Appendix A WATER SUPPLY SERVICING

A.1 DOMESTIC WATER DEMAND ESTIMATE

5731 Hazeldean Road Development - Domestic Water Demand Estimates

Building ID	Area (m^2)	Population	Daily Rate of Demand [1]	Avg Day Demand [2]		Max Day Demand [3]		Peak Hour Demand [3]	
				(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
BLDG W	-	333	350	80.9	1.35	202.3	3.37	445.2	7.42
BLDG E	-	256	350	62.2	1.04	155.6	2.59	342.2	5.70
Office 1	1244	-	5	8.6	0.14	13.0	0.22	23.3	0.39
Total Site :				**151.8**	**2.53**	**370.9**	**6.18**	**810.7**	**13.51**

1. 5 L/m^2/day is used to calculate water demand for retail and office space. This flow rate is at the high end of the range used for ‘shopping centres’ in the Ministry of Environment Design Guidelines for Sewers and Drinking Water Systems along with the City of Ottawa Sewer Design Guidelines (2012), Appendix 4A.

2. For the purpose of this study it is predicted that commercial/office facilities will be operated 12 hours per day.
3. Water demand criteria used to estimate peak demand rates for office space are as follows:
   maximum day demand rate = 1.5 x average day demand rate
   maximum hour demand rate = 1.8 x maximum day demand rate
4. Water demand criteria used to estimate peak demand rates for residential areas are as follows:
   maximum day demand rate = 2.5 x average day demand rate
   maximum hour demand rate = 2.2 x maximum day demand rate

A.2 FIRE FLOW REQUIREMENTS PER FUS

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 1604-01225
Project Name: 5731 Hazeldean Road
Date: September 25, 2020
Data input by: Dustin Thiffault

Fire Flow Calculation #: 1
Building Type/Description/Name: 5 Storey Res.

Notes:
Building Classification C (per OBC Section 3.2.2.43A), max. building area of 9,000m2 separated by fire walls.

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			9,000 Square Metres (m2)	9,000	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						21,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	N/A	17,850
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-5,355
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-1,785
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.3	m	5,355
			East Side	10.1 to 20.0m	0.15			
			South Side	Fire Wall	0.1			
			West Side	30.1 to 45.0m	0.05			
6	Obtain Required Fire Flow, Duration & Volume	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**16,000**
		Total Required Fire Flow (above) in L/s:						**267**
		Required Duration of Fire Flow (hrs)						**3.50**
		Required Volume of Fire Flow (m^3)						**3,360**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 1604-01225
Project Name: 5731 Hazeldean Road
Date: September 25, 2020
Data input by: Dustin Thiffault

Fire Flow Calculation #: 2
Building Type/Description/Name: 4 Storey Long Term Care

Notes:
Building Classification B Div. 2 (Floor assemblies are 2hr fire separations per OBC Section 3.2.2.38)

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			3,425 / Square Metres (m2)	3,425	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						10,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	N/A	8,500
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-2,550
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-850
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.15	m	1,275
			East Side	45.1m or greater	0			
			South Side	45.1m or greater	0			
			West Side	10.1 to 20.0m	0.15			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						**6,000**
		Total Required Fire Flow (above) in L/s:						**100**
		Required Duration of Fire Flow (hrs)						**2.00**
		Required Volume of Fire Flow (m^3)						**720**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 1604-01225
Project Name: 5731 Hazeldean Road
Date: September 25, 2020
Data input by: Dustin Thiffault

Fire Flow Calculation #: 3
Building Type/Description/Name: Office/Retail #1

Notes:
Building Classification D/E

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			2	2	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			622 Square Metres (m2)	1,244	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						6,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	6,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-1,800
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-600
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	3.1 to 10.0m	0.2	0.4	m	2,400
			East Side	10.1 to 20.0m	0.15			
			South Side	45.1m or greater	0			
			West Side	30.1 to 45.0m	0.05			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						**6,000**
		Total Required Fire Flow (above) in L/s:						**100**
		Required Duration of Fire Flow (hrs)						**2.00**
		Required Volume of Fire Flow (m^3)						**720**

A.3 HYDRAULIC ANALYSIS RESULTS

Potable Water Hydraulic Model Results

Average Daily Demand

Nodes

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (m)	Pressure (psi)	Pressure (kPa)
1	0.14	104.74	161.7	56.96	80.9	557.7
10	1.35	103.4	161.69	58.29	82.8	570.7
11	0	103.82	161.69	57.87	82.2	566.6
12	0	103.74	161.69	57.95	82.3	567.4
13	0	103.55	161.69	58.14	82.6	569.2
14	1.04	104.53	161.69	57.16	81.2	559.6
2	0	104.66	161.7	57.04	81.0	558.5
3	0	104.58	161.7	57.12	81.1	559.2
4	0	104.08	161.7	57.62	81.8	564.1
5	0	104.12	161.7	57.57	81.7	563.6
6	0	104.22	161.7	57.47	81.6	562.7
7	0	103.35	161.7	58.34	82.8	571.2
8	0	103.33	161.7	58.37	82.9	571.5
9	0	103.28	161.69	58.41	82.9	571.9

Links

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)	Status	Flow Reversal Count
1000	1	2000	15.91	200	110	-2.53	0.08	0	0.07	Open	0
1001	2	1	6.5	250	110	-2.39	0.05	0	0.02	Open	0
1002	3	2	7.13	250	110	-2.39	0.05	0	0.02	Open	0
1003	4	3	42.5	250	110	-2.39	0.05	0	0.02	Open	0
1004	5	4	13.86	250	110	-2.39	0.05	0	0.02	Open	0
1005	6	5	26.52	250	110	-2.39	0.05	0	0.02	Open	0
1006	7	6	63.56	250	110	-2.39	0.05	0	0.02	Open	0
1007	8	7	6.1	250	110	-2.39	0.05	0	0.02	Open	0
1008	9	8	34.68	250	110	-2.39	0.05	0	0.02	Open	0
1009	10	9	10.03	250	110	-2.39	0.05	0	0.02	Open	0
1010	11	10	36.64	250	110	-1.04	0.02	0	0	Open	0
1011	12	11	18.45	250	110	-1.04	0.02	0	0.01	Open	0
1012	13	12	6.1	250	110	-1.04	0.02	0	0	Open	0
1013	14	13	72.53	250	110	-1.04	0.02	0	0	Open	0

Potable Water Hydraulic Model Results

Maximum Daily Demand + Fire Flow

Nodes

ID	Static Demand (L/s)	Static Pressure (m)	Static Head (m)	Fire-Flow Demand (L/s)	Residual Pressure (m)	Pressure (psi)	Pressure (kPa)	Available Flow at Hydrant (L/s)	Available Flow Pressure (m)
11	0	51.65	155.47	100	44.75	63.5	438.1	257.5	14.07
14	2.59	50.94	155.47	100	41.87	59.5	409.9	221.0	14.07
2	0	50.83	155.49	267	43.49	61.8	425.8	645.6	14.07
6	0	51.26	155.48	267	31.63	44.9	309.7	379.4	14.07
9	0	52.19	155.47	267	18.31	26.0	179.3	285.0	14.07

Peak Hour Demand

Nodes

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (m)	Pressure (psi)	Pressure (kPa)
1	0.39	104.74	156.48	51.74	73.5	506.6
10	7.42	103.4	156.37	52.97	75.2	518.6
11	0	103.82	156.37	52.55	74.6	514.5
12	0	103.74	156.37	52.63	74.7	515.3
13	0	103.55	156.36	52.81	75.0	517.0
14	5.7	104.53	156.36	51.83	73.6	507.4
2	0	104.66	156.47	51.81	73.6	507.2
3	0	104.58	156.47	51.89	73.7	508.0
4	0	104.08	156.45	52.37	74.4	512.7
5	0	104.12	156.44	52.32	74.3	512.2
6	0	104.22	156.43	52.2	74.1	511.1
7	0	103.35	156.4	53.04	75.3	519.3
8	0	103.33	156.39	53.06	75.3	519.5
9	0	103.28	156.38	53.09	75.4	519.8

Links

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)	Status	Flow Reversal Count
1000	1	2000	15.91	200	110	-13.51	0.43	0.02	1.55	Open	0
1001	2	1	6.5	250	110	-13.12	0.27	0	0.5	Open	0
1002	3	2	7.13	250	110	-13.12	0.27	0	0.5	Open	0
1003	4	3	42.5	250	110	-13.12	0.27	0.02	0.49	Open	0
1004	5	4	13.86	250	110	-13.12	0.27	0.01	0.5	Open	0
1005	6	5	26.52	250	110	-13.12	0.27	0.01	0.49	Open	0
1006	7	6	63.56	250	110	-13.12	0.27	0.03	0.49	Open	0
1007	8	7	6.1	250	110	-13.12	0.27	0	0.49	Open	0
1008	9	8	34.68	250	110	-13.12	0.27	0.02	0.5	Open	0
1009	10	9	10.03	250	110	-13.12	0.27	0	0.49	Open	0
1010	11	10	36.64	250	110	-5.7	0.12	0	0.11	Open	0
1011	12	11	18.45	250	110	-5.7	0.12	0	0.11	Open	0
1012	13	12	6.1	250	110	-5.7	0.12	0	0.11	Open	0
1013	14	13	72.53	250	110	-5.7	0.12	0.01	0.11	Open	0

Appendix B WASTEWATER SERVICING

B.1 SANITARY SEWER DESIGN

Stantec

SUBDIVISION:

Nautical Lands Group - Wellings of Stittsville Senior's Living and Extendicare L.T.C.

DATE:	25/9/2020
REVISION:	1
DESIGNED BY:	MJS
CHECKED BY:	DT

SANITARY SEWER DESIGN SHEET

(City of Ottawa)

FILE NUMBER: 1604-01195

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	350 L/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	50,000 L/ha/day	MAXIMUM VELOCITY	3.00 m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000 L/ha/day	MANNINGS n	0.013
PEAKING FACTOR (COMM., INST.):	1.5	INDUSTRIAL (LIGHT)	35,000 L/ha/day	BEDDING CLASS	B
PERSONS / SINGLE UNIT	3.4	INSTITUTIONAL	50,000 L/ha/day	MINIMUM COVER	2.50 m
SINGLE PERSON UNITS	1.0	INFILTRATION	0.28 L/s/ha		
PERSONS / APARTMENT	1.8				

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	SINGLE	Single Person Units	APT.	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)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (L/s)
Wellings, LTC, CRU																						
ENTIRE SITE	SAN 2	SAN 1	1.32	0	256	185	589	1.32	589	3.94	9.4	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.00	1.46	1.46	0.1
	SAN 1	MAIN	0.00	0	0	0	0	1.32	589	3.94	9.4	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.46	0.1

LOCATION			INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (L/s)	FLOW (L/s)	LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (l/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Wellings, LTC, CRU															
ENTIRE SITE	SAN 2	SAN 1	2.90	2.90	0.8	10.3	6.0	300	PVC	SDR 35	0.25	48.0	**21.47%**	0.68	0.45
	SAN 1	MAIN	0.00	2.90	0.8	10.3	27.1	300	PVC	SDR 35	0.25	48.0	**21.47%**	0.68	0.45

Appendix C STORMWATER MANAGEMENT

C.1 STORM SEWER DESIGN SHEET AND ROOF STORAGE CALCULATIONS

MAP No.
CARTE No. 2

FLOOD RISK MAP
POOLE CREEK
CARTE DU RISQUE D'INONDATION

LEGEND / LÉGENDE

- Regulatory Floodplain / La Crue Régulatrice
- Regulatory Limit / Limite Réglementaire
- Contours / Courbes
- Stream / Ruisseau
- Cross Sections / La coupe traversale

Cross Section Number — 1 — Nombre de la coupe traversale
Regulatory Flood Elevation (m) — 102.11 — Niveau de la crue regulatrice (m)

INDEX CONTOUR INTERVAL 2 METRES
WITH 0.5 METRE INTERMEDIATE CONTOUR
NORTH AMERICAN DATUM 1983

COURBES DE NIVEAU PRINCIPALES DE 2.0 MÈTRE
AVEC COURBES DE NIVEAU INTERMÉDIAIRES DE 0.5 MÈTRES
SYSTÈME DE RÉFÉRENCE GÉODÉSIQUE NORD-AMÉRIQUE 1983

GENERAL INFORMATION

Vertical Datum: Mean sea level
Horizontal Datum: North American 1983
Map Projection: Ottawa Transverse Mercator Projection

