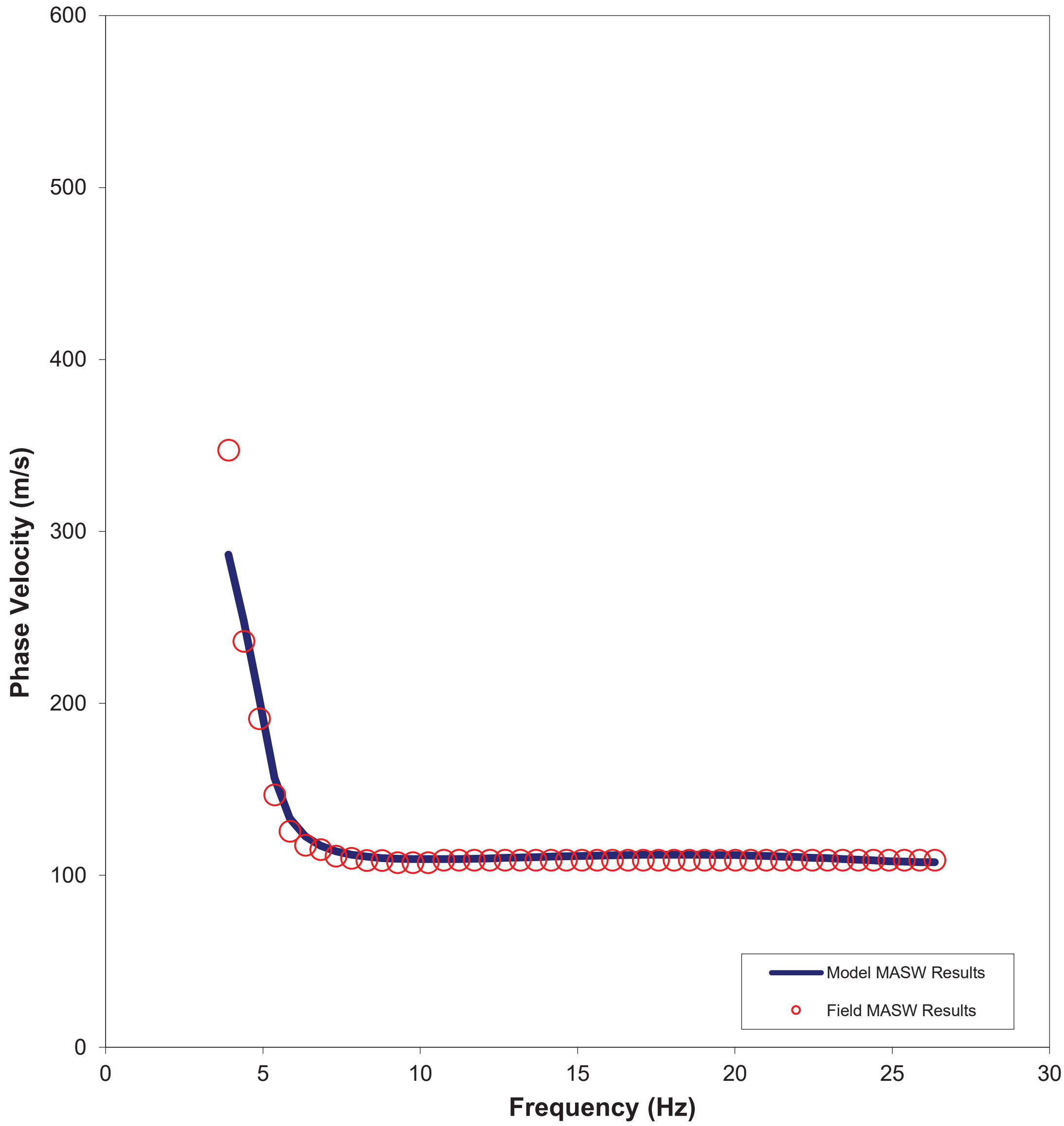


Figure 15: Comparison of Field (red dots) vs. Modelled Data (blue line) along the MASW Line 2

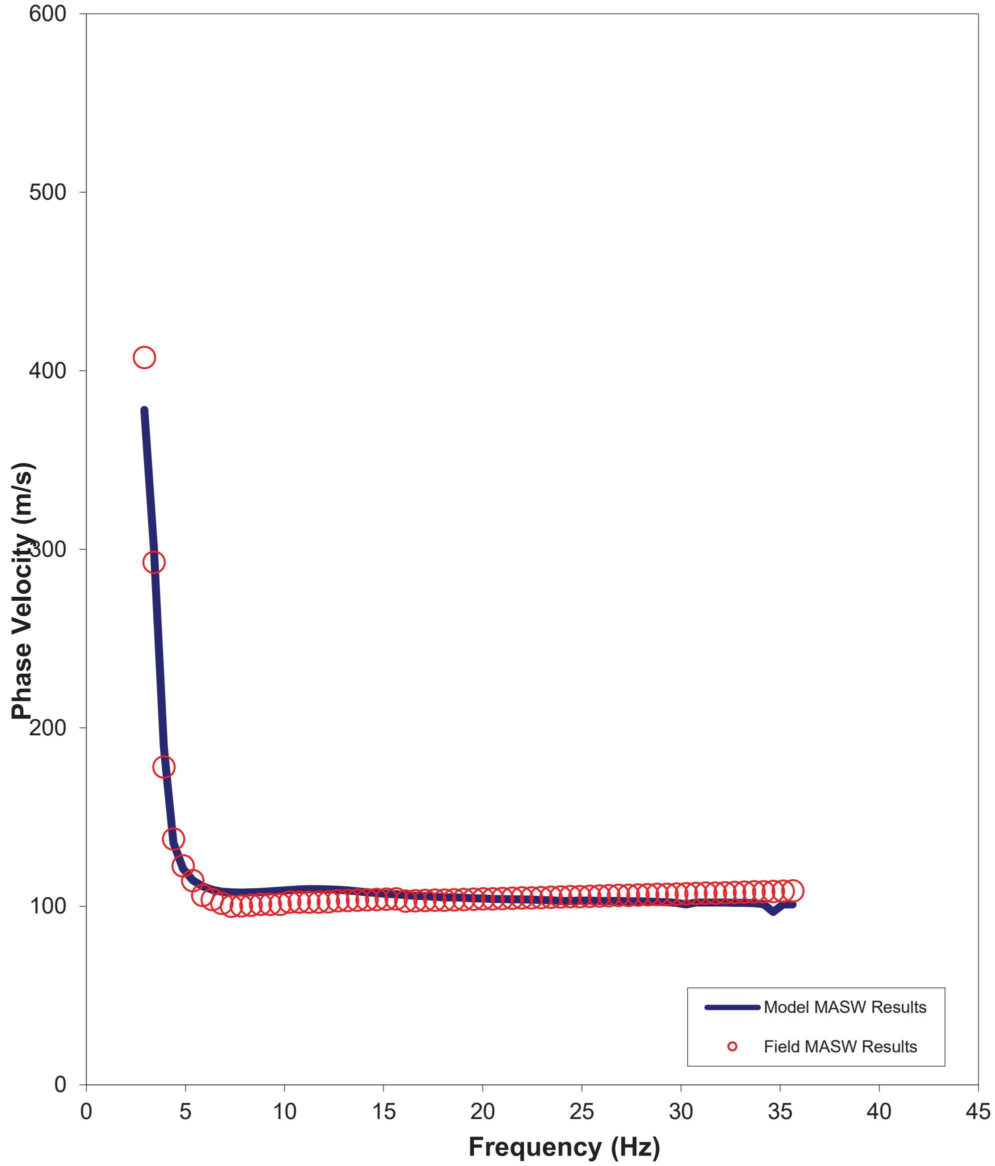


Figure 16: Comparison of Field (red dots) vs. Modelled Data (blue line) along the MASW Line 3