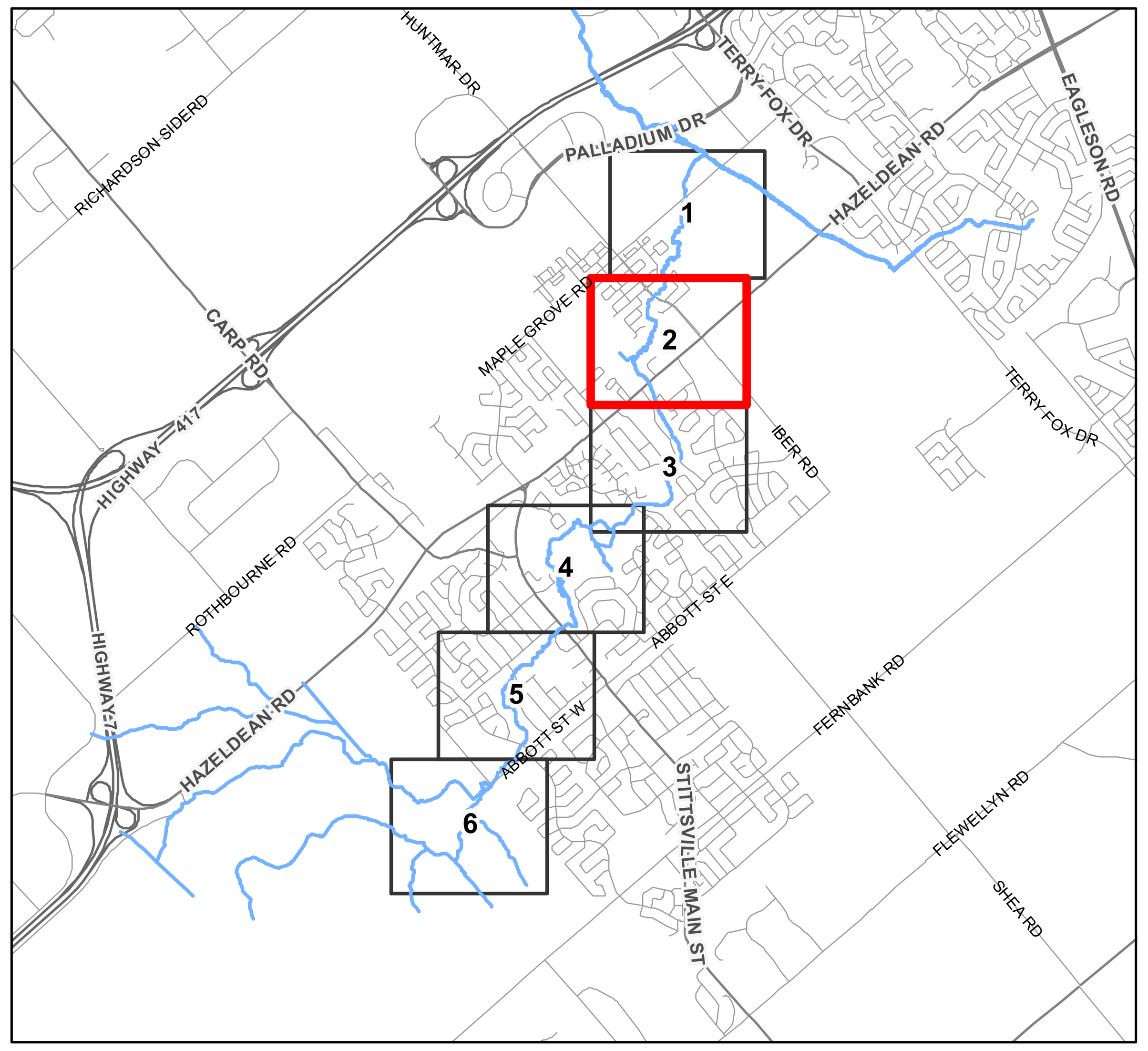
RENSEIGNMENTS GÉNÉRAUX

Niveau de référence vertical: Niveau moyen de la mer
Niveau de référence horizontal: Nord-americain 1983
Projection cartographique: Projection Mercator Transverse d'Ottawa

Mississippi Valley Conservation Authority

Ottawa

SHEET INDEX / TABLEAU D'ASSEMBLAGE



Date Modified / Date de modification: 29/01/2015

SCALE 1:2000 ÉCHELLE
0 25 50 100 150 200
Meters / Mètres

This map and the associated information displayed are to be used for general illustrative purposes only. Although best efforts have been made to create accuracy; due to the complex and extensive nature of the data, all representations and/or information provided herein are approximate and to be verified by user. User hereby acknowledges that this map is not intended for true and accurate navigational purposes and hereby accepts and assumes all inherent risks associated with the use of this map.

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Digital Elevation Information © GeoDigital International Inc, Spring 2008

Revision #	Issue
1 - Nov. 14 2013	Public review
2 - Dec. 4, 2013	Board approval
3 - Jan. 21,2015	Final

LICENSED PROFESSIONAL ENGINEER
J. S. A. PRICE
Jan. 20/15
PROVINCE OF ONTARIO

Stantec

5731 Hazeldean Road		STORM SEWER DESIGN SHEET (City of Ottawa)
DATE:	25-Sep-2020	
REVISION:	3	
DESIGNED BY:	DT	FILE NUMBER: 1604-01195
CHECKED BY:	MS	

DESIGN PARAMETERS

$I = a / (t+b)^c$ (As per City of Ottawa Guidelines, 2012)

	1:5 yr	1:100 yr				
a =	998.071	1735.688	MANNING'S n =	0.013	BEDDING CLASS =	B
b =	6.053	6.014	MINIMUM COVER:	2.00	m	
c =	0.814	0.820	TIME OF ENTRY	10	min	

LOCATION			DRAINAGE AREA																PIPE SELECTION											
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (5-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (-)	ACCUM. AREA (5YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	ACCUM. AREA (100YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	I_{5-YEAR} (mm/h)	$I_{10-YEAR}$ (mm/h)	$Q_{CONTROL}$ (NOTE 1) (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETER (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
	TANKOUT	102	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	13.92	87.22	149.21	42.3	42.3	42.3	2.8	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**31.80%**	0.81	0.61	0.08
													14.00																	
	103	102	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	0.0	3.0	450	450	CIRCULAR	CONCRETE	-	1.00	298.1	**0.00%**	1.82	0.00	0.00
													10.00																	
	102	101	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	14.00	86.94	148.74	0.0	42.3	42.3	70.7	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**31.80%**	0.81	0.61	1.94
	101	100	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	15.94	80.65	137.87	0.0	42.3	42.3	101.6	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**31.80%**	0.81	0.61	2.79
	100	HEADWALL	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	18.72	73.18	125.00	62.4	104.7	104.7	11.1	675	675	CIRCULAR	CONCRETE	-	1.40	1037.6	**10.09%**	2.81	1.50	0.12
													18.85							675	675									
L201A-D	STUB (209)	104	0.72	0.00	0.00	0.75	0.72	0.538	0.538	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	155.7	38.2	375	375	CIRCULAR	PVC	-	1.00	164.8	**94.44%**	1.56	1.62	0.39
													10.39																	
ST110A-D	110	106	0.17	0.00	0.00	0.48	0.17	0.081	0.081	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	23.5	12.5	375	375	CIRCULAR	PVC	-	1.00	164.8	**14.24%**	1.56	0.91	0.23
													10.23																	
	500	501	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	0.0	26.1	200	200	CIRCULAR	PVC	-	1.00	33.3	**0.00%**	1.05	0.00	0.00
	501	111	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	0.0	4.0	200	200	CIRCULAR	PVC	-	1.00	33.3	**0.00%**	1.05	0.00	0.00
													10.00																	
	502	111	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	0.0	2.8	200	200	CIRCULAR	PVC	-	1.00	33.3	**0.00%**	1.05	0.00	0.00
													10.00																	
ST111A-C	111	107	0.34	0.00	0.00	0.68	0.34	0.233	0.233	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	67.3	110.4	375	375	CIRCULAR	PVC	-	0.70	137.9	**48.81%**	1.31	1.11	1.66
ST107A	107	106	0.28	0.00	0.00	0.71	0.62	0.199	0.431	0.00	0.000	0.000	11.66	96.17	164.68	0.0	0.0	115.2	63.3	450	450	CIRCULAR	CONCRETE	-	0.50	210.3	**54.79%**	1.28	1.13	0.94
													12.60																	
	106	105	0.00	0.00	0.00	0.00	0.79	0.000	0.512	0.00	0.000	0.000	12.60	92.22	157.85	0.0	0.0	131.3	17.6	525	525	CIRCULAR	CONCRETE	-	0.20	200.6	**65.43%**	0.90	0.83	0.35
													12.95																	
ST108C-F	108A	108	0.37	0.00	0.10	0.46	0.37	0.172	0.172	0.00	0.000	0.000	10.00	104.19	178.56	5.0	5.0	54.7	85.0	375	375	CIRCULAR	PVC	-	0.50	116.6	**46.92%**	1.11	0.93	1.53
ST108A, L202A	108	105	0.00	0.00	0.74	0.90	0.37	0.000	0.172	0.00	0.000	0.000	11.53	96.76	165.70	45.7	50.7	96.8	36.3	450	450	CIRCULAR	CONCRETE	-	0.30	162.9	**59.45%**	0.99	0.89	0.68
													12.21																	
	105	104	0.00	0.00	0.00	0.00	1.16	0.000	0.684	0.00	0.000	0.000	12.95	90.83	155.45	0.0	50.7	223.3	39.1	600	600	CIRCULAR	CONCRETE	-	0.20	286.5	**77.95%**	0.98	0.96	0.68
													13.63																	
L104A	104	103	0.03	0.00	0.00	0.77	1.91	0.023	1.245	0.00	0.000	0.000	13.63	88.27	151.04	0.0	50.7	356.0	16.3	675	675	CIRCULAR	CONCRETE	-	0.20	392.2	**90.78%**	1.06	1.08	0.25
	103	TANKIN2	0.00	0.00	0.00	0.00	1.91	0.000	1.245	0.00	0.000	0.000	13.88	87.37	149.48	0.0	50.7	352.9	2.8	675	675	CIRCULAR	CONCRETE	-	0.20	392.1	**90.00%**	1.06	1.08	0.04
													13.92							675	675									
ST507A	507	TANKIN3	0.05	0.00	0.00	0.77	0.05	0.039	0.039	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	11.1	0.9	200	200	CIRCULAR	PVC	-	1.00	33.3	**33.45%**	1.05	0.80	0.02
													10.02							200	200									
	511	510	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	0.0	24.0	250	250	CIRCULAR	CONCRETE	-	0.25	30.2	**0.00%**	0.61	0.00	0.00
	510	509	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	0.0	41.2	250	250	CIRCULAR	CONCRETE	-	0.25	30.0	**0.00%**	0.61	0.00	0.00
	509	508	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	0.0	40.4	250	250	CIRCULAR	CONCRETE	-	0.25	30.2	**0.00%**	0.61	0.00	0.00
ST508A	508	TANKIN1	0.09	0.00	0.00	0.20	0.09	0.018	0.018	0.00	0.000	0.000	10.00	104.19	178.56	0.0	0.0	5.2	8.7	250	250	CIRCULAR	CONCRETE	-	0.25	30.4	**17.11%**	0.61	0.38	0.39
													10.39							250	250									

Stormwater Management Calculations

File No: **160401195**
Project: **5731 Hazeldean**
Date: **25-Sep-20**

SWM Approach:
Post-development to Pre-development flows

Post-Development Site Conditions:

Overall Runoff Coefficient for Site and Sub-Catchment Areas

Runoff Coefficient Table								
Catchment Type	**Sub-catchment Area ID / Description**		**Area (ha) "A"**		**Runoff Coefficient "C"**	**"A x C"**		**Overall Runoff Coefficient**
Roof	L202A	Hard	0.34		0.9	0.308		
		Soft	0.00		0.2	0.000		
		Subtotal		0.343			0.308	0.900
Roof	ST108A	Hard	0.40		0.9	0.363		
		Soft	0.00		0.2	0.000		
		Subtotal		0.404			0.363	0.900
Roof	ST108C	Hard	0.06		0.9	0.056		
		Soft	0.00		0.2	0.000		
		Subtotal		0.062			0.056	0.900
Total				**0.808**			**0.728**	
Overall Runoff Coefficient= C:								**0.90**

Total Roof Areas	**0.808 ha**
Total Tributary Surface Areas (Controlled and Uncontrolled)	**0.000 ha**
Total Tributary Area to Outlet	**0.808 ha**
Total Uncontrolled Areas (Non-Tributary)	**0.000 ha**
Total Site	**0.808 ha**

Stormwater Management Calculations

Project #160401195, 5731 Hazeldean
Modified Rational Method Calculatons for Storage

5 yr Intensity I = a/(t + b)^c
City of Ottawa

a =	998.071		**t (min)**	**I (mm/hr)**
b =	6.053		5	141.18
c =	0.814		10	104.19
			15	83.56
			20	70.25
			25	60.90
			30	53.93
			35	48.52
			40	44.18
			45	40.63
			50	37.65
			55	35.12
			60	32.94

5 YEAR Modified Rational Method for Entire Site

Subdrainage Area: L202A — Roof
Area (ha): 0.34 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
5	141.18	120.98	16.61	104.37	31.31	90.1	0.00
10	104.19	89.29	18.65	70.64	42.39	101.2	0.00
15	83.56	71.60	19.21	52.39	47.15	104.2	0.00
20	70.25	60.20	19.43	40.78	48.93	105.4	0.00
25	60.90	52.19	19.45	32.74	**49.11**	105.5	0.00
30	53.93	46.21	19.36	26.86	48.35	105.0	0.00
35	48.52	41.58	19.20	22.38	47.00	104.1	0.00
40	44.18	37.86	18.99	18.87	45.29	103.0	0.00
45	40.63	34.82	18.76	16.06	43.35	101.8	0.00
50	37.65	32.27	18.51	13.76	41.27	100.4	0.00
55	35.12	30.10	18.18	11.92	39.32	98.6	0.00
60	32.94	28.23	17.82	10.41	37.48	96.7	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	105.50	0.11	19.45	49.11	137.00	0.00

Subdrainage Area: ST108A — Roof
Area (ha): 0.40 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
5	141.18	142.62	19.39	123.23	36.97	90.2	0.00
10	104.19	105.25	21.77	83.49	50.09	101.2	0.00
15	83.56	84.41	22.44	61.97	55.77	104.3	0.00
20	70.25	70.97	22.69	48.27	57.93	105.5	0.00
25	60.90	61.52	22.72	38.79	**58.19**	105.7	0.00
30	53.93	54.48	22.62	31.85	57.34	105.2	0.00
35	48.52	49.01	22.44	26.57	55.80	104.4	0.00
40	44.18	44.63	22.21	22.43	53.82	103.3	0.00
45	40.63	41.04	21.94	19.10	51.57	102.0	0.00
50	37.65	38.04	21.66	16.38	49.14	100.7	0.00
55	35.12	35.48	21.30	14.18	46.80	99.0	0.00
60	32.94	33.28	20.88	12.40	44.63	97.1	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	105.67	0.11	22.72	58.19	161.50	0.00