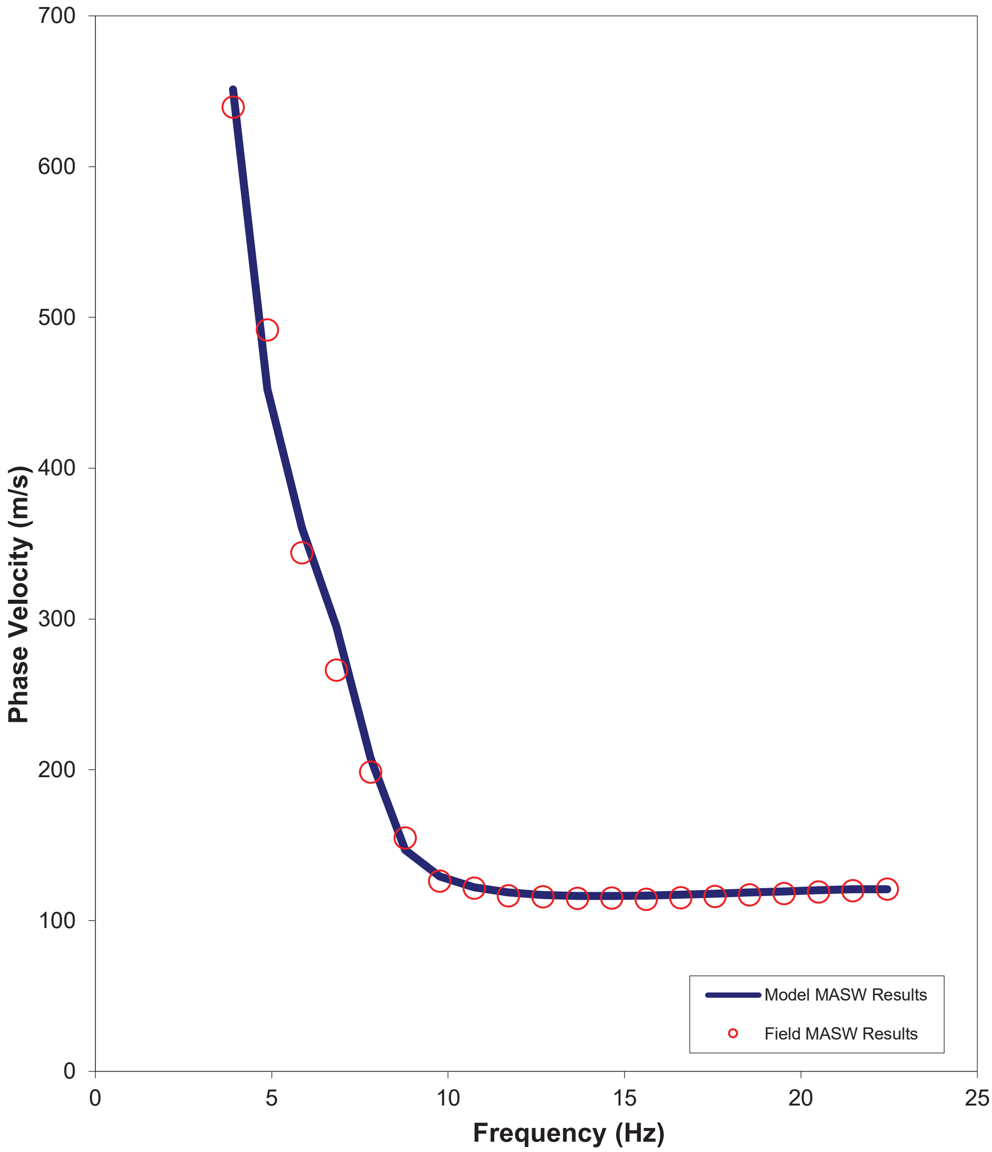


Figure 17: Comparison of Field (red dots) vs. Modelled Data (blue line) along the MASW Line 4

To calculate the average shear-wave velocity as required by the National Building Code of Canada (NBCC 2015), the results were modelled to 30 metres below ground surface. The average shear-wave velocity along MASW Line 1 was found to be 211 m/s (Table 2). The average shear-wave velocity along MASW Line 2 was found to be 198 m/s (Table 3). The average shear-wave velocity along MASW Line 3 was found to be 176 m/s (Table 4). The average shear-wave velocity along MASW Line 4 was found to be 268 m/s (Table 5).

The NBCC 2015 requires special site specific evaluation if certain soil types are encountered on the site, so the site classification stated here should be reviewed, and modified if necessary, according to borehole stratigraphy, standard penetration resistance results, and undrained shear strength measurements, if available for this site.

Table 2: Shear-Wave Velocity Profile along the MASW line 1

Model Layer (mbgs)		Layer Thickness (m)	Shear Wave Velocity (m/s)	Shear Wave Travel Time Through Layer (s)
Top	Bottom			
0.00	1.07	1.07	93	0.011498
1.07	2.31	1.24	93	0.013267
2.31	3.71	1.40	98	0.014353
3.71	5.27	1.57	90	0.017329
5.27	7.01	1.73	100	0.017316
7.01	8.90	1.90	97	0.019599
8.90	10.96	2.06	170	0.012140
10.96	13.19	2.23	312	0.007123
13.19	15.58	2.39	432	0.005528
15.58	18.13	2.55	509	0.005023
18.13	20.85	2.72	547	0.004975
20.85	23.74	2.88	559	0.005163
23.74	26.79	3.05	723	0.004217
26.79	30.00	3.21	727	0.004420
			Vs Average to 30 mbgs (m/s)	**211**

Table 3: Shear-Wave Velocity Profile along the MASW line 2

Model Layer (mbgs)		Layer Thickness (m)	Shear Wave Velocity (m/s)	Shear Wave Travel Time Through Layer (s)
Top	Bottom			
0.00	1.07	1.07	126	0.008475
1.07	2.31	1.24	126	0.009779
2.31	3.71	1.40	106	0.013266
3.71	5.27	1.57	94	0.016742
5.27	7.01	1.73	100	0.017247
7.01	8.90	1.90	125	0.015147
8.90	10.96	2.06	173	0.011895
10.96	13.19	2.23	248	0.008989
13.19	15.58	2.39	269	0.008896
15.58	18.13	2.55	330	0.007747
18.13	20.85	2.72	336	0.008092
20.85	23.74	2.88	339	0.008512
23.74	26.79	3.05	340	0.008967
26.79	30.00	3.21	433	0.007423
			Vs Average to 30 mbgs (m/s)	**198**

Table 4: Shear-Wave Velocity Profile along the MASW line 3

Model Layer (mbgs)		Layer Thickness (m)	Shear Wave Velocity (m/s)	Shear Wave Travel Time Through Layer (s)
Top	Bottom			
0.00	1.07	1.07	91	0.011826
1.07	2.31	1.24	91	0.013646
2.31	3.71	1.40	87	0.016153
3.71	5.27	1.57	113	0.013867
5.27	7.01	1.73	98	0.017616
7.01	8.90	1.90	101	0.018731
8.90	10.96	2.06	100	0.020696
10.96	13.19	2.23	155	0.014399
13.19	15.58	2.39	276	0.008661
15.58	18.13	2.55	343	0.007453
18.13	20.85	2.72	388	0.007012
20.85	23.74	2.88	414	0.006976
23.74	26.79	3.05	426	0.007158
26.79	30.00	3.21	555	0.005790
			Vs Average to 30 mbgs (m/s)	**176**

Table 5: Shear-Wave Velocity Profile along the MASW line 4

Model Layer (mbgs)		Layer Thickness (m)	Shear Wave Velocity (m/s)	Shear Wave Travel Time Through Layer (s)
Top	Bottom			
0.00	1.07	1.07	94	0.011341
1.07	2.31	1.24	94	0.013085
2.31	3.71	1.40	101	0.013903
3.71	5.27	1.57	114	0.013779
5.27	7.01	1.73	150	0.011561
7.01	8.90	1.90	262	0.007243
8.90	10.96	2.06	337	0.006109
10.96	13.19	2.23	458	0.004864
13.19	15.58	2.39	481	0.004964
15.58	18.13	2.55	487	0.005242
18.13	20.85	2.72	567	0.004800
20.85	23.74	2.88	562	0.005131
23.74	26.79	3.05	562	0.005424
26.79	30.00	3.21	729	0.004411
			Vs Average to 30 mbgs (m/s)	**268**

Limitations

This technical memorandum is based on data and information collected by Golder Associates Ltd. and is based solely on the conditions of the properties at the time of the work, supplemented by historical information and data obtained by Golder Associates Ltd. as described in this memo.

Golder Associates Ltd. has relied in good faith on all information provided and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the reports as a result of omissions, misinterpretation, or fraudulent acts of the persons contacted or errors or omissions in the reviewed documentation.

The services performed, as described in this memo, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

Any use which a third party makes of this memo, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this memo.

The findings and conclusions of this memo are valid only as of the date of this memo. If new information is discovered in future work, including excavations, borings, or other studies, Golder Associates Ltd. should be requested to re-evaluate the conclusions of this memo, and to provide amendments as required.

Closure

We trust that this technical memorandum meets your needs at the present time. If you have any questions or require clarification, please contact the undersigned at your convenience.

GOLDER ASSOCIATES LTD.

Stephane Sol, Ph.D., P. Geo.
Senior Geophysicist

Christopher Phillips, M.Sc., P. Geo.
Senior Geophysicist, Principal

SS/CRP/jl

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GOLDER

TABLE 2 - SHRINKAGE LIMIT DETERMINATIONS

Borehole Number	18-08	
Sample Number	4	
Depth, m	3.05-3.66	
Shrinkage Dish Number	1	2
Mass of the dry soil pat, g	17.68	17.48
Mass of dry soil pat + shrinkage dish, g	40.84	39.71
Mass of shrinkage dish, g	23.16	22.23
Volume of shrinkage dish, cm^3	13.40	13.33
Mass of wet soil + shrinkage dish, g	47.81	46.61
Moisture content of the soil	39.42	39.47
Mass of dry soil pat before waxing, g	17.68	17.48
Volume of dry soil pat + wax, cm^3	14.46	15.79
Mass of dry soil pat + wax in air, g	22.22	23.28
Mass of dry soil pat + wax in water, g	7.76	7.49
Mass of wax, g	4.54	5.80
Volume of wax, cm^3	4.91	6.27
Specific gravity of wax	0.925	0.925
Volume of dry soil pat, cm^3	9.55	9.52
SHRINKAGE LIMIT, SL	**17.66**	**17.68**
SHRINKAGE RATIO, R	**1.85**	**1.84**
Project Numb 18108333 (2000)	Date Tested	December 3, 2018
Tested By X. Meng	Checked By	[signature]

Notes:
Shrinkage limits of samples determined according to ASTM D4943-18 standard.
Test carried out using wax method.
Microsere Wax 5214.

Certificate of Analysis

eurofins | Environment Testing

Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Mr. Alex Meacoe
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1821076
Date Submitted: 2018-11-20
Date Reported: 2018-11-27
Project: 18108333/1000
COC #: 838159

Group	Analyte	MRL	Units	Guideline	1400203	1400204	1400205	1400206
				Lab I.D.	1400203	1400204	1400205	1400206
				Sample Matrix	Soil	Soil	Soil	Soil
				Sample Type				
				Sampling Date	2018-11-01	2018-10-29	2018-10-30	2018-11-07
				Sample I.D.	18-24 sa3/5-7'	18-25 sa3/5-7'	18-29 sa3/5-7'	18-06 sa3A/5.5-6'8"
Anions	Cl	0.002	%		<0.002	<0.002	<0.002	<0.002
	SO4	0.01	%		<0.01	<0.01	<0.01	0.05
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.30	0.18	0.19	0.24
	pH	2.00			7.43	7.96	8.00	7.15
	Resistivity	1	ohm-cm		3330	5880	5260	4170

Group	Analyte	MRL	Units	Guideline	1400207
				Lab I.D.	1400207
				Sample Matrix	Soil
				Sample Type	
				Sampling Date	2018-11-08
				Sample I.D.	18-09 sa3/5-7'
Anions	Cl	0.002	%		<0.002
	SO4	0.01	%		0.01
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.18
	pH	2.00			7.97
	Resistivity	1	ohm-cm		5560

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

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Client:	Golder Associates Ltd. (Ottawa) 1931 Robertson Road Ottawa, ON K2H 5B7	Report Number:	1702391
Attention:	Ms. Kim MacDonald	Date Submitted:	2017-02-17
PO#:		Date Reported:	2017-02-22
Invoice to:	Golder Associates Ltd. (Ottawa)	Project:	1771847
		COC #:	815762

Group	Analyte	MRL	Units	Guideline			
				Lab I.D.	1281581	1281582	1281583
				Sample Matrix	Soil	Soil	Soil
				Sample Type			
				Sampling Date	2017-02-02	2017-02-03	2017-02-14
				Sample I.D.	BH 17-1 SA 1/2.5-4.5	BH 17-10 SA2/2.5-4.5	BH 17-14 SA1/2.5-4.5
General Chemistry	Cl	0.002	%		0.003	0.003	0.004
	Electrical Conductivity	0.05	mS/cm		0.20	0.15	0.18
	pH	2.0			7.4	7.1	6.9
	Resistivity	1	ohm-cm		5000	6670	5560
	SO4	0.01	%		0.01	<0.01	<0.01

Guideline = *** = Guideline Exceedence**

All analysis completed in Ottawa, Ontario (unless otherwise indicated by ** which indicates analysis was completed in Mississauga, Ontario).
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

eurofins | Environment Testing

Client:	Golder Associates Ltd. (Ottawa) 1931 Robertson Road Ottawa, ON K2H 5B7	Report Number:	1705915
Attention:	Mr. Steve Dunlop	Date Submitted:	2017-04-21
PO#:		Date Reported:	2017-04-28
Invoice to:	Golder Associates Ltd. (Ottawa)	Project:	1771847
		COC #:	817524

Group	Analyte	MRL	Units	Guideline	1289218	1289219	1289220	1289221
				Lab I.D.	1289218	1289219	1289220	1289221
				Sample Matrix	Soil	Soil	Soil	Soil
				Sample Type				
				Sampling Date	2017-03-30	2017-03-30	2017-03-30	2017-03-30
				Sample I.D.	BH17-19 sa2 5-7	BH17-29 sa2 5-7	BH17-37 sa2 5-7	BH17-47 sa2 5-7
Agri. - Soil	pH	2.0			8.0	8.0	8.0	8.1
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.22	0.19	0.20	0.19
	Resistivity	1	ohm-cm		4540	5260	5000	5260
	SO4	0.01	%		<0.01	<0.01	<0.01	<0.01
Subcontract	Cl	0.002	%		<0.002	0.003	0.002	<0.002