Subdrainage Area: ST108C — Roof
Area (ha): 0.06 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
5	141.18	21.96	4.07	17.90	5.37	88.3	0.00
10	104.19	16.21	4.51	11.70	7.02	97.9	0.00
15	83.56	13.00	4.63	8.37	7.53	100.6	0.00
20	70.25	10.93	4.64	6.29	**7.55**	100.6	0.00
25	60.90	9.47	4.59	4.88	7.32	99.7	0.00
30	53.93	8.39	4.51	3.88	6.99	97.8	0.00
35	48.52	7.55	4.40	3.15	6.61	95.5	0.00
40	44.18	6.87	4.29	2.58	6.20	93.1	0.00
45	40.63	6.32	4.18	2.14	5.78	90.7	0.00
50	37.65	5.86	4.07	1.79	5.37	88.3	0.00
55	35.12	5.46	3.96	1.51	4.97	85.9	0.00
60	32.94	5.13	3.85	1.27	4.58	83.6	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	100.64	0.10	4.64	7.55	24.87	0.00

Project #160401195, 5731 Hazeldean
Modified Rational Method Calculatons for Storage

100 yr Intensity I = a/(t + b)
City of Ottawa

a =	1735.688		**t (min)**	**I (mm/hr)**
b =	6.014		5	242.70
c =	0.820		10	178.56
			15	142.89
			20	119.95
			25	103.85
			30	91.87
			35	82.58
			40	75.15
			45	69.05
			50	63.95
			55	59.62
			60	55.89

100 YEAR Modified Rational Method for Entire Site

Subdrainage Area: L202A — Roof
Area (ha): 0.34 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	170.02	23.72	146.30	87.78	128.7	0.00
20	119.95	114.21	25.23	88.98	106.77	136.9	0.00
30	91.87	87.47	25.60	61.87	**111.37**	138.9	0.00
40	75.15	71.55	25.53	46.02	110.45	138.5	0.00
50	63.95	60.90	25.25	35.65	106.94	137.0	0.00
60	55.89	53.22	24.86	28.36	102.10	134.9	0.00
70	49.79	47.41	24.42	22.99	96.56	132.5	0.00
80	44.99	42.84	23.95	18.89	90.67	129.9	0.00
90	41.11	39.14	23.47	15.68	84.65	127.3	0.00
100	37.90	36.09	22.97	13.12	78.71	124.6	0.00
110	35.20	33.52	22.36	11.15	73.62	121.3	0.00
120	32.89	31.32	21.78	9.54	68.70	118.2	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	138.90	0.14	25.60	111.37	137.00	0.00

Subdrainage Area: ST108A — Roof
Area (ha): 0.40 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	200.42	27.68	172.74	103.64	128.7	0.00
20	119.95	134.64	29.47	105.17	126.20	137.0	0.00
30	91.87	103.12	29.91	73.21	**131.77**	139.1	0.00
40	75.15	84.35	29.83	54.51	130.83	138.7	0.00
50	63.95	71.78	29.52	42.27	126.81	137.3	0.00
60	55.89	62.74	29.07	33.67	121.20	135.2	0.00
70	49.79	55.89	28.56	27.32	114.75	132.8	0.00
80	44.99	50.50	28.02	22.48	107.89	130.3	0.00
90	41.11	46.14	27.47	18.68	100.86	127.7	0.00
100	37.90	42.54	26.91	15.63	93.81	125.1	0.00
110	35.20	39.51	26.21	13.30	87.78	121.9	0.00
120	32.89	36.92	25.53	11.39	82.00	118.7	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	139.08	0.14	29.91	131.77	161.50	-0.01

Subdrainage Area: ST108C — Roof
Area (ha): 0.06 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	30.87	5.83	25.04	15.02	126.5	0.00
20	119.95	20.74	6.11	14.63	17.55	132.5	0.00
30	91.87	15.88	6.11	9.77	**17.59**	132.6	0.00
40	75.15	12.99	6.02	6.97	16.74	130.6	0.00
50	63.95	11.06	5.88	5.17	15.52	127.7	0.00
60	55.89	9.66	5.72	3.94	14.18	124.2	0.00
70	49.79	8.61	5.52	3.08	12.95	119.9	0.00
80	44.99	7.78	5.33	2.45	11.76	115.6	0.00
90	41.11	7.11	5.14	1.97	10.62	111.6	0.00
100	37.90	6.55	4.96	1.59	9.53	107.7	0.00
110	35.20	6.09	4.80	1.29	8.51	104.1	0.00
120	32.89	5.69	4.64	1.05	7.55	100.6	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	132.62	0.13	6.11	17.59	24.87	0.00

Stormwater Management Calculations

Project #160401195, 5731 Hazeldean
Modified Rational Method Calculatons for Storage

Project #160401195, 5731 Hazeldean
Modified Rational Method Calculatons for Storage

Project #160401195, 5731 Hazeldean
Roof Drain Design Sheet, Area ST108A
Standard Zurn Model Z-105-5 Control-Flo Single Notch Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0004	0.0054	1	0.025	90	1	1	0.025
0.050	0.0008	0.0108	6	0.050	359	5	6	0.050
0.075	0.0012	0.0161	20	0.075	808	14	20	0.075
0.100	0.0015	0.0215	48	0.100	1436	28	48	0.100
0.125	0.0019	0.0269	93	0.125	2243	46	93	0.125
0.150	0.0023	0.0323	162	0.150	3230	68	162	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
5.2	486.8	5.2	0.13522
19.4	880.8	14.2	0.37989
47.1	1286.5	27.7	0.73725
92.7	1696.8	45.6	1.20857
160.8	2109.4	68.0	1.79451

Rooftop Storage Summary

Total Building Area (sq.m)		4038
Assume Available Roof Area (sq.	80%	3230
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		14
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		162
Estimated 100 Year Drawdown Time (h)		1.5

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Zurn Drain Catalogue

Head (m)	L/min	L/s	Notch Rating
0.051	45.5	0.00076	232

Calculation Results

	5yr	100yr	Available
Qresult (cu.m/s)	0.023	0.030	-
Depth (m)	0.106	0.139	0.150
Volume (cu.m)	58.2	131.8	161.5
Draintime (hrs)	0.9	1.5	

Project #160401195, 5731 Hazeldean
Roof Drain Design Sheet, Area L202A
Standard Zurn Model Z-105-5 Control-Flo Single Notch Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0004	0.0046	1	0.025	76	1	1	0.025
0.050	0.0008	0.0092	5	0.050	304	4	5	0.050
0.075	0.0012	0.0138	17	0.075	685	12	17	0.075
0.100	0.0015	0.0184	41	0.100	1218	23	41	0.100
0.125	0.0019	0.0230	79	0.125	1903	39	79	0.125
0.150	0.0023	0.0276	137	0.150	2740	58	137	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
4.4	481.8	4.4	0.13382
16.5	871.8	12.1	0.37598
40.0	1273.2	23.5	0.72965
78.6	1679.3	38.7	1.19612
136.4	2087.6	57.7	1.77602

Rooftop Storage Summary

Total Building Area (sq.m)		3425
Assume Available Roof Area (sq.	80%	2740
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		12
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		137
Estimated 100 Year Drawdown Time (h)		1.5

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Zurn Drain Catalogue

Head (m)	L/min	L/s	Notch Rating
0.051	45.5	0.00076	232

Calculation Results

	5yr	100yr	Available
Qresult (cu.m/s)	0.019	0.026	-
Depth (m)	0.106	0.139	0.150
Volume (cu.m)	49.1	111.4	137.0
Draintime (hrs)	0.8	1.5	

Project #160401195, 5731 Hazeldean
Roof Drain Design Sheet, Area ST108C
Standard Zurn Model Z-105-5 Control-Flo Single Notch Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0004	0.0012	0	0.025	14	0	0	0.025
0.050	0.0008	0.0023	1	0.050	55	1	1	0.050
0.075	0.0012	0.0035	3	0.075	124	2	3	0.075
0.100	0.0015	0.0046	7	0.100	221	4	7	0.100
0.125	0.0019	0.0058	14	0.125	345	7	14	0.125
0.150	0.0023	0.0069	25	0.150	497	10	25	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
0.8	349.9	0.8	0.09718
3.0	633.1	2.2	0.27304
7.3	924.6	4.3	0.52988
14.3	1219.5	7.0	0.86863
24.8	1516.1	10.5	1.28976

Rooftop Storage Summary

Total Building Area (sq.m)		622
Assume Available Roof Area (sq.	80%	497
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		3
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		25
Estimated 100 Year Drawdown Time (h)		1.0

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Zurn Drain Catalogue

Head (m)	L/min	L/s	Notch Rating
0.051	45.5	0.00076	232

Calculation Results

	5yr	100yr	Available
Qresult (cu.m/s)	0.005	0.006	-
Depth (m)	0.101	0.133	0.150
Volume (cu.m)	7.6	17.6	24.9
Draintime (hrs)	0.5	1.0	

Outlet Rip-Rap Sizing

US Army Corps of Enginners
1991 Procedure
EM1601
Common values

V	1.62	m/s	
y	0.37125	m	
Z	3.00	H:1V	
phi	42	degrees	
r	300	m	
W	1	m	
Ss	2.5	rock specific gravity	
g	9.806	m/s^2	
theta	18.4	degrees	bank angle with horizontal

SF	1.1
Cs	0.3
Kl	1
Cv	0.79
Ct	1

D_{50} =	0.048	m
M_{50} =	0.147	kg

Selected D50	0.060	m
Min. thickness	0.120	m

C.2 SAMPLE PCSWMM MODEL INPUT (12HR 100YR SCS)

```
[TITLE]
;;Project Title/Notes

[OPTIONS]
;;Option             Value
FLOW_UNITS           LPS
INFILTRATION         CURVE_NUMBER
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         ELEVATION
MIN_SLOPE            0
ALLOW_PONDING        YES
SKIP_STEADY_STATE    NO

START_DATE           07/23/2009
START_TIME           00:00:00
REPORT_START_DATE    07/23/2009
REPORT_START_TIME    00:00:00
END_DATE             07/24/2009
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:05:00
WET_STEP             00:05:00
DRY_STEP             00:05:00
ROUTING_STEP         1
RULE_STEP            00:00:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0
LENGTHENING_STEP     0
MIN_SURFAREA         0
MAX_TRIALS           8
HEAD_TOLERANCE       0.0015
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              4

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
CONSTANT         0.0
DRY_ONLY         NO

[RAINGAGES]
```



```
;;Name           Format    Interval SCF      Source
;;-------------- --------- -------- -------- ----------
RG1              INTENSITY 0:15     1.0      TIMESERIES 100SCS

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack

;;-------------- ---------------- ---------------- -------- -------- -------- -------- --------
----------------
;0.20
EXT_1            RG1              EXT1-OF          0.073108 0        16.449   33.3     0

;0.76
EXT2             RG1              EXT2-OF          0.051084 80       11.494   2        0

;0.77
L104A            RG1              ST104A-S         0.030543 81.429   32.1     2        0

;0.64
L201A            RG1              L201A-S          0.225585 62.857   88.7     2        0

;0.75
L201B            RG1              L201B-S          0.156297 78.571   76       3        0

;0.76
L201C            RG1              L201C-S          0.185634 80       83       2.5      0

;0.90
L201D            RG1              L201D-S          0.141633 100      48       1        0

;0.90
L202A            RG1              L202A-S          0.342508 100      77.065   1.5      0

;0.71
ST107A           RG1              ST107A-S         0.281705 72.857   225      1.5      0

;0.90
ST108A           RG1              ST108A-S         0.403752 100      90.846   1.5      0

;0.90
ST108C           RG1              ST108C-S         0.062183 100      13.991   1.5      0

;0.51
ST108D           RG1              108              0.367742 37.721   82.743   1.2      0

;0.25
ST110A           RG1              110              0.074661 7.143    16.799   0.8      0
```

```
;0.90
ST110C           RG1              110              0.029561 100      26.6     10       0

;0.25
ST110D           RG1              110              0.074098 7.143    16.672   0.8      0

;0.66
ST111A           RG1              ST111A-S         0.256459 65.714   107.5    0.8      0

;0.90
ST111B           RG1              111              0.037296 100      88       0.8      0

;0.63
ST111C           RG1              ST111C-S         0.043507 61.429   36.8     1.5      0

;0.77
ST507A           RG1              ST507A-S         0.051188 81.429   25.8     1.5      0

;0.20
ST508A           RG1              508              0.096396 0        158.9    1        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
EXT_1            0.013      0.2        1.57       4.67       0          PERVIOUS   100
EXT2             0.013      0.2        1.57       4.67       0          PERVIOUS   100
L104A            0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
L201A            0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
L201B            0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
L201C            0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
L201D            0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
L202A            0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ST107A           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ST108A           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ST108C           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ST108D           0.013      0.2        1.57       4.67       0          PERVIOUS   100
ST110A           0.013      0.2        1.57       4.67       0          PERVIOUS   100
ST110C           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ST110D           0.013      0.2        1.57       4.67       0          PERVIOUS   100
ST111A           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ST111B           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ST111C           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ST507A           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ST508A           0.013      0.2        1.57       4.67       0          PERVIOUS   100

[INFILTRATION]
;;Subcatchment   CurveNum              DryTime
```



```
;;-------------- ---------- ---------- ----------
EXT_1            80         13.2       7
EXT2             80         13.2       7
L104A            80         13.2       7
L201A            80         13.2       7
L201B            80         13.2       7
L201C            80         13.2       7
L201D            80         13.2       7
L202A            80         13.2       7
ST107A           80         13.2       7
ST108A           80         13.2       7
ST108C           80         13.2       7
ST108D           80         13.2       7
ST110A           80         13.2       7
ST110C           80         13.2       7
ST110D           80         13.2       7
ST111A           80         13.2       7
ST111B           80         13.2       7
ST111C           80         13.2       7
ST507A           80         13.2       7
ST508A           80         13.2       7

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
110              100.686    3.814      0          0          0
201              101.164    3.336      0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
EXT1-OF          102.88     FREE                        NO
EXT2-OF          104.2      FREE                        NO
HEADWALL         98.7       FREE                        NO
POOLE_OF1        100.1      FREE                        NO
POOLE_OF2        101.059    FREE                        NO
ST104A-OF        0          FREE                        NO
ST107A-OF        0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap
Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------
      -------- --------
100              99.4     2.735      0          FUNCTIONAL 1.13       0          0          0        0
101              99.603   3.691      0          FUNCTIONAL 1.13       0          0          0        0
102              99.779   3.752      0          FUNCTIONAL 1.13       0          0          0        0
103              100.035  3.526      0          FUNCTIONAL 1.13       0          0          0        0
```

104	100.078	3.493	0	FUNCTIONAL	1.13	0	0	0	0
105	100.232	3.406	0	FUNCTIONAL	1.13	0	0	0	0
106	100.342	2.976	0	FUNCTIONAL	1.13	0	0	0	0
107	100.803	2.417	0	FUNCTIONAL	1.13	0	0	0	0
108	97.239	7.127	0	TABULAR	RWHtank			0	0
111	101.422	2.65	0	FUNCTIONAL	1.13	0	0	0	0
508	101.06	1.79	0	TABULAR	ST508A-S			0	0
L201A-S	102.24	1.73	0	TABULAR	L201A-S			0	0
L201B-S	101.83	1.73	0	TABULAR	L201B-S			0	0
L201C-S	101.83	1.73	0	TABULAR	L201C-S			0	0
L201D-S	102.81	1.5	0	FUNCTIONAL	0	0	0	0	0
L202A-S	115.75	0.15	0	TABULAR	L202A			0	0
ST104A-S	101.52	2.1	0	TABULAR	ST104A-S			0	0
ST107A-S	101.13	2.1	0	TABULAR	ST107A-S			0	0
ST108A-S	118.6	0.15	0	TABULAR	ST108A			0	0
ST108C-S	110.4	0.15	0	TABULAR	ST108C			0	0
ST111A-S	101.86	2.4	0	TABULAR	ST111A-S			0	0
ST111C-S	101.95	2.1	0	FUNCTIONAL	0	0	0	0	0
ST507A-S	101.57	2.1	0	TABULAR	ST507A-S			0	0
TANK	100.1	3.27	0	TABULAR	TANK			0	0

[CONDUITS]

;;Name	From Node	To Node	Length	Roughness	InOffset	OutOffset	InitFlow	MaxFlow
201-104	201	104	78.257	0.013	101.164	100.382	0	0
L201A-T	L201A-S	ST104A-S	30.8	0.013	103.82	103.47	0	0
L201B-T	L201B-S	ST104A-S	38.4	0.013	103.51	103.47	0	0
L201C-T	L201C-S	ST507A-S	34.8	0.013	103.51	103.49	0	0
Pipe_13	100	HEADWALL	11.135	0.013	99.548	99.52	0	0
Pipe_14	106	105	17.55995	0.013	100.411	100.376	0	0
Pipe_14_(1)	105	104	39.10268	0.013	100.301	100.222	0	0
Pipe_16	110	106	12.50838	0.013	100.686	100.561	0	0
Pipe_17	111	107	110.3626	0.013	101.65	100.877	0	0
Pipe_21	104	103	16.284	0.013	100.143	100.11	0	0
Pipe_23	508	TANK	8.730414	0.013	101.6588	101.637	0	0

Pipe_26	101	100	101.5684	0.013	99.936	99.733	0	0
Pipe_27	108	105	36.34	0.013	100.441	100.332	0	0
Pipe_29	107	106	63.29649	0.013	100.802	100.486	0	0
Pipe_31	102	101	70.701	0.013	100.083	99.942	0	0
Pipe_34	103	TANK	2.81	0.013	100.106	100.1	0	0
ST104A-T	ST104A-S	ST104A-OF	2.5	0.025	103.47	102.88	0	0
ST107A-T	ST107A-S	ST107A-OF	2.5	0.025	103.08	103.04	0	0
ST111A-T	ST111A-S	ST111C-S	40.9	0.013	104.26	103.75	0	0
ST111B-T	ST111C-S	ST107A-S	60	0.013	103.75	103.08	0	0
ST507A-T	ST507A-S	ST104A-S	14.9	0.013	103.5	103.47	0	0
W1	103	102	3	0.013	102	101.97	0	0

[ORIFICES]

;;Name	From Node	To Node	Type	Offset	Qcoeff	Gated	CloseTime
L201A-O	L201A-S	201	SIDE	102.24	0.572	NO	0
L201B-O	L201B-S	201	SIDE	101.83	0.572	NO	0
L201C-O	L201C-S	201	SIDE	101.83	0.572	NO	0
OR1	TANK	102	SIDE	100.1	0.65	NO	0
OR2	TANK	102	SIDE	100.7	0.65	NO	0
OR3	TANK	102	SIDE	101	0.65	NO	0
ST104A-O	ST104A-S	104	SIDE	101.52	0.572	NO	0
ST107A-O	ST107A-S	107	SIDE	101.13	0.65	NO	0
ST109C-O	L201D-S	201	SIDE	102.81	0.65	NO	0
ST111A-O	ST111A-S	111	SIDE	101.86	0.572	NO	0
ST111C-O	ST111C-S	111	SIDE	101.95	0.65	NO	0
ST111C-O1	ST111C-S	111	SIDE	101.95	0.65	NO	0

[OUTLETS]

;;Name	From Node	To Node	Offset	Type	QTable/Qcoeff	Qexpon	Gated
OL1	TANK	POOLE_OF1	100.1	TABULAR/HEAD	TANK_BASEFLOW		NO
OL2	508	POOLE_OF2	101.06	TABULAR/HEAD	BIOSWALE_BASEFLOW		NO

```
ST108A-O        ST108A-S        108             118.6       TABULAR/HEAD     ST108A-O
NO
ST108B-O        L202A-S         108             115.75      TABULAR/HEAD     L202A-O
NO
ST108C-O        ST108C-S        108             110.4       TABULAR/HEAD     ST108C-O
NO
ST507A-O        ST507A-S        TANK            101.57      FUNCTIONAL/HEAD  7.996            0.499
NO

[XSECTIONS]
;;Link          Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
201-104         CIRCULAR     0.375            0          0          0          1
L201A-T         IRREGULAR    Overland         0          0          0          1
L201B-T         IRREGULAR    Overland         0          0          0          1
L201C-T         IRREGULAR    Overland         0          0          0          1
Pipe_13         CIRCULAR     0.675            0          0          0          1
Pipe_14         CIRCULAR     0.525            0          0          0          1
Pipe_14_(1)     CIRCULAR     0.6              0          0          0          1
Pipe_16         CIRCULAR     0.375            0          0          0          1
Pipe_17         CIRCULAR     0.375            0          0          0          1
Pipe_21         CIRCULAR     0.675            0          0          0          1
Pipe_23         CIRCULAR     0.25             0          0          0          1
Pipe_26         CIRCULAR     0.45             0          0          0          1
Pipe_27         CIRCULAR     0.45             0          0          0          1
Pipe_29         CIRCULAR     0.45             0          0          0          1
Pipe_31         CIRCULAR     0.45             0          0          0          1
Pipe_34         CIRCULAR     0.675            0          0          0          1
ST104A-T        IRREGULAR    Overland         0          0          0          1
ST107A-T        IRREGULAR    Overland         0          0          0          1
ST111A-T        IRREGULAR    Overland         0          0          0          1
ST111B-T        IRREGULAR    Overland         0          0          0          1
ST507A-T        IRREGULAR    Overland         0          0          0          1
W1              CIRCULAR     0.45             0          0          0          1
L201A-O         CIRCULAR     0.127            0          0          0
L201B-O         CIRCULAR     0.095            0          0          0
L201C-O         CIRCULAR     0.108            0          0          0
OR1             CIRCULAR     0.11             0          0          0
OR2             CIRCULAR     0.15             0          0          0
OR3             CIRCULAR     0.15             0          0          0
ST104A-O        CIRCULAR     0.083            0          0          0
ST107A-O        CIRCULAR     0.2              0          0          0
ST109C-O        CIRCULAR     0.2              0          0          0
ST111A-O        CIRCULAR     0.076            0          0          0
ST111C-O        CIRCULAR     0.2              0          0          0
ST111C-O1       CIRCULAR     0.2              0          0          0

[TRANSECTS]
```



```
;;Transect Data in HEC-2 format
;
NC 0.013    0.013    0.013
X1 Overland          5        0.15     6.85     0.0      0.0      0.0      0.0      0.0
GR 0.15     0        0        0.15     0        6.85     0.15     7        0.15     7
;
;[LE: 0][RE: 7]
NC 0.013    0.013    0.013
X1 Overland(orig)    4        0.15     6.85     0.0      0.0      0.0      0.0      0.0
GR 0.15     0        0        0.15     0        6.85     0.15     7

[LOSSES]
;;Link          Kentry     Kexit      Kavg       Flap Gate  Seepage
;;-------------- ---------- ---------- ---------- ---------- ----------
201-104         0          1.344      0          NO         0
Pipe_14         0          0.053      0          NO         0
Pipe_14_(1)     0          0.022      0          NO         0
Pipe_16         0          1.344      0          NO         0
Pipe_17         0          1.344      0          NO         0
Pipe_21         0          0.022      0          NO         0
Pipe_26         0          0.423      0          NO         0
Pipe_27         0          1.344      0          NO         0
Pipe_29         0          0.053      0          NO         0
Pipe_31         0          1.344      0          NO         0
W1              0          1.344      0          NO         0

[INFLOWS]
;;Node          Constituent      Time Series      Type     Mfactor  Sfactor  Baseline Pattern
;;-------------- ---------------- ---------------- -------- -------- -------- -------- --------
100             FLOW             ""               FLOW     1.0      1        175

[CURVES]
;;Name          Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
BIOSWALE_BASEFLOW Rating     0          0
BIOSWALE_BASEFLOW            0.01       0.3
BIOSWALE_BASEFLOW            10         0.3

L202A-O         Rating     0          0
L202A-O                    0.025      4.6
L202A-O                    0.05       9.2
L202A-O                    0.075      13.8
L202A-O                    0.1        18.4
L202A-O                    0.125      23
L202A-O                    0.15       27.6

ST108A-O        Rating     0          0
ST108A-O                   0.025      5.4
```

ST108A-O		0.05	10.8
ST108A-O		0.075	16.1
ST108A-O		0.1	21.5
ST108A-O		0.125	26.9
ST108A-O		0.15	32.3
ST108C-O	Rating	0	0
ST108C-O		0.025	1.2
ST108C-O		0.05	2.3
ST108C-O		0.075	3.5
ST108C-O		0.1	4.6
ST108C-O		0.125	5.8
ST108C-O		0.15	6.9
ST108D-O	Rating	0	0
ST108D-O		0.025	0.8
ST108D-O		0.05	1.5
ST108D-O		0.075	2.3
ST108D-O		0.1	3.1
ST108D-O		0.125	3.8
ST108D-O		0.15	4.6
ST108E-O	Rating	0	0
ST108E-O		0.025	0.4
ST108E-O		0.05	0.8
ST108E-O		0.075	1.2
ST108E-O		0.1	1.5
ST108E-O		0.125	1.9
ST108E-O		0.15	2.3
TANK_BASEFLOW	Rating	0	0
TANK_BASEFLOW		0.01	0.66
TANK_BASEFLOW		10	0.66
L201A-S	Storage	0	0
L201A-S		1.38	0
L201A-S		1.58	214.3
L201A-S		1.5801	0
L201A-S		1.73	0
L201B-S	Storage	0	0
L201B-S		1.38	0
L201B-S		1.68	369.9
L201B-S		1.6801	0
L201B-S		1.73	0
L201C-S	Storage	0	0
L201C-S		1.38	0