Group	Analyte	MRL	Units	Guideline	1289222
				Lab I.D.	1289222
				Sample Matrix	Soil
				Sample Type	
				Sampling Date	2017-03-30
				Sample I.D.	BH17-57 sa2 5-7
Agri. - Soil	pH	2.0			8.0
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.16
	Resistivity	1	ohm-cm		6250
	SO4	0.01	%		<0.01
Subcontract	Cl	0.002	%		<0.002

Guideline = *** = Guideline Exceedence**

All analysis completed in Ottawa, Ontario (unless otherwise indicated by ** which indicates analysis was completed in Mississauga, Ontario).
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

146 Colonnade Rd. Unit 8, Ottawa, ON K2E 7Y1

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 to 5 – SLOPE STABILITY ANALYSIS SECTIONS

FIGURE 6 – TEST FILL PILE SETTLEMENT MONITORING PROGRAM

DRAWING5036-4 - TEST HOLE LOCATION PLAN

DRAWING5036-5 - PERMISSIBLE GRADE RAISE PLAN

DRAWING5036-6 - TREE PLANTING SETBACK RECOMMENDATIONS

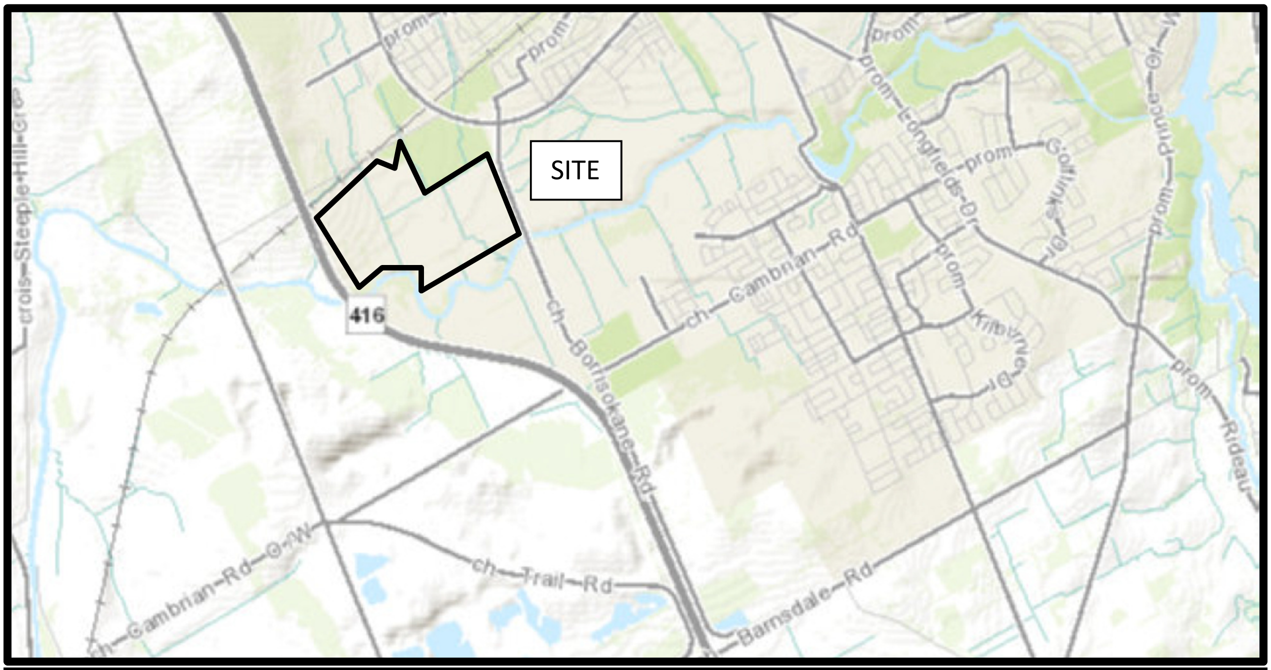
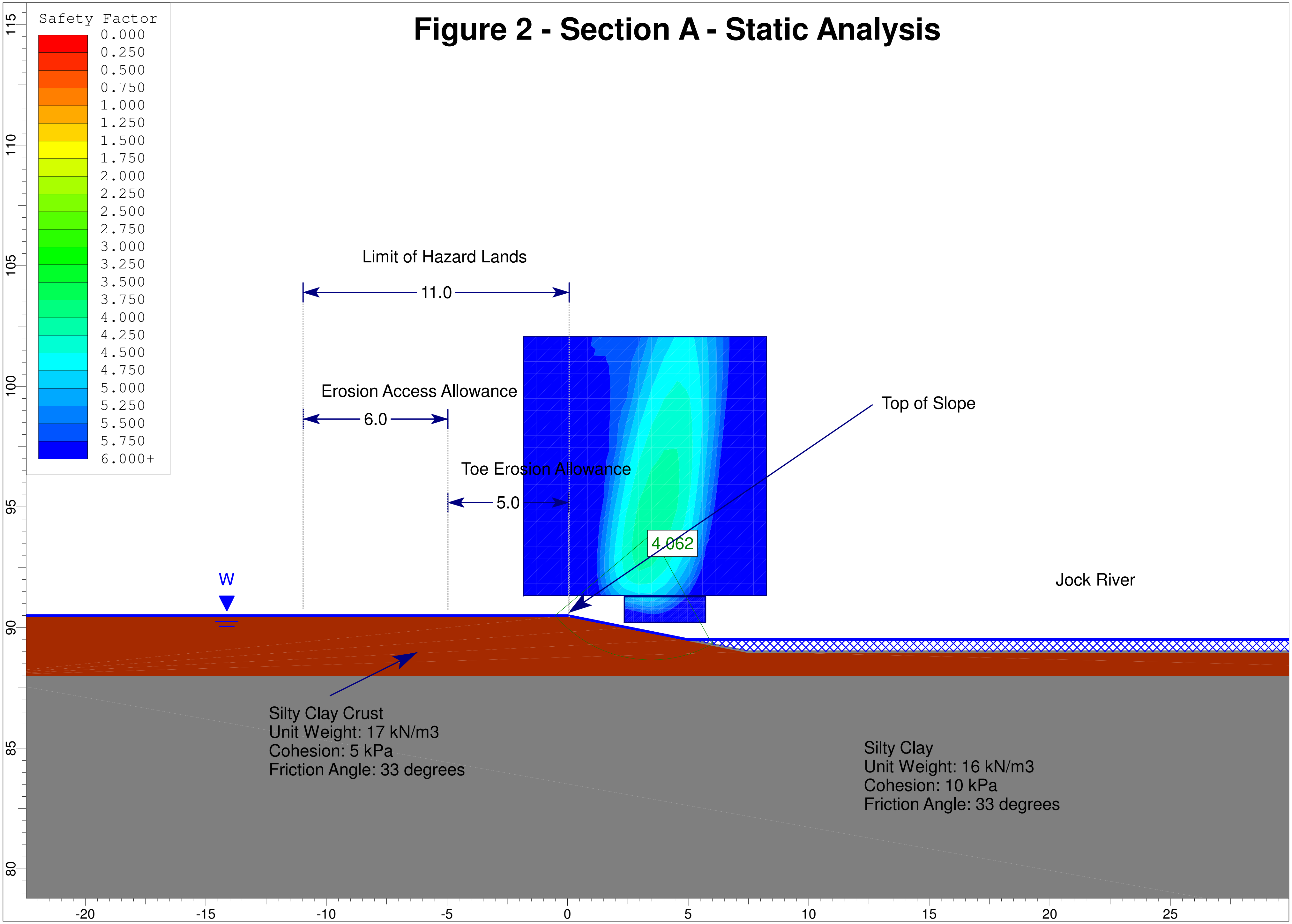


FIGURE 1

KEY PLAN

Figure 2 - Section A - Static Analysis



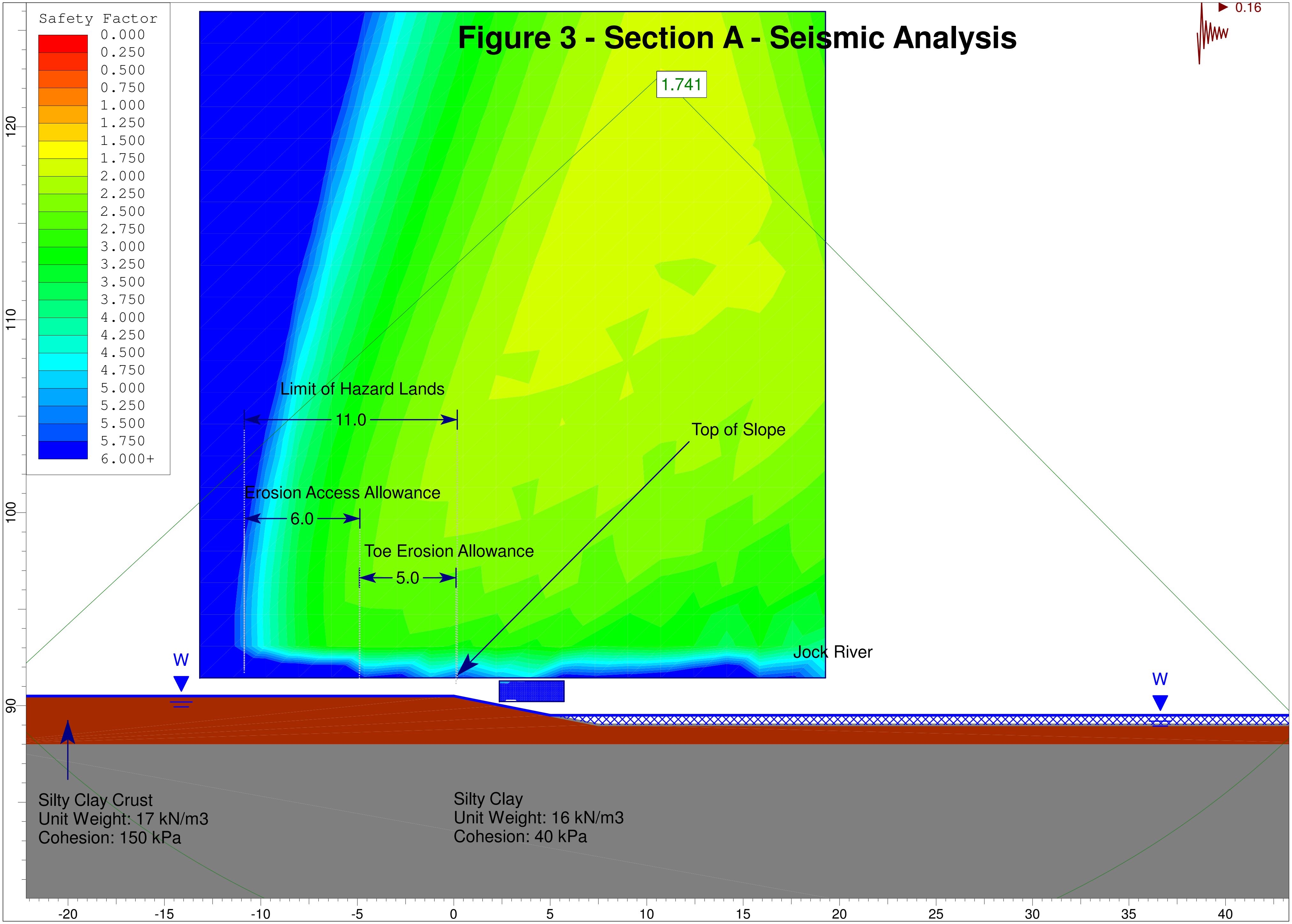


Figure 3 - Section A - Seismic Analysis
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
1.741
Limit of Hazard Lands
11.0
Erosion Access Allowance
6.0
Toe Erosion Allowance
5.0
Top of Slope
Jock River
W
W
Silty Clay Crust
Unit Weight: 17 kN/m3
Cohesion: 150 kPa
Silty Clay
Unit Weight: 16 kN/m3
Cohesion: 40 kPa
120
110
100
90
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40