L201C-S		1.68	464.4
L201C-S		1.6801	0
L201C-S		1.73	0
L202A	Storage	0	0
L202A		0.025	76
L202A		0.05	304
L202A		0.075	685
L202A		0.1	1218
L202A		0.125	1903
L202A		0.15	2740
RWHtank	Storage	0	113.747
RWHtank		3.202	113.747
RWHtank		3.203	0
RWHtank		5	0
ST104A-S	Storage	0	0
ST104A-S		1.8	0
ST104A-S		1.95	117.9
ST104A-S		1.9501	0
ST104A-S		2.1	0
ST107A-S	Storage	0	0
ST107A-S		1.8	0
ST107A-S		1.95	46.9
ST107A-S		1.9501	0
ST107A-S		2.1	0
ST108A	Storage	0	0
ST108A		0.025	90
ST108A		0.05	359
ST108A		0.075	808
ST108A		0.1	1436
ST108A		0.125	2243
ST108A		0.15	3230
ST108C	Storage	0	0
ST108C		0.025	14
ST108C		0.05	55
ST108C		0.075	124
ST108C		0.1	221
ST108C		0.125	345
ST108C		0.15	497
ST111A-S	Storage	0	0
ST111A-S		2.1	0
ST111A-S		2.4	724

```
ST507A-S         Storage    0          0
ST507A-S                    1.8        0
ST507A-S                    1.92       347.7
ST507A-S                    1.9201     0
ST507A-S                    2.1        0

ST508A-S         Storage    0          0
ST508A-S                    0.7        152
ST508A-S                    0.701      0
ST508A-S                    1.741      0
ST508A-S                    1.991      118.2

TANK             Storage    0          560.7
TANK                        0.026      560.7
TANK                        0.051      560.7
TANK                        0.077      560.7
TANK                        0.102      559.44
TANK                        0.127      559.44
TANK                        0.153      558.18
TANK                        0.178      556.92
TANK                        0.204      555.66
TANK                        0.229      554.4
TANK                        0.254      551.88
TANK                        0.28       549.36
TANK                        0.305      546.84
TANK                        0.331      543.06
TANK                        0.356      539.28
TANK                        0.381      534.24
TANK                        0.407      527.94
TANK                        0.432      521.64
TANK                        0.458      514.08
TANK                        0.483      505.26
TANK                        0.508      495.18
TANK                        0.534      483.84
TANK                        0.559      478.8
TANK                        0.585      464.94
TANK                        0.61       449.82
TANK                        0.635      434.7
TANK                        0.661      419.58
TANK                        0.686      403.2
TANK                        0.712      383.04
TANK                        0.737      360.36
TANK                        0.762      347.76
TANK                        0.796      335.16
TANK                        0.813      320.04
TANK                        0.839      304.92
TANK                        0.864      289.8
```



```
TANK                        0.889      272.16
TANK                        0.915      258.3
TANK                        0.94       244.44
TANK                        0.965      233.1
TANK                        0.991      221.76
TANK                        1.016      211.68
TANK                        1.041      201.6
TANK                        1.067      192.78
TANK                        1.092      185.22
TANK                        1.118      180.18
TANK                        1.143      176.4
TANK                        1.168      172.62
TANK                        1.194      170.1
TANK                        1.219      167.58
TANK                        1.245      165.06
TANK                        1.27       163.8
TANK                        1.295      162.54
TANK                        1.321      162.54
TANK                        1.346      162.54
TANK                        1.372      161.28
TANK                        1.397      161.28
TANK                        1.422      161.28
TANK                        1.448      161.28
TANK                        1.473      161.28
TANK                        1.499      161.28
TANK                        1.524      161.28
TANK                        1.549      161.28
TANK                        1.575      161.28
TANK                        1.6        161.28
TANK                        1.626      161.28
TANK                        1.651      161.28
TANK                        1.676      161.28
TANK                        1.702      161.28
TANK                        1.727      161.28
TANK                        1.753      161.28
TANK                        1.778      161.28
TANK                        1.803      161.28
TANK                        1.829      161.28
TANK                        1.83       0
TANK                        5          0

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
;MTO Distribution, 15min intervals
002SCS                      0:00       0
002SCS                      0:15       1.08
002SCS                      0:30       1.08
```

002SCS	0:45	1.08
002SCS	1:00	1.08
002SCS	1:15	1.08
002SCS	1:30	1.08
002SCS	1:45	1.08
002SCS	2:00	1.296
002SCS	2:15	1.296
002SCS	2:30	1.296
002SCS	2:45	1.296
002SCS	3:00	1.728
002SCS	3:15	1.728
002SCS	3:30	1.728
002SCS	3:45	1.728
002SCS	4:00	2.592
002SCS	4:15	2.592
002SCS	4:30	3.456
002SCS	4:45	3.456
002SCS	5:00	5.184
002SCS	5:15	5.184
002SCS	5:30	20.736
002SCS	5:45	57.024
002SCS	6:00	7.776
002SCS	6:15	7.776
002SCS	6:30	3.456
002SCS	6:45	3.456
002SCS	7:00	2.592
002SCS	7:15	2.592
002SCS	7:30	2.592
002SCS	7:45	2.592
002SCS	8:00	1.512
002SCS	8:15	1.512
002SCS	8:30	1.512
002SCS	8:45	1.512
002SCS	9:00	1.512
002SCS	9:15	1.512
002SCS	9:30	1.512
002SCS	9:45	1.512
002SCS	10:00	0.864
002SCS	10:15	0.864
002SCS	10:30	0.864
002SCS	10:45	0.864
002SCS	11:00	0.864
002SCS	11:15	0.864
002SCS	11:30	0.864
002SCS	11:45	0.864
002SCS	12:00	0
005SCS	0:00:00	0

005SCS	0:15:00	1.44
005SCS	0:30:00	1.44
005SCS	0:45:00	1.44
005SCS	1:00:00	1.44
005SCS	1:15:00	1.44
005SCS	1:30:00	1.44
005SCS	1:45:00	1.44
005SCS	2:00:00	1.728
005SCS	2:15:00	1.728
005SCS	2:30:00	1.728
005SCS	2:45:00	1.728
005SCS	3:00:00	2.304
005SCS	3:15:00	2.304
005SCS	3:30:00	2.304
005SCS	3:45:00	2.304
005SCS	4:00:00	3.456
005SCS	4:15:00	3.456
005SCS	4:30:00	4.608
005SCS	4:45:00	4.608
005SCS	5:00:00	6.912
005SCS	5:15:00	6.912
005SCS	5:30:00	27.648
005SCS	5:45:00	76.032
005SCS	6:00:00	10.368
005SCS	6:15:00	10.368
005SCS	6:30:00	4.608
005SCS	6:45:00	4.608
005SCS	7:00:00	3.456
005SCS	7:15:00	3.456
005SCS	7:30:00	3.456
005SCS	7:45:00	3.456
005SCS	8:00:00	2.016
005SCS	8:15:00	2.016
005SCS	8:30:00	2.016
005SCS	8:45:00	2.016
005SCS	9:00:00	2.016
005SCS	9:15:00	2.016
005SCS	9:30:00	2.016
005SCS	9:45:00	2.016
005SCS	10:00:00	1.152
005SCS	10:15:00	1.152
005SCS	10:30:00	1.152
005SCS	10:45:00	1.152
005SCS	11:00:00	1.152
005SCS	11:15:00	1.152
005SCS	11:30:00	1.152
005SCS	11:45:00	1.152
005SCS	12:00:00	0

010SCS	0:00:00	0
010SCS	0:15:00	1.68
010SCS	0:30:00	1.68
010SCS	0:45:00	1.68
010SCS	1:00:00	1.68
010SCS	1:15:00	1.68
010SCS	1:30:00	1.68
010SCS	1:45:00	1.68
010SCS	2:00:00	2.02
010SCS	2:15:00	2.02
010SCS	2:30:00	2.02
010SCS	2:45:00	2.02
010SCS	3:00:00	2.69
010SCS	3:15:00	2.69
010SCS	3:30:00	2.69
010SCS	3:45:00	2.69
010SCS	4:00:00	4.03
010SCS	4:15:00	4.03
010SCS	4:30:00	5.38
010SCS	4:45:00	5.38
010SCS	5:00:00	8.06
010SCS	5:15:00	8.06
010SCS	5:30:00	32.26
010SCS	5:45:00	88.7
010SCS	6:00:00	12.1
010SCS	6:15:00	12.1
010SCS	6:30:00	5.38
010SCS	6:45:00	5.38
010SCS	7:00:00	4.03
010SCS	7:15:00	4.03
010SCS	7:30:00	4.03
010SCS	7:45:00	4.03
010SCS	8:00:00	2.35
010SCS	8:15:00	2.35
010SCS	8:30:00	2.35
010SCS	8:45:00	2.35
010SCS	9:00:00	2.35
010SCS	9:15:00	2.35
010SCS	9:30:00	2.35
010SCS	9:45:00	2.35
010SCS	10:00:00	1.34
010SCS	10:15:00	1.34
010SCS	10:30:00	1.34
010SCS	10:45:00	1.34
010SCS	11:00:00	1.34
010SCS	11:15:00	1.34
010SCS	11:30:00	1.34

010SCS	11:45:00	1.34
010SCS	12:00:00	0

025SCS	0:00:00	0
025SCS	0:15:00	1.98
025SCS	0:30:00	1.98
025SCS	0:45:00	1.98
025SCS	1:00:00	1.98
025SCS	1:15:00	1.98
025SCS	1:30:00	1.98
025SCS	1:45:00	1.98
025SCS	2:00:00	2.376
025SCS	2:15:00	2.376
025SCS	2:30:00	2.376
025SCS	2:45:00	2.376
025SCS	3:00:00	3.168
025SCS	3:15:00	3.168
025SCS	3:30:00	3.168
025SCS	3:45:00	3.168
025SCS	4:00:00	4.752
025SCS	4:15:00	4.752
025SCS	4:30:00	6.336
025SCS	4:45:00	6.336
025SCS	5:00:00	9.504
025SCS	5:15:00	9.504
025SCS	5:30:00	38.016
025SCS	5:45:00	104.544
025SCS	6:00:00	14.256
025SCS	6:15:00	14.256
025SCS	6:30:00	6.336
025SCS	6:45:00	6.336
025SCS	7:00:00	4.752
025SCS	7:15:00	4.752
025SCS	7:30:00	4.752
025SCS	7:45:00	4.752
025SCS	8:00:00	2.772
025SCS	8:15:00	2.772
025SCS	8:30:00	2.772
025SCS	8:45:00	2.772
025SCS	9:00:00	2.772
025SCS	9:15:00	2.772
025SCS	9:30:00	2.772
025SCS	9:45:00	2.772
025SCS	10:00:00	1.584
025SCS	10:15:00	1.584
025SCS	10:30:00	1.584
025SCS	10:45:00	1.584
025SCS	11:00:00	1.584

025SCS	11:15:00	1.584
025SCS	11:30:00	1.584
025SCS	11:45:00	1.584
025SCS	12:00:00	0

050SCS	0:00:00	0
050SCS	0:15:00	2.19
050SCS	0:30:00	2.19
050SCS	0:45:00	2.19
050SCS	1:00:00	2.19
050SCS	1:15:00	2.19
050SCS	1:30:00	2.19
050SCS	1:45:00	2.19
050SCS	2:00:00	2.628
050SCS	2:15:00	2.628
050SCS	2:30:00	2.628
050SCS	2:45:00	2.628
050SCS	3:00:00	3.504
050SCS	3:15:00	3.504
050SCS	3:30:00	3.504
050SCS	3:45:00	3.504
050SCS	4:00:00	5.256
050SCS	4:15:00	5.256
050SCS	4:30:00	7.008
050SCS	4:45:00	7.008
050SCS	5:00:00	10.512
050SCS	5:15:00	10.512
050SCS	5:30:00	42.048
050SCS	5:45:00	115.632
050SCS	6:00:00	15.768
050SCS	6:15:00	15.768
050SCS	6:30:00	7.008
050SCS	6:45:00	7.008
050SCS	7:00:00	5.256
050SCS	7:15:00	5.256
050SCS	7:30:00	5.256
050SCS	7:45:00	5.256
050SCS	8:00:00	3.066
050SCS	8:15:00	3.066
050SCS	8:30:00	3.066
050SCS	8:45:00	3.066
050SCS	9:00:00	3.066
050SCS	9:15:00	3.066
050SCS	9:30:00	3.066
050SCS	9:45:00	3.066
050SCS	10:00:00	1.752
050SCS	10:15:00	1.752
050SCS	10:30:00	1.752

050SCS	10:45:00	1.752
050SCS	11:00:00	1.752
050SCS	11:15:00	1.752
050SCS	11:30:00	1.752
050SCS	11:45:00	1.752
050SCS	12:00:00	0

;MTO Distribution, 15min intervals

100SCS	0:00	0
100SCS	0:15	2.4
100SCS	0:30	2.4
100SCS	0:45	2.4
100SCS	1:00	2.4
100SCS	1:15	2.4
100SCS	1:30	2.4
100SCS	1:45	2.4
100SCS	2:00	2.4
100SCS	2:15	2.88
100SCS	2:30	2.88
100SCS	2:45	2.88
100SCS	3:00	2.88
100SCS	3:15	3.84
100SCS	3:30	3.84
100SCS	3:45	3.84
100SCS	4:00	3.84
100SCS	4:15	5.76
100SCS	4:30	5.76
100SCS	4:45	7.68
100SCS	5:00	7.68
100SCS	5:15	11.52
100SCS	5:30	11.52
100SCS	5:45	46.08
100SCS	6:00	126.72
100SCS	6:15	17.28
100SCS	6:30	17.28
100SCS	6:45	7.68
100SCS	7:00	7.68
100SCS	7:15	5.76
100SCS	7:30	5.76
100SCS	7:45	5.76
100SCS	8:00	5.76
100SCS	8:15	3.36
100SCS	8:30	3.36
100SCS	8:45	3.36
100SCS	9:00	3.36
100SCS	9:15	3.36
100SCS	9:30	3.36
100SCS	9:45	3.36

```
100SCS                      10:00      3.36
100SCS                      10:15      1.92
100SCS                      10:30      1.92
100SCS                      10:45      1.92
100SCS                      11:00      1.92
100SCS                      11:15      1.92
100SCS                      11:30      1.92
100SCS                      11:45      1.92
100SCS                      12:00      0

120SCS                      0:00       0
120SCS                      0:15       2.88
120SCS                      0:30       2.88
120SCS                      0:45       2.88
120SCS                      1:00       2.88
120SCS                      1:15       2.88
120SCS                      1:30       2.88
120SCS                      1:45       2.88
120SCS                      2:00       2.88
120SCS                      2:15       3.456
120SCS                      2:30       3.456
120SCS                      2:45       3.456
120SCS                      3:00       3.456
120SCS                      3:15       4.608
120SCS                      3:30       4.608
120SCS                      3:45       4.608
120SCS                      4:00       4.608
120SCS                      4:15       6.912
120SCS                      4:30       6.912
120SCS                      4:45       9.216
120SCS                      5:00       9.216
120SCS                      5:15       13.824
120SCS                      5:30       13.824
120SCS                      5:45       55.296
120SCS                      6:00       152.064
120SCS                      6:15       20.736
120SCS                      6:30       20.736
120SCS                      6:45       9.216
120SCS                      7:00       9.216
120SCS                      7:15       6.912
120SCS                      7:30       6.912
120SCS                      7:45       6.912
120SCS                      8:00       6.912
120SCS                      8:15       4.032
120SCS                      8:30       4.032
120SCS                      8:45       4.032
120SCS                      9:00       4.032
120SCS                      9:15       4.032
```



```
120SCS                      9:30       4.032
120SCS                      9:45       4.032
120SCS                      10:00      4.032
120SCS                      10:15      2.304
120SCS                      10:30      2.304
120SCS                      10:45      2.304
120SCS                      11:00      2.304
120SCS                      11:15      2.304
120SCS                      11:30      2.304
120SCS                      11:45      2.304
120SCS                      12:00      0

[REPORT]
;;Reporting Options
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]
Node       ST104A-S         RD
Node       ST107A-S         RD
Node       ST111A-S         RD
Node       ST111C-S         RD
Node       ST507A-S         RD
Link       L201A-T          MJ
Link       L201B-T          MJ
Link       L201C-T          MJ
Link       ST104A-T         MJ
Link       ST107A-T         MJ
Link       ST111A-T         MJ
Link       ST111B-T         MJ
Link       ST507A-T         MJ

[MAP]
DIMENSIONS       350551.92255     5015913.69355     350858.28245     5016191.78345
UNITS            Meters

[COORDINATES]
;;Node           X-Coord            Y-Coord
```

C.3 SAMPLE PCSWMM MODEL OUTPUT (12HR 100YR SCS)

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.014)

WARNING 03: negative offset ignored for Link Pipe_29

Element Count

Number of rain gages 1
Number of subcatchments ... 20
Number of nodes 33
Number of links 40
Number of pollutants 0
Number of land uses 0

Raingage Summary

Name	Data Source	Data Type	Recording Interval
RG1	100SCS	INTENSITY	15 min.

Subcatchment Summary

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
EXT_1	0.07	16.45	0.00	33.3000	RG1	EXT1-OF
EXT2	0.05	11.49	80.00	2.0000	RG1	EXT2-OF
L104A	0.03	32.10	81.43	2.0000	RG1	ST104A-S
L201A	0.23	88.70	62.86	2.0000	RG1	L201A-S
L201B	0.16	76.00	78.57	3.0000	RG1	L201B-S
L201C	0.19	83.00	80.00	2.5000	RG1	L201C-S
L201D	0.14	48.00	100.00	1.0000	RG1	L201D-S
L202A	0.34	77.06	100.00	1.5000	RG1	L202A-S
ST107A	0.28	225.00	72.86	1.5000	RG1	ST107A-S
ST108A	0.40	90.85	100.00	1.5000	RG1	ST108A-S
ST108C	0.06	13.99	100.00	1.5000	RG1	ST108C-S
ST108D	0.37	82.74	37.72	1.2000	RG1	108
ST110A	0.07	16.80	7.14	0.8000	RG1	110
ST110C	0.03	26.60	100.00	10.0000	RG1	110
ST110D	0.07	16.67	7.14	0.8000	RG1	110
ST111A	0.26	107.50	65.71	0.8000	RG1	ST111A-S

ST111B	0.04	88.00	100.00	0.8000	RG1	111
ST111C	0.04	36.80	61.43	1.5000	RG1	ST111C-S
ST507A	0.05	25.80	81.43	1.5000	RG1	ST507A-S
ST508A	0.10	158.90	0.00	1.0000	RG1	508

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
110	JUNCTION	100.69	3.81	0.0	
201	JUNCTION	101.16	3.34	0.0	
EXT1-OF	OUTFALL	102.88	0.00	0.0	
EXT2-OF	OUTFALL	104.20	0.00	0.0	
HEADWALL	OUTFALL	98.70	1.49	0.0	
POOLE_OF1	OUTFALL	100.10	0.00	0.0	
POOLE_OF2	OUTFALL	101.06	0.00	0.0	
ST104A-OF	OUTFALL	0.00	103.03	0.0	
ST107A-OF	OUTFALL	0.00	103.19	0.0	
100	STORAGE	99.40	2.73	0.0	Yes
101	STORAGE	99.60	3.69	0.0	
102	STORAGE	99.78	3.75	0.0	
103	STORAGE	100.03	3.53	0.0	
104	STORAGE	100.08	3.49	0.0	
105	STORAGE	100.23	3.41	0.0	
106	STORAGE	100.34	2.98	0.0	
107	STORAGE	100.80	2.42	0.0	
108	STORAGE	97.24	7.13	0.0	
111	STORAGE	101.42	2.65	0.0	
508	STORAGE	101.06	1.79	0.0	
L201A-S	STORAGE	102.24	1.73	0.0	
L201B-S	STORAGE	101.83	1.73	0.0	
L201C-S	STORAGE	101.83	1.73	0.0	
L201D-S	STORAGE	102.81	1.50	0.0	
L202A-S	STORAGE	115.75	0.15	0.0	
ST104A-S	STORAGE	101.52	2.10	0.0	
ST107A-S	STORAGE	101.13	2.10	0.0	
ST108A-S	STORAGE	118.60	0.15	0.0	
ST108C-S	STORAGE	110.40	0.15	0.0	
ST111A-S	STORAGE	101.86	2.40	0.0	
ST111C-S	STORAGE	101.95	2.10	0.0	
ST507A-S	STORAGE	101.57	2.10	0.0	
TANK	STORAGE	100.10	3.27	0.0	

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Link Summary
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Name	From Node	To Node	Type	Length	%Slope	Roughness
201-104	201	104	CONDUIT	78.3	0.9993	0.0130
L201A-T	L201A-S	ST104A-S	CONDUIT	30.8	1.1364	0.0130
L201B-T	L201B-S	ST104A-S	CONDUIT	38.4	0.1042	0.0130
L201C-T	L201C-S	ST507A-S	CONDUIT	34.8	0.0575	0.0130
Pipe_13	100	HEADWALL	CONDUIT	11.1	0.2515	0.0130
Pipe_14	106	105	CONDUIT	17.6	0.1993	0.0130
Pipe_14_(1)	105	104	CONDUIT	39.1	0.2020	0.0130
Pipe_16	110	106	CONDUIT	12.5	0.9994	0.0130
Pipe_17	111	107	CONDUIT	110.4	0.7004	0.0130
Pipe_21	104	103	CONDUIT	16.3	0.2027	0.0130
Pipe_23	508	TANK	CONDUIT	8.7	0.2497	0.0130
Pipe_26	101	100	CONDUIT	101.6	0.1999	0.0130
Pipe_27	108	105	CONDUIT	36.3	0.2999	0.0130
Pipe_29	107	106	CONDUIT	63.3	0.5008	0.0130
Pipe_31	102	101	CONDUIT	70.7	0.1994	0.0130
Pipe_34	103	TANK	CONDUIT	2.8	0.2135	0.0130
ST104A-T	ST104A-S	ST104A-OF	CONDUIT	2.5	24.2860	0.0130
ST107A-T	ST107A-S	ST107A-OF	CONDUIT	2.5	1.6002	0.0130
ST111A-T	ST111A-S	ST111C-S	CONDUIT	40.9	1.2470	0.0130
ST111B-T	ST111C-S	ST107A-S	CONDUIT	60.0	1.1167	0.0130
ST507A-T	ST507A-S	ST104A-S	CONDUIT	14.9	0.2013	0.0130
W1	103	102	CONDUIT	3.0	1.0001	0.0130
L201A-O	L201A-S	201	ORIFICE			
L201B-O	L201B-S	201	ORIFICE			
L201C-O	L201C-S	201	ORIFICE			
OR1	TANK	102	ORIFICE			
OR2	TANK	102	ORIFICE			
OR3	TANK	102	ORIFICE			
ST104A-O	ST104A-S	104	ORIFICE			
ST107A-O	ST107A-S	107	ORIFICE			
ST109C-O	L201D-S	201	ORIFICE			
ST111A-O	ST111A-S	111	ORIFICE			
ST111C-O	ST111C-S	111	ORIFICE			
ST111C-O1	ST111C-S	111	ORIFICE			
OL1	TANK	POOLE_OF1	OUTLET			
OL2	508	POOLE_OF2	OUTLET			
ST108A-O	ST108A-S	108	OUTLET			
ST108B-O	L202A-S	108	OUTLET			
ST108C-O	ST108C-S	108	OUTLET			
ST507A-O	ST507A-S	TANK	OUTLET			

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Cross Section Summary

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Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
201-104	CIRCULAR	0.38	0.11	0.09	0.38	1	175.28
L201A-T	Overland	0.15	1.03	0.14	7.00	1	2311.17
L201B-T	Overland	0.15	1.03	0.14	7.00	1	699.72
L201C-T	Overland	0.15	1.03	0.14	7.00	1	519.74
Pipe_13	CIRCULAR	0.68	0.36	0.17	0.68	1	421.55
Pipe_14	CIRCULAR	0.53	0.22	0.13	0.53	1	192.01
Pipe_14_(1)	CIRCULAR	0.60	0.28	0.15	0.60	1	276.00
Pipe_16	CIRCULAR	0.38	0.11	0.09	0.38	1	175.29
Pipe_17	CIRCULAR	0.38	0.11	0.09	0.38	1	146.75
Pipe_21	CIRCULAR	0.68	0.36	0.17	0.68	1	378.43
Pipe_23	CIRCULAR	0.25	0.05	0.06	0.25	1	29.72
Pipe_26	CIRCULAR	0.45	0.16	0.11	0.45	1	127.47
Pipe_27	CIRCULAR	0.45	0.16	0.11	0.45	1	156.15
Pipe_29	CIRCULAR	0.45	0.16	0.11	0.45	1	201.78
Pipe_31	CIRCULAR	0.45	0.16	0.11	0.45	1	127.33
Pipe_34	CIRCULAR	0.68	0.36	0.17	0.68	1	388.45
ST104A-T	Overland	0.15	1.03	0.14	7.00	1	10684.06
ST107A-T	Overland	0.15	1.03	0.14	7.00	1	2742.50
ST111A-T	Overland	0.15	1.03	0.14	7.00	1	2421.02
ST111B-T	Overland	0.15	1.03	0.14	7.00	1	2291.05
ST507A-T	Overland	0.15	1.03	0.14	7.00	1	972.81
W1	CIRCULAR	0.45	0.16	0.11	0.45	1	285.13

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Transect Summary
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Transect Overland

Area:

0.0196	0.0392	0.0588	0.0784	0.0980
0.1177	0.1374	0.1571	0.1768	0.1965
0.2162	0.2360	0.2558	0.2756	0.2954
0.3152	0.3351	0.3550	0.3748	0.3947
0.4147	0.4346	0.4546	0.4745	0.4945
0.5145	0.5346	0.5546	0.5747	0.5947
0.6148	0.6350	0.6551	0.6752	0.6954
0.7156	0.7358	0.7560	0.7762	0.7965
0.8168	0.8371	0.8574	0.8777	0.8980
0.9184	0.9388	0.9592	0.9796	1.0000

Hrad:

0.0208	0.0415	0.0622	0.0829	0.1036
0.1242	0.1448	0.1653	0.1858	0.2063

0.2268	0.2472	0.2676	0.2879	0.3083
0.3285	0.3488	0.3690	0.3892	0.4094
0.4295	0.4496	0.4697	0.4897	0.5097
0.5297	0.5496	0.5695	0.5894	0.6093
0.6291	0.6489	0.6686	0.6884	0.7081
0.7277	0.7474	0.7670	0.7865	0.8061
0.8256	0.8451	0.8646	0.8840	0.9034
0.9228	0.9421	0.9614	0.9807	1.0000

Width:

0.9580	0.9589	0.9597	0.9606	0.9614
0.9623	0.9631	0.9640	0.9649	0.9657
0.9666	0.9674	0.9683	0.9691	0.9700
0.9709	0.9717	0.9726	0.9734	0.9743
0.9751	0.9760	0.9769	0.9777	0.9786
0.9794	0.9803	0.9811	0.9820	0.9829
0.9837	0.9846	0.9854	0.9863	0.9871
0.9880	0.9889	0.9897	0.9906	0.9914
0.9923	0.9931	0.9940	0.9949	0.9957
0.9966	0.9974	0.9983	0.9991	1.0000

Transect Overland(orig)

Area:

0.0196	0.0392	0.0588	0.0784	0.0980
0.1177	0.1374	0.1571	0.1768	0.1965
0.2162	0.2360	0.2558	0.2756	0.2954
0.3152	0.3351	0.3550	0.3748	0.3947
0.4147	0.4346	0.4546	0.4745	0.4945
0.5145	0.5346	0.5546	0.5747	0.5947
0.6148	0.6350	0.6551	0.6752	0.6954
0.7156	0.7358	0.7560	0.7762	0.7965
0.8168	0.8371	0.8574	0.8777	0.8980
0.9184	0.9388	0.9592	0.9796	1.0000

Hrad:

0.0208	0.0415	0.0622	0.0829	0.1036
0.1242	0.1448	0.1653	0.1858	0.2063
0.2268	0.2472	0.2676	0.2879	0.3083
0.3285	0.3488	0.3690	0.3892	0.4094
0.4295	0.4496	0.4697	0.4897	0.5097
0.5297	0.5496	0.5695	0.5894	0.6093
0.6291	0.6489	0.6686	0.6884	0.7081
0.7277	0.7474	0.7670	0.7865	0.8061
0.8256	0.8451	0.8646	0.8840	0.9034
0.9228	0.9421	0.9614	0.9807	1.0000

Width:

0.9580	0.9589	0.9597	0.9606	0.9614
0.9623	0.9631	0.9640	0.9649	0.9657
0.9666	0.9674	0.9683	0.9691	0.9700
0.9709	0.9717	0.9726	0.9734	0.9743