Figure 4 - Section B - Static Analysis

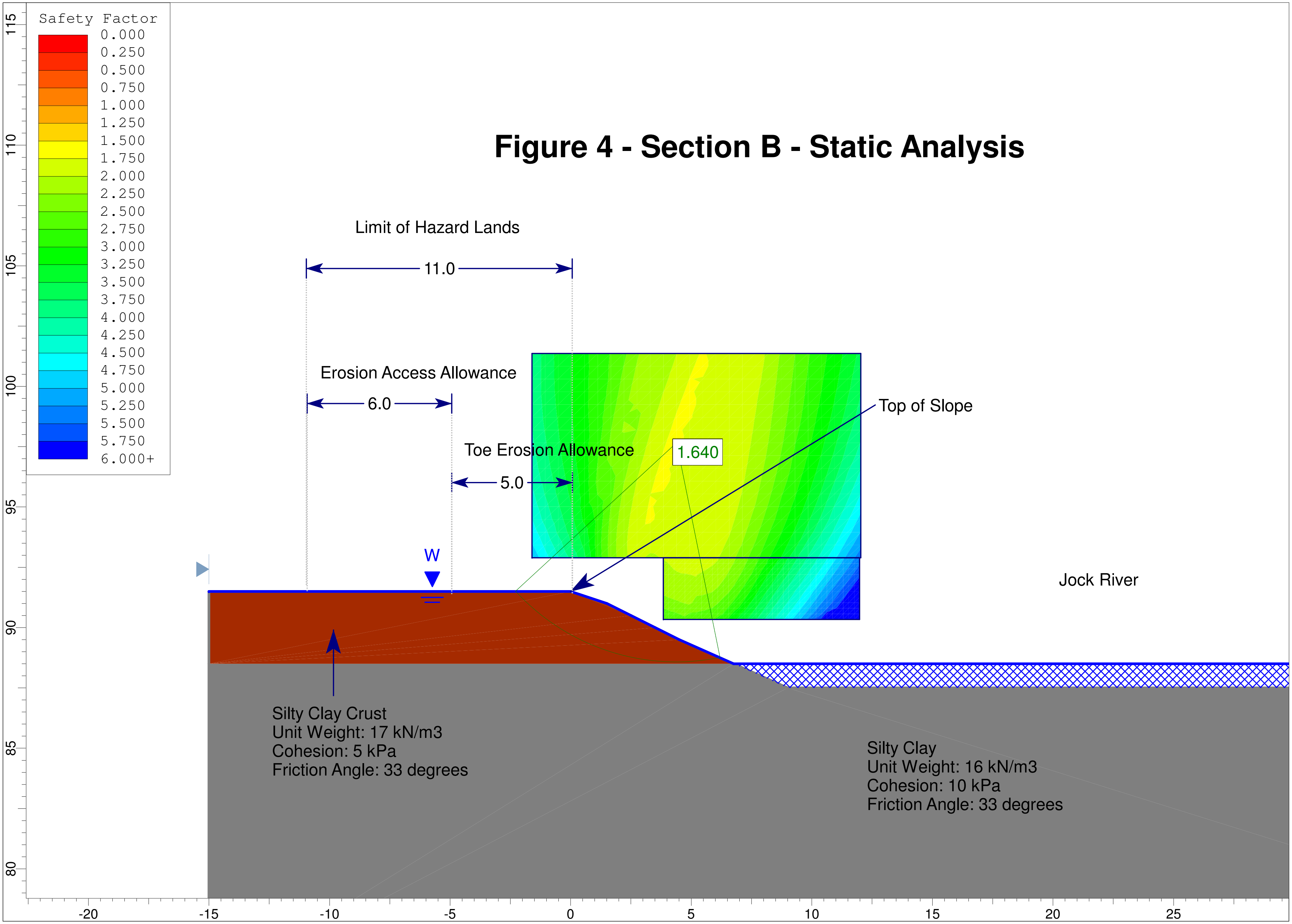
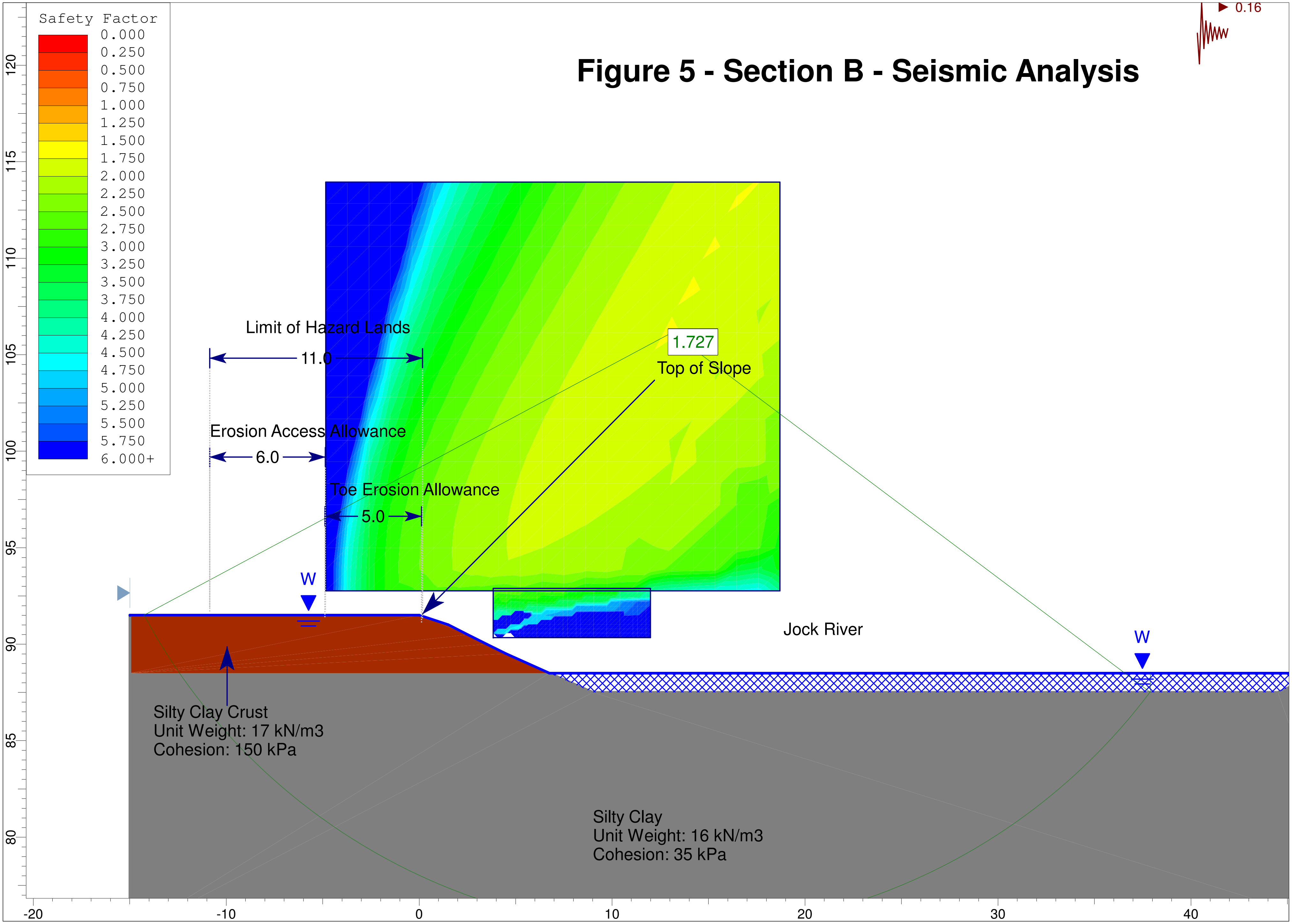