0.9751	0.9760	0.9769	0.9777	0.9786
0.9794	0.9803	0.9811	0.9820	0.9829
0.9837	0.9846	0.9854	0.9863	0.9871
0.9880	0.9889	0.9897	0.9906	0.9914
0.9923	0.9931	0.9940	0.9949	0.9957
0.9966	0.9974	0.9983	0.9991	1.0000

```
*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 07/23/2009 00:00:00
Ending Date .............. 07/24/2009 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 1.00 sec
Variable Time Step ....... NO
Maximum Trials ........... 8
Number of Threads ........ 4
Head Tolerance ........... 0.001500 m

**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.285        95.520
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.038        12.572
```

Surface Runoff	0.244	81.642
Final Storage	0.005	1.574
Continuity Error (%)	-0.282	

Flow Routing Continuity	Volume hectare-m	Volume 10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.244	2.437
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	1.512	15.120
External Outflow	1.715	17.152
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.041	0.408
Continuity Error (%)	-0.017	

Highest Flow Instability Indexes

Link Pipe_34 (3)

Routing Time Step Summary

Minimum Time Step :	1.00 sec
Average Time Step :	1.00 sec
Maximum Time Step :	1.00 sec
Percent in Steady State :	0.00
Average Iterations per Step :	2.00
Percent Not Converging :	0.03

Subcatchment Runoff Summary

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
EXT_1	95.52	0.00	0.00	41.82	0.00	52.63	52.63	0.04	18.39	0.551
EXT2	95.52	0.00	0.00	8.36	75.45	86.14	86.14	0.04	17.03	0.902
L104A	95.52	0.00	0.00	7.74	86.36	9.82	86.36	0.03	10.14	0.904
L201A	95.52	0.00	0.00	15.53	78.68	19.56	78.68	0.18	68.87	0.824
L201B	95.52	0.00	0.00	8.95	85.22	11.33	85.22	0.13	51.31	0.892
L201C	95.52	0.00	0.00	8.35	85.83	10.57	85.83	0.16	61.21	0.899
L201D	95.52	0.00	0.00	0.00	94.34	0.00	94.34	0.13	49.85	0.988
L202A	95.52	0.00	0.00	0.00	94.37	0.00	94.37	0.32	120.55	0.988
ST107A	95.52	0.00	0.00	11.33	82.84	14.34	82.84	0.23	90.66	0.867
ST108A	95.52	0.00	0.00	0.00	94.37	0.00	94.37	0.38	142.11	0.988
ST108C	95.52	0.00	0.00	0.00	94.37	0.00	94.37	0.06	21.89	0.988
ST108D	95.52	0.00	0.00	26.05	35.53	68.00	68.00	0.25	93.04	0.712
ST110A	95.52	0.00	0.00	38.83	6.71	54.74	54.74	0.04	12.92	0.573
ST110C	95.52	0.00	0.00	0.00	93.99	0.00	93.99	0.03	10.41	0.984
ST110D	95.52	0.00	0.00	38.83	6.71	54.74	54.74	0.04	12.82	0.573
ST111A	95.52	0.00	0.00	14.34	79.88	18.03	79.88	0.20	78.28	0.836
ST111B	95.52	0.00	0.00	0.00	94.00	0.00	94.00	0.04	13.13	0.984
ST111C	95.52	0.00	0.00	16.12	78.11	20.37	78.11	0.03	13.40	0.818
ST507A	95.52	0.00	0.00	7.76	86.44	9.81	86.44	0.04	16.95	0.905
ST508A	95.52	0.00	0.00	41.82	0.00	52.70	52.70	0.05	24.58	0.552

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Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
110	JUNCTION	0.13	1.25	101.93	0 06:51	1.24
201	JUNCTION	0.07	0.87	102.03	0 06:33	0.82
EXT1-OF	OUTFALL	0.00	0.00	102.88	0 00:00	0.00
EXT2-OF	OUTFALL	0.00	0.00	104.20	0 00:00	0.00
HEADWALL	OUTFALL	0.00	0.00	98.70	0 00:00	0.00
POOLE_OF1	OUTFALL	0.00	0.00	100.10	0 00:00	0.00
POOLE_OF2	OUTFALL	0.00	0.00	101.06	0 00:00	0.00
ST104A-OF	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
ST107A-OF	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
100	STORAGE	0.44	0.52	99.92	0 06:54	0.52
101	STORAGE	0.41	0.73	100.33	0 06:54	0.73
102	STORAGE	0.40	0.75	100.53	0 06:53	0.75
103	STORAGE	0.46	1.88	101.91	0 06:51	1.88
104	STORAGE	0.42	1.84	101.92	0 06:51	1.84
105	STORAGE	0.34	1.70	101.93	0 06:51	1.70
106	STORAGE	0.29	1.59	101.93	0 06:51	1.59
107	STORAGE	0.12	1.14	101.94	0 06:51	1.13
108	STORAGE	2.72	4.73	101.97	0 06:51	4.73
111	STORAGE	0.25	0.53	101.95	0 06:51	0.53
508	STORAGE	0.44	0.98	102.04	0 06:46	0.86
L201A-S	STORAGE	0.06	1.57	103.81	0 06:18	1.57
L201B-S	STORAGE	0.08	1.57	103.40	0 06:19	1.57
L201C-S	STORAGE	0.08	1.56	103.39	0 06:18	1.56
L201D-S	STORAGE	0.02	0.40	103.21	0 06:15	0.40
L202A-S	STORAGE	0.02	0.14	115.89	0 06:20	0.14
ST104A-S	STORAGE	0.03	0.58	102.10	0 06:15	0.58
ST107A-S	STORAGE	0.08	1.10	102.23	0 06:15	1.10
ST108A-S	STORAGE	0.02	0.14	118.74	0 06:20	0.14
ST108C-S	STORAGE	0.01	0.14	110.54	0 06:19	0.14
ST111A-S	STORAGE	0.24	2.32	104.18	0 06:26	2.32
ST111C-S	STORAGE	0.00	0.08	102.03	0 06:15	0.08
ST507A-S	STORAGE	0.05	1.85	103.42	0 06:17	1.84
TANK	STORAGE	0.39	1.81	101.91	0 06:51	1.81

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Node Inflow Summary
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Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
110	JUNCTION	36.14	50.12	0 06:15	0.109	0.109	-0.008
201	JUNCTION	0.00	139.49	0 06:15	0	0.604	0.525
EXT1-OF	OUTFALL	18.39	18.39	0 06:15	0.0385	0.0385	0.000
EXT2-OF	OUTFALL	17.03	17.03	0 06:15	0.044	0.044	0.000
HEADWALL	OUTFALL	0.00	308.06	0 06:54	0	17	0.000
POOLE_OF1	OUTFALL	0.00	0.66	0 01:21	0	0.0541	0.000
POOLE_OF2	OUTFALL	0.00	0.30	0 05:31	0	0.02	0.000
ST104A-OF	OUTFALL	0.00	0.00	0 00:00	0	0	0.000 ltr
ST107A-OF	OUTFALL	0.00	0.00	0 00:00	0	0	0.000 ltr
100	STORAGE	175.00	308.06	0 06:54	15.1	17	0.014
101	STORAGE	0.00	133.14	0 06:52	0	1.88	-0.115
102	STORAGE	0.00	133.19	0 06:51	0	1.88	0.015
103	STORAGE	0.00	460.74	0 06:16	0	1.9	-0.002
104	STORAGE	0.00	493.83	0 06:15	0	1.89	-0.271
105	STORAGE	0.00	368.03	0 06:15	0	1.32	0.177
106	STORAGE	0.00	258.71	0 06:15	0	0.615	-0.342
107	STORAGE	0.00	134.10	0 06:15	0	0.506	0.269
108	STORAGE	93.04	300.34	0 06:14	0.25	1.06	-0.149
111	STORAGE	13.13	43.78	0 06:15	0.0351	0.274	0.419
508	STORAGE	24.58	45.46	0 06:46	0.0508	0.0732	-0.145
L201A-S	STORAGE	68.87	68.87	0 06:15	0.177	0.177	0.010
L201B-S	STORAGE	51.31	51.31	0 06:15	0.133	0.133	0.003
L201C-S	STORAGE	61.21	61.21	0 06:15	0.159	0.159	0.006
L201D-S	STORAGE	49.85	49.85	0 06:15	0.134	0.134	-0.000
L202A-S	STORAGE	120.55	120.55	0 06:15	0.323	0.323	-0.001
ST104A-S	STORAGE	10.14	10.14	0 06:15	0.0264	0.0264	-0.000
ST107A-S	STORAGE	90.66	90.66	0 06:15	0.233	0.233	0.009
ST108A-S	STORAGE	142.11	142.11	0 06:15	0.381	0.381	-0.001
ST108C-S	STORAGE	21.89	21.89	0 06:15	0.0587	0.0587	-0.001
ST111A-S	STORAGE	78.28	78.28	0 06:15	0.205	0.205	0.000
ST111C-S	STORAGE	13.40	13.40	0 06:15	0.034	0.034	-0.000
ST507A-S	STORAGE	16.95	16.95	0 06:15	0.0442	0.0442	-0.008
TANK	STORAGE	0.00	468.62	0 06:16	0	1.96	0.013

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Node Surcharge Summary
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Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
110	JUNCTION	2.90	0.873	2.566
201	JUNCTION	1.73	0.495	2.466

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Node Flooding Summary
****

No nodes were flooded.

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Storage Volume Summary
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Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
100	0.000	16	0	0	0.001	19	0 06:54	308.06
101	0.000	11	0	0	0.001	20	0 06:54	133.06
102	0.000	11	0	0	0.001	20	0 06:53	133.14
103	0.001	13	0	0	0.002	53	0 06:51	457.76
104	0.000	12	0	0	0.002	53	0 06:51	460.74
105	0.000	10	0	0	0.002	50	0 06:51	350.10
106	0.000	10	0	0	0.002	53	0 06:51	225.44
107	0.000	5	0	0	0.001	47	0 06:51	133.62
108	0.286	79	0	0	0.364	100	0 06:14	228.42
111	0.000	9	0	0	0.001	20	0 06:51	43.68
508	0.028	52	0	0	0.053	99	0 06:46	37.19
L201A-S	0.000	1	0	0	0.019	90	0 06:18	39.40
L201B-S	0.000	1	0	0	0.023	42	0 06:19	22.19
L201C-S	0.000	1	0	0	0.025	36	0 06:18	28.50
L201D-S	0.000	0	0	0	0.000	0	0 00:00	49.85
L202A-S	0.008	6	0	0	0.119	86	0 06:20	26.20
ST104A-S	0.000	0	0	0	0.000	0	0 00:00	10.05
ST107A-S	0.000	0	0	0	0.000	0	0 00:00	90.42
ST108A-S	0.010	6	0	0	0.141	86	0 06:20	30.68
ST108C-S	0.001	4	0	0	0.019	76	0 06:19	6.31
ST111A-S	0.003	3	0	0	0.058	54	0 06:26	17.37
ST111C-S	0.000	0	0	0	0.000	0	0 00:00	13.39
ST507A-S	0.000	0	0	0	0.003	16	0 06:17	10.86
TANK	0.179	30	0	0	0.590	100	0 06:51	173.95

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
EXT1-OF	30.28	1.47	18.39	0.038
EXT2-OF	46.16	1.10	17.03	0.044
HEADWALL	100.00	196.71	308.06	16.996
POOLE_OF1	95.53	0.66	0.66	0.054
POOLE_OF2	77.53	0.30	0.30	0.020
ST104A-OF	0.00	0.00	0.00	0.000
ST107A-OF	0.00	0.00	0.00	0.000
System	49.93	200.24	0.00	17.152

****
Link Flow Summary
****

Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
201-104	CONDUIT	139.88	0 06:10	1.64	0.80	1.00
L201A-T	CHANNEL	0.00	0 00:00	0.00	0.00	0.00
L201B-T	CHANNEL	0.00	0 00:00	0.00	0.00	0.00
L201C-T	CHANNEL	0.00	0 00:00	0.00	0.00	0.00
Pipe_13	CONDUIT	308.06	0 06:54	1.59	0.73	0.53
Pipe_14	CONDUIT	225.44	0 06:15	1.14	1.17	1.00
Pipe_14_(1)	CONDUIT	350.10	0 06:15	1.24	1.27	1.00
Pipe_16	CONDUIT	57.53	0 06:15	0.87	0.33	1.00
Pipe_17	CONDUIT	43.68	0 06:15	1.02	0.30	0.90
Pipe_21	CONDUIT	460.74	0 06:16	1.29	1.22	1.00
Pipe_23	CONDUIT	41.98	0 06:46	0.93	1.41	1.00
Pipe_26	CONDUIT	133.06	0 06:54	1.08	1.04	0.72
Pipe_27	CONDUIT	228.42	0 06:15	1.44	1.46	1.00
Pipe_29	CONDUIT	133.62	0 06:15	1.34	0.66	1.00
Pipe_31	CONDUIT	133.14	0 06:52	0.87	1.05	0.93
Pipe_34	CONDUIT	457.76	0 06:16	1.43	1.18	1.00
ST104A-T	CHANNEL	0.00	0 00:00	0.00	0.00	0.00