Figure 5 - Section B - Seismic Analysis



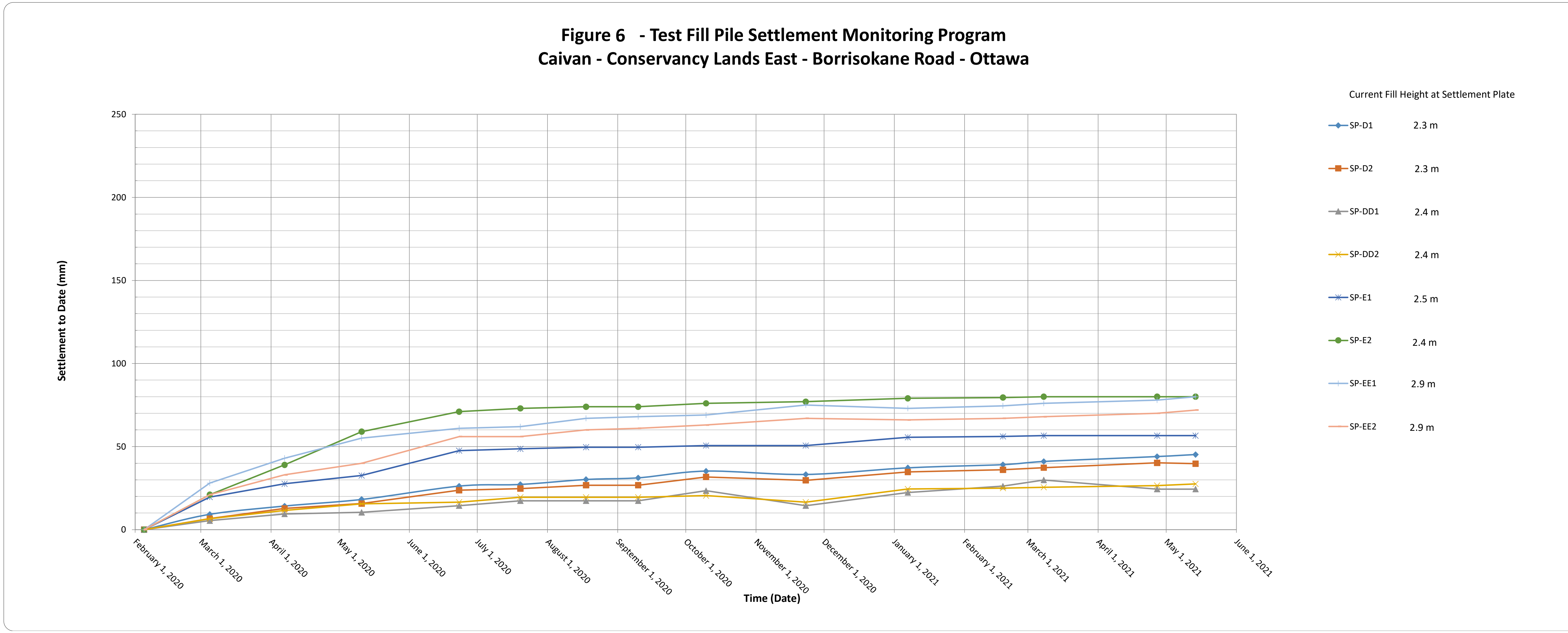
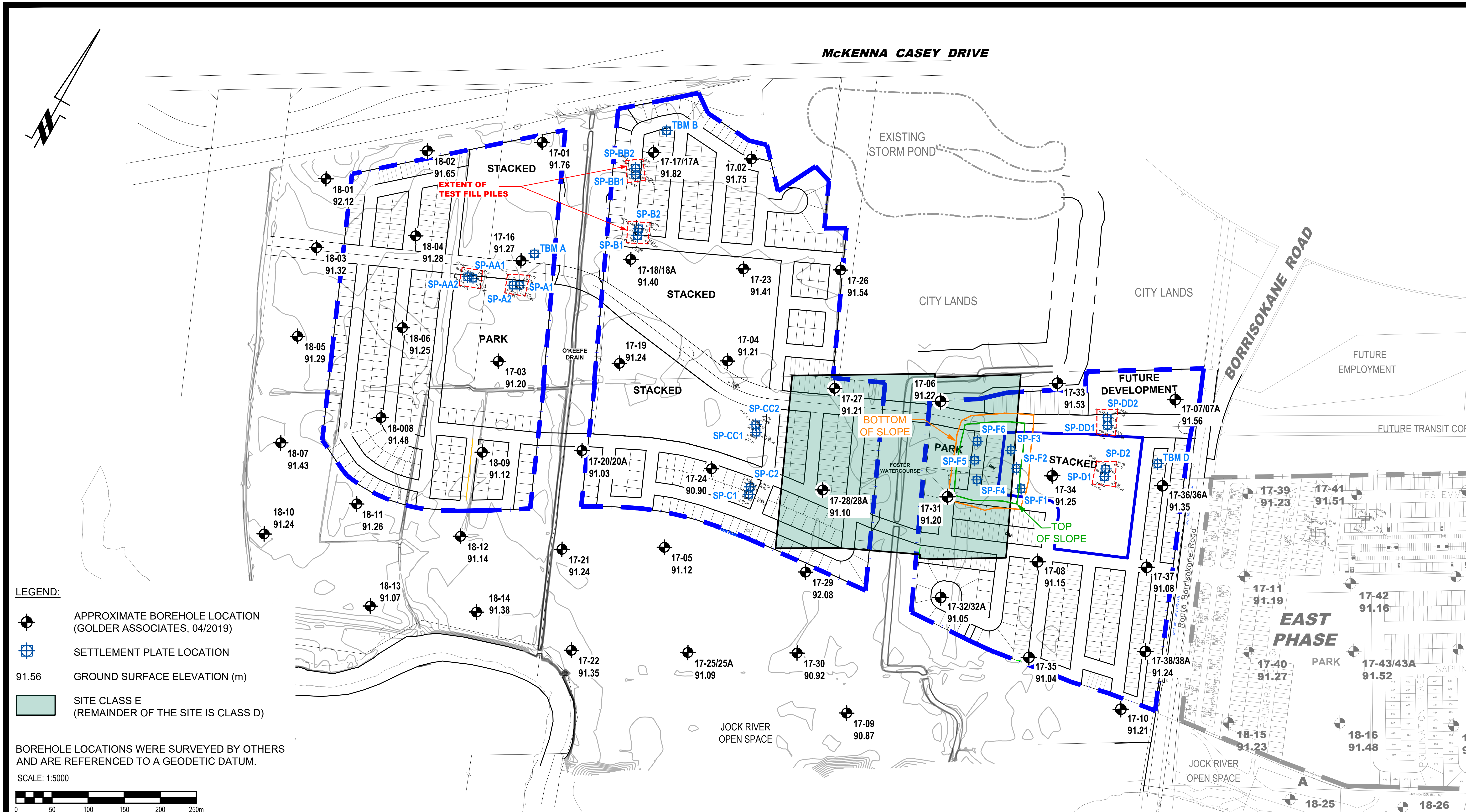


Figure 6 - Test Fill Pile Settlement Monitoring Program
Caivan - Conservancy Lands East - Borrisokane Road - Ottawa
Settlement to Date (mm)
250
200
150
100
50
0
Time (Date)
February 1, 2020
March 1, 2020
April 1, 2020
May 1, 2020
June 1, 2020
July 1, 2020
August 1, 2020
September 1, 2020
October 1, 2020
November 1, 2020
December 1, 2020
January 1, 2021
February 1, 2021
March 1, 2021
April 1, 2021
May 1, 2021
June 1, 2021
Current Fill Height at Settlement Plate
SP-D1 2.3 m
SP-D2 2.3 m
SP-DD1 2.4 m
SP-DD2 2.4 m
SP-E1 2.5 m
SP-E2 2.4 m
SP-EE1 2.9 m
SP-EE2 2.9 m



PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
3	UPDATED TO LATEST CONCEPTUAL PLAN REVISED SITE BOUNDARIES	04/03/2024	KP
2	UPDATED TO LATEST CONCEPTUAL PLAN	08/12/2022	KP
1	UPDATED TO LATEST CONCEPTUAL PLAN	19/10/2021	OC

CAIVAN COMMUNITIES

GEOTECHNICAL INVESTIGATION
PROP. RESIDENTIAL DEVELOPMENT - CONSERVANCY LANDS WEST

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale:	1:5000	Date:	02/2021
Drawn by:	MPG	Report No.:	PG5036-2
Checked by:	SD	Dwg. No.:	PG5036-4
Approved by:	SD	Revision No.:	3

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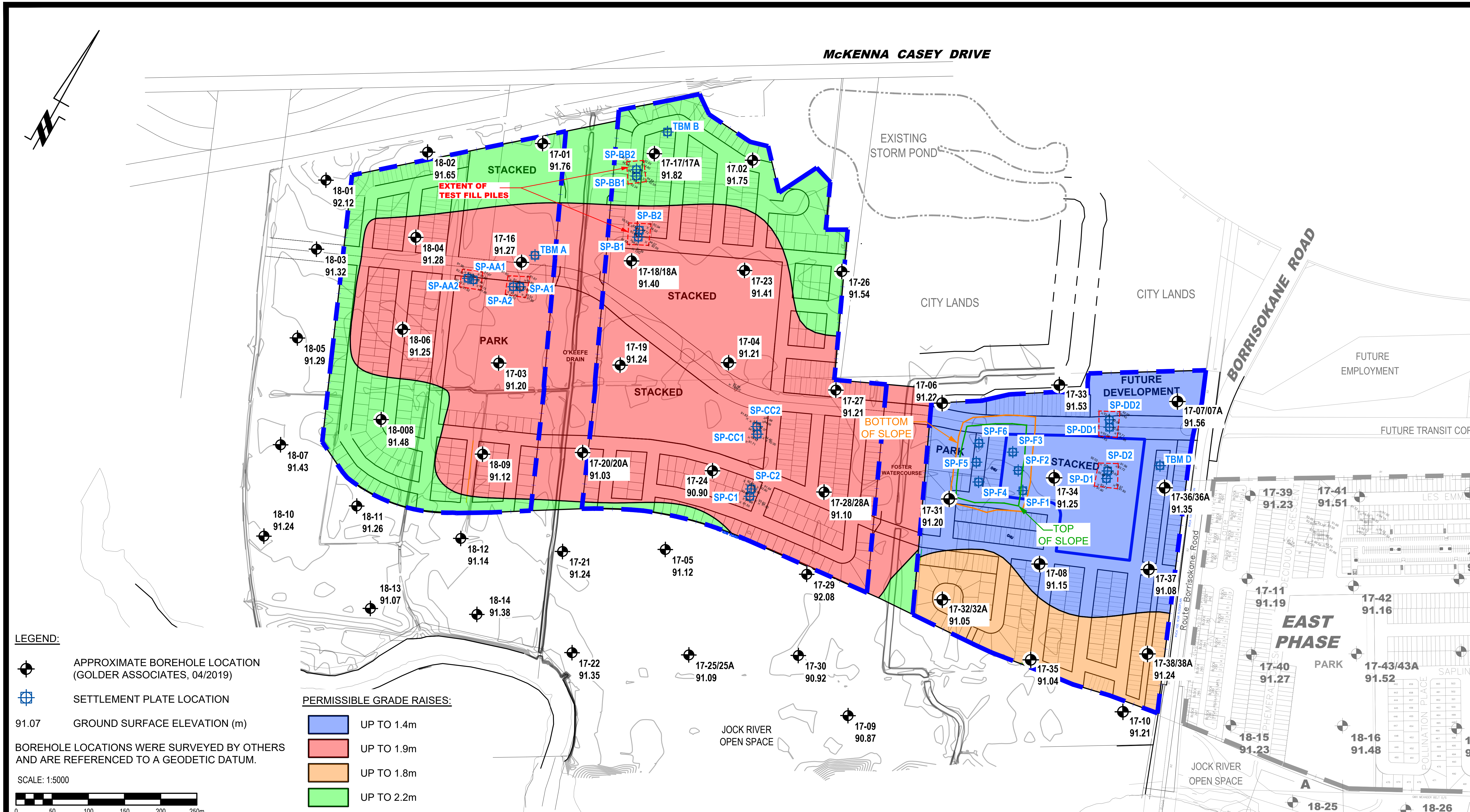
11x17



PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
4	UPDATED TO LATEST CONCEPTUAL PLAN REVISED SITE BOUNDARIES	04/03/2024	KP
3	UPDATED TO LATEST CONCEPTUAL PLAN	08/12/2022	KP
2	GRADE RAISE RESTRICTIONS UPDATED	30/11/2021	KP
1	UPDATED TO LATEST CONCEPTUAL PLAN	19/10/2021	OC

CAIVAN COMMUNITIES

GEOTECHNICAL INVESTIGATION

PROP. RESIDENTIAL DEVELOPMENT - CONSERVANCY LANDS WEST

OTTAWA, ONTARIO

Title:

PERMISSIBLE GRADE RAISE PLAN

Scale: 1:5000	Date: 09/2019
Drawn by: MPG	Report No.: PG5036-2
Checked by: SD	Dwg. No.: PG5036-5
Approved by: SD	Revision No.: 4

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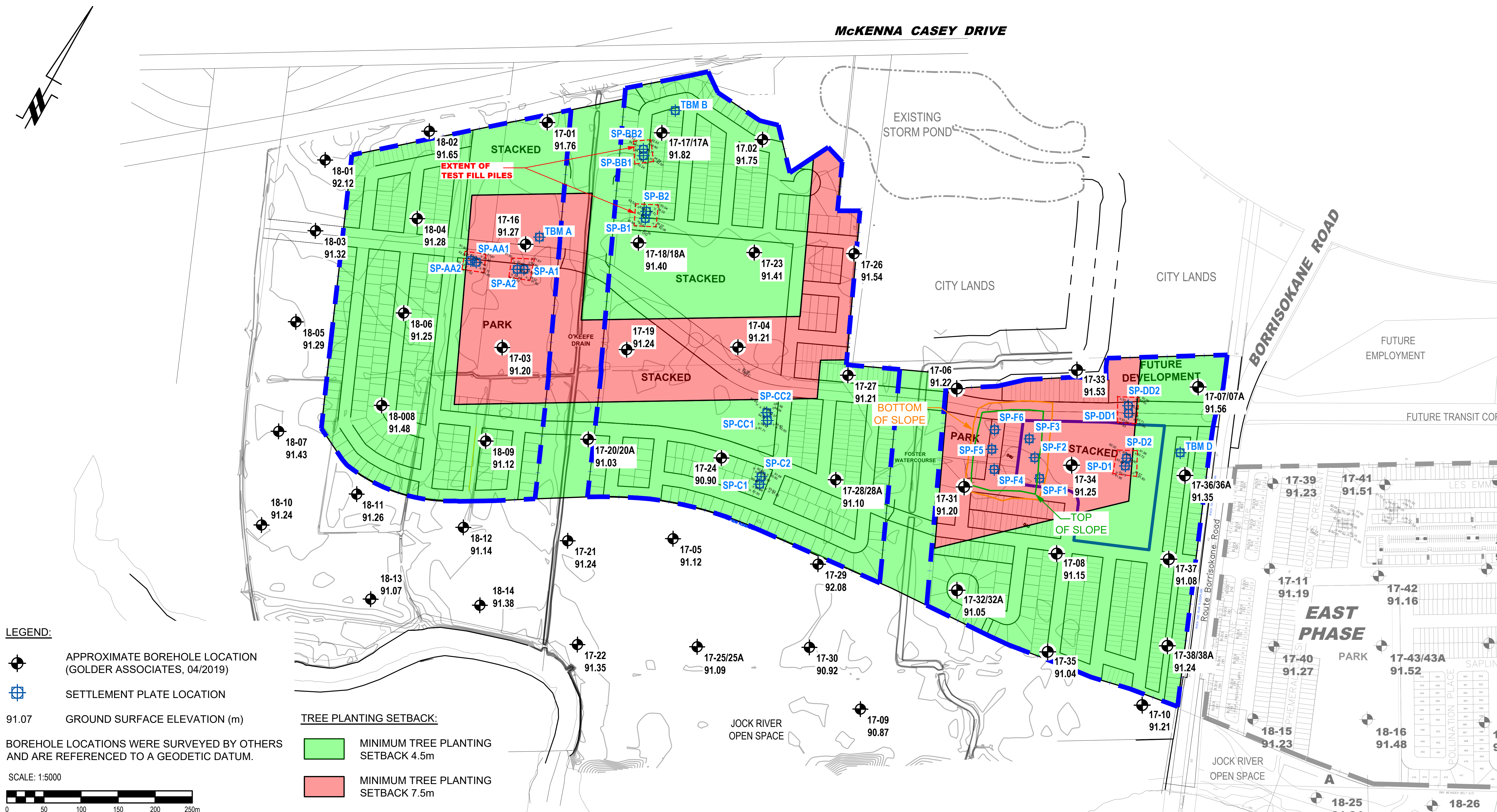

LEGEND:

- APPROXIMATE BOREHOLE LOCATION (GOLDER ASSOCIATES, 04/2019)
- SETTLEMENT PLATE LOCATION
- 91.07 GROUND SURFACE ELEVATION (m)

BOREHOLE LOCATIONS WERE SURVEYED BY OTHERS AND ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:5000

0 50 100 150 200 250m

TREE PLANTING SETBACK:

- MINIMUM TREE PLANTING SETBACK 4.5m (green)
- MINIMUM TREE PLANTING SETBACK 7.5m (red)

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
3	UPDATED TO LATEST CONCEPTUAL PLAN REVISED SITE BOUNDARIES	04/03/2024	KP
2	UPDATED TO LATEST CONCEPTUAL PLAN	08/12/2022	KP
1	UPDATED TO LATEST CONCEPTUAL PLAN	19/10/2021	OC

CAIVAN COMMUNITIES

GEOTECHNICAL INVESTIGATION
PROP. RESIDENTIAL DEVELOPMENT - CONSERVANCY LANDS WEST

OTTAWA, ONTARIO

Title:

TREE PLANTING SETBACK PLAN

Scale: 1:5000	Date: 09/2019
Drawn by: MPG	Report No.: PG5036-2
Checked by: SD	Dwg. No.: PG5036-6
Approved by: SD	Revision No.: 3

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11x17