ST107A-T	CHANNEL	0.00	0	00:00	0.00	0.00	0.00
ST111A-T	CHANNEL	0.00	0	00:00	0.00	0.00	0.00
ST111B-T	CHANNEL	0.00	0	00:00	0.00	0.00	0.00
ST507A-T	CHANNEL	0.00	0	00:00	0.00	0.00	0.00
W1	CONDUIT	0.00	0	00:00	0.00	0.00	0.00
L201A-O	ORIFICE	39.40	0	06:18			1.00
L201B-O	ORIFICE	22.19	0	06:19			1.00
L201C-O	ORIFICE	28.50	0	06:18			1.00
OR1	ORIFICE	32.25	0	06:50			1.00
OR2	ORIFICE	54.32	0	06:51			1.00
OR3	ORIFICE	46.62	0	06:51			1.00
ST104A-O	ORIFICE	10.05	0	06:15			1.00
ST107A-O	ORIFICE	90.42	0	06:15			1.00
ST109C-O	ORIFICE	49.85	0	06:15			1.00
ST111A-O	ORIFICE	17.37	0	06:26			1.00
ST111C-O	ORIFICE	6.69	0	06:15			0.38
ST111C-O1	ORIFICE	6.69	0	06:15			0.38
OL1	DUMMY	0.66	0	01:21			
OL2	DUMMY	0.30	0	05:31			
ST108A-O	DUMMY	30.68	0	06:20			
ST108B-O	DUMMY	26.20	0	06:20			
ST108C-O	DUMMY	6.31	0	06:19			
ST507A-O	DUMMY	10.86	0	06:17			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	---------- Fraction of Time in Flow Class ---------- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
201-104	1.00	0.04	0.00	0.00	0.39	0.00	0.00	0.57	0.29	0.00
L201A-T	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L201B-T	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L201C-T	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipe_13	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
Pipe_14	1.00	0.04	0.00	0.00	0.40	0.00	0.00	0.56	0.02	0.00
Pipe_14_(1)	1.00	0.04	0.00	0.00	0.54	0.00	0.00	0.42	0.08	0.00
Pipe_16	1.00	0.04	0.00	0.00	0.31	0.00	0.00	0.65	0.05	0.00
Pipe_17	1.00	0.04	0.00	0.00	0.16	0.00	0.00	0.80	0.11	0.00
Pipe_21	1.00	0.04	0.00	0.00	0.94	0.00	0.00	0.02	0.12	0.00
Pipe_23	1.00	0.69	0.00	0.00	0.04	0.00	0.01	0.26	0.00	0.00
Pipe_26	1.00	0.00	0.08	0.00	0.72	0.00	0.00	0.20	0.54	0.00
Pipe_27	1.00	0.05	0.20	0.00	0.42	0.00	0.02	0.32	0.06	0.00
Pipe_29	1.00	0.04	0.00	0.00	0.34	0.00	0.00	0.62	0.17	0.00

Pipe_31	1.00	0.07	0.00	0.00	0.91	0.00	0.00	0.02	0.00	0.00
Pipe_34	1.00	0.04	0.00	0.00	0.90	0.06	0.00	0.00	0.01	0.00
ST104A-T	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST107A-T	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST111A-T	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST111B-T	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST507A-T	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W1	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

Conduit	--------- Hours Full -------- Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201-104	1.73	1.73	5.13	0.01	0.01
Pipe_14	3.50	3.50	3.73	0.01	0.01
Pipe_14_(1)	3.73	3.73	4.38	0.01	0.02
Pipe_16	2.90	2.90	3.50	0.01	0.01
Pipe_17	0.01	0.01	2.29	0.01	0.01
Pipe_21	4.41	4.41	4.74	0.02	0.02
Pipe_23	0.10	0.10	0.27	0.11	0.02
Pipe_26	0.01	0.01	0.01	0.66	0.01
Pipe_27	3.82	3.82	4.79	0.02	0.11
Pipe_29	2.29	2.29	3.50	0.01	0.01
Pipe_31	0.01	0.01	0.01	0.68	0.01
Pipe_34	4.79	4.79	4.87	0.02	0.01

Analysis begun on: Wed Sep 23 14:49:21 2020
Analysis ended on: Wed Sep 23 14:49:23 2020
Total elapsed time: 00:00:02

C.4 OIL/GRIT SEPARATOR SIZING CALCULATIONS

Stormceptor Design Summary
PCSWMM for Stormceptor

Project Information

Date	11/4/2016
Project Name	5731 Hazeldean
Project Number	160401195
Location	Ottawa, ON

Designer Information

Company	Stantec Consulting Ltd.
Contact	N/A

Rainfall

Name	OTTAWA MACDONALD-CARTIER INT'L A
State	ON
ID	6000
Years of Records	1967 to 2003
Latitude	45°19'N
Longitude	75°40'W

Notes

N/A

Water Quality Objective

TSS Removal (%)	80

Drainage Area

Total Area (ha)	2.72
Imperviousness (%)	70

The Stormceptor System model STC 3000 achieves the water quality objective removing 80% TSS for a CLOCA (clay, silt and sand) particle size distribution.

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0	0

Stormceptor Sizing Summary

Stormceptor Model	**TSS Removal %**
STC 300	60
STC 750	73
STC 1000	73
STC 1500	74
STC 2000	79
STC 3000	**80**
STC 4000	84
STC 5000	84
STC 6000	87
STC 9000	90
STC 10000	90
STC 14000	92

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

CLOCA (clay, silt and sand)

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
850	3.3	2.65	0.1465		50	3.9	2.65	0.0022
425	23.4	2.65	0.0698		36	2.6	2.65	0.0012
300	17.5	2.65	0.0439		22	1.3	2.65	0.0004
250	6.5	2.65	0.0335		12	1.9	2.65	0.0004
212	6.5	2.65	0.0259		9	0	2.65	0.0004
150	11.7	2.65	0.0145		6.5	1.3	2.65	0.0004
125	5.2	2.65	0.0105		3	1.3	2.65	0.0004
100	3.9	2.65	0.0070		1.5	1.3	2.65	0.0004
75	3.9	2.65	0.0040		1	4.5	2.65	0.0004

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.

Appendix D POOLE CREEK EROSION ANALYSIS

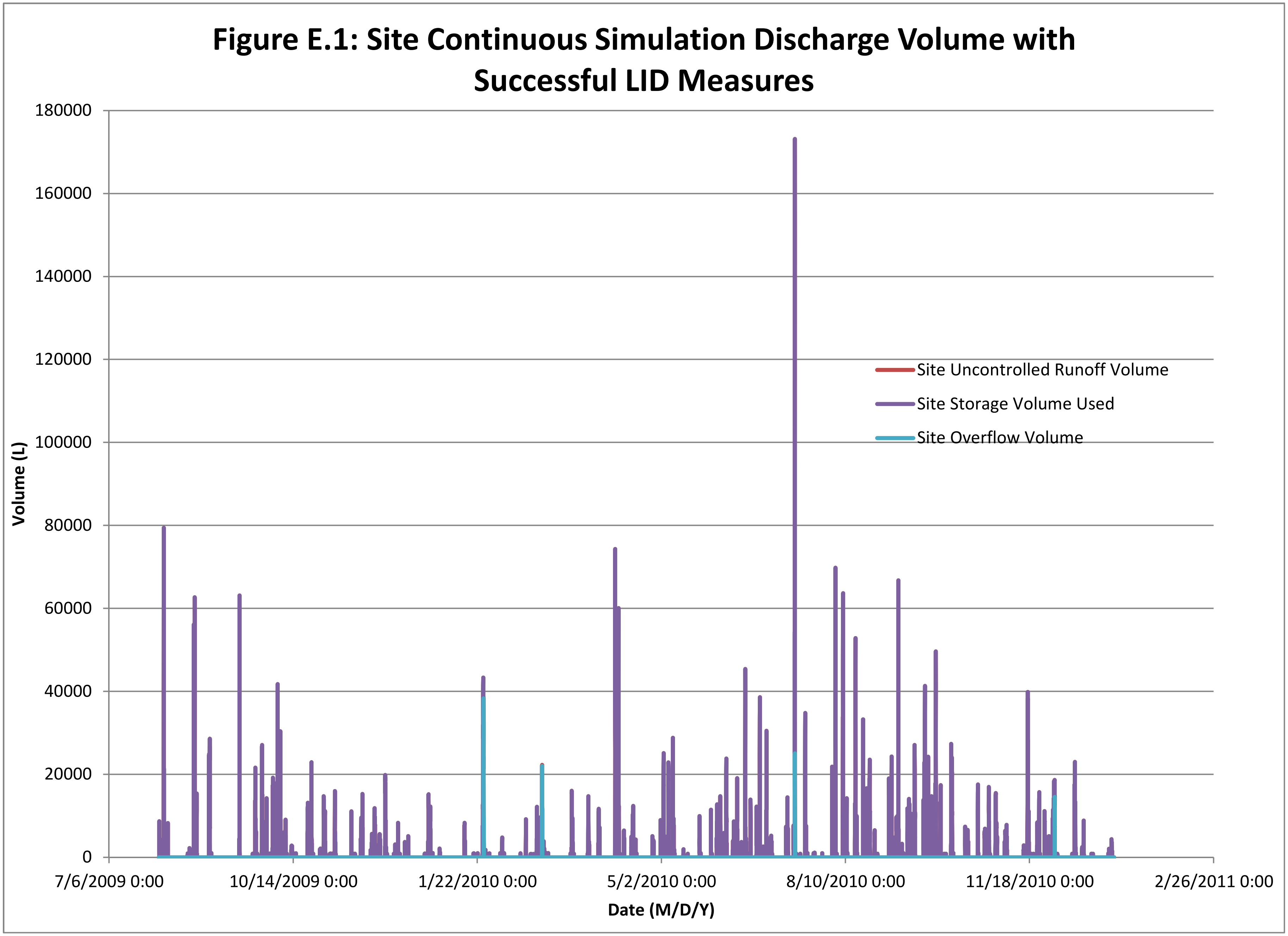

Figure E.1: Site Continuous Simulation Discharge Volume with Successful LID Measures
Volume (L)
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
Site Uncontrolled Runoff Volume
Site Storage Volume Used
Site Overflow Volume
7/6/2009 0:00
10/14/2009 0:00
1/22/2010 0:00
5/2/2010 0:00
8/10/2010 0:00
11/18/2010 0:00
2/26/2011 0:00
Date (M/D/Y)

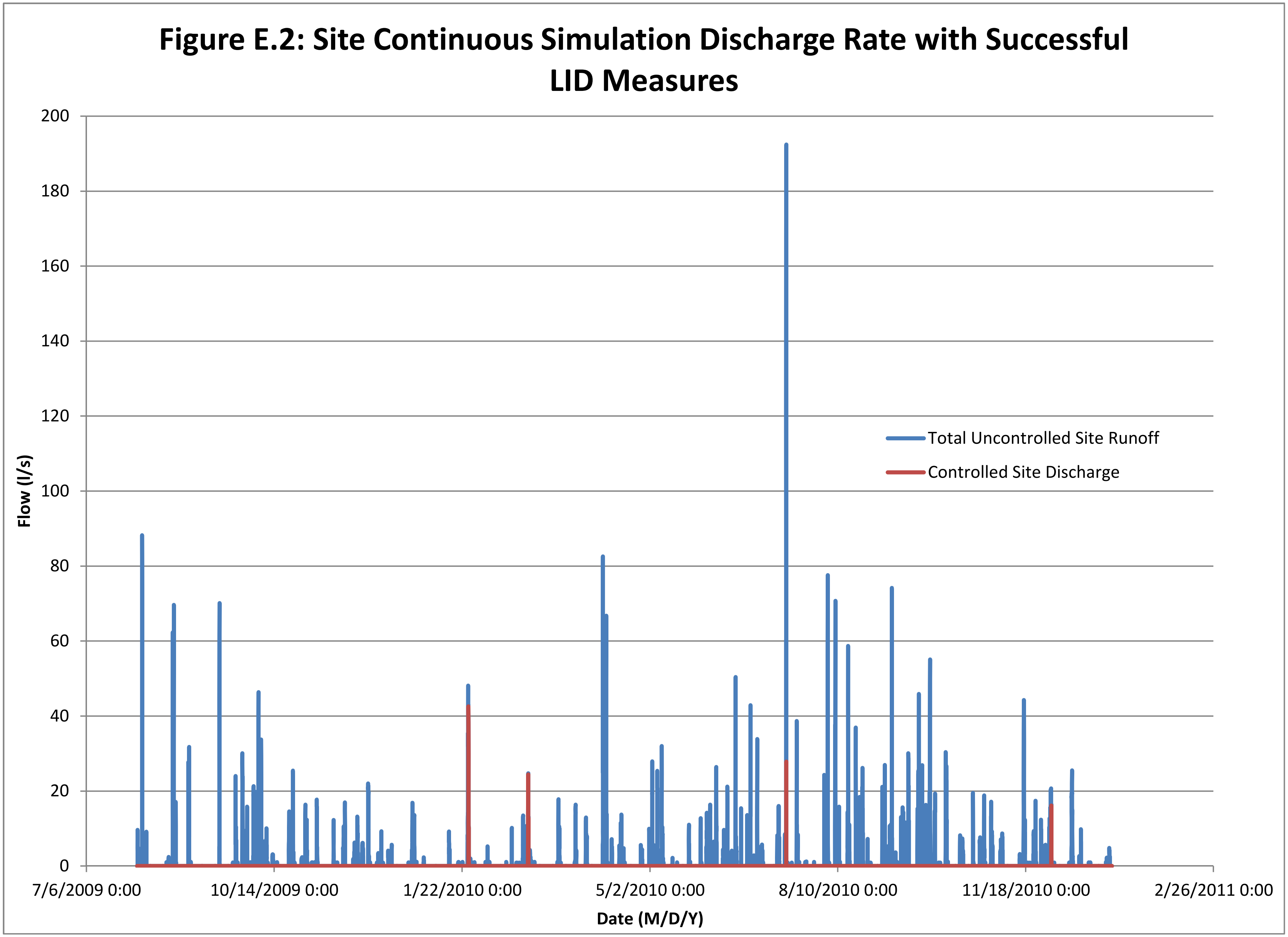

Figure E.2: Site Continuous Simulation Discharge Rate with Successful LID Measures
Flow (l/s)
200
180
160
140
120
100
80
60
40
20
0
7/6/2009 0:00
10/14/2009 0:00
1/22/2010 0:00
5/2/2010 0:00
8/10/2010 0:00
11/18/2010 0:00
2/26/2011 0:00
Date (M/D/Y)
Total Uncontrolled Site Runoff
Controlled Site Discharge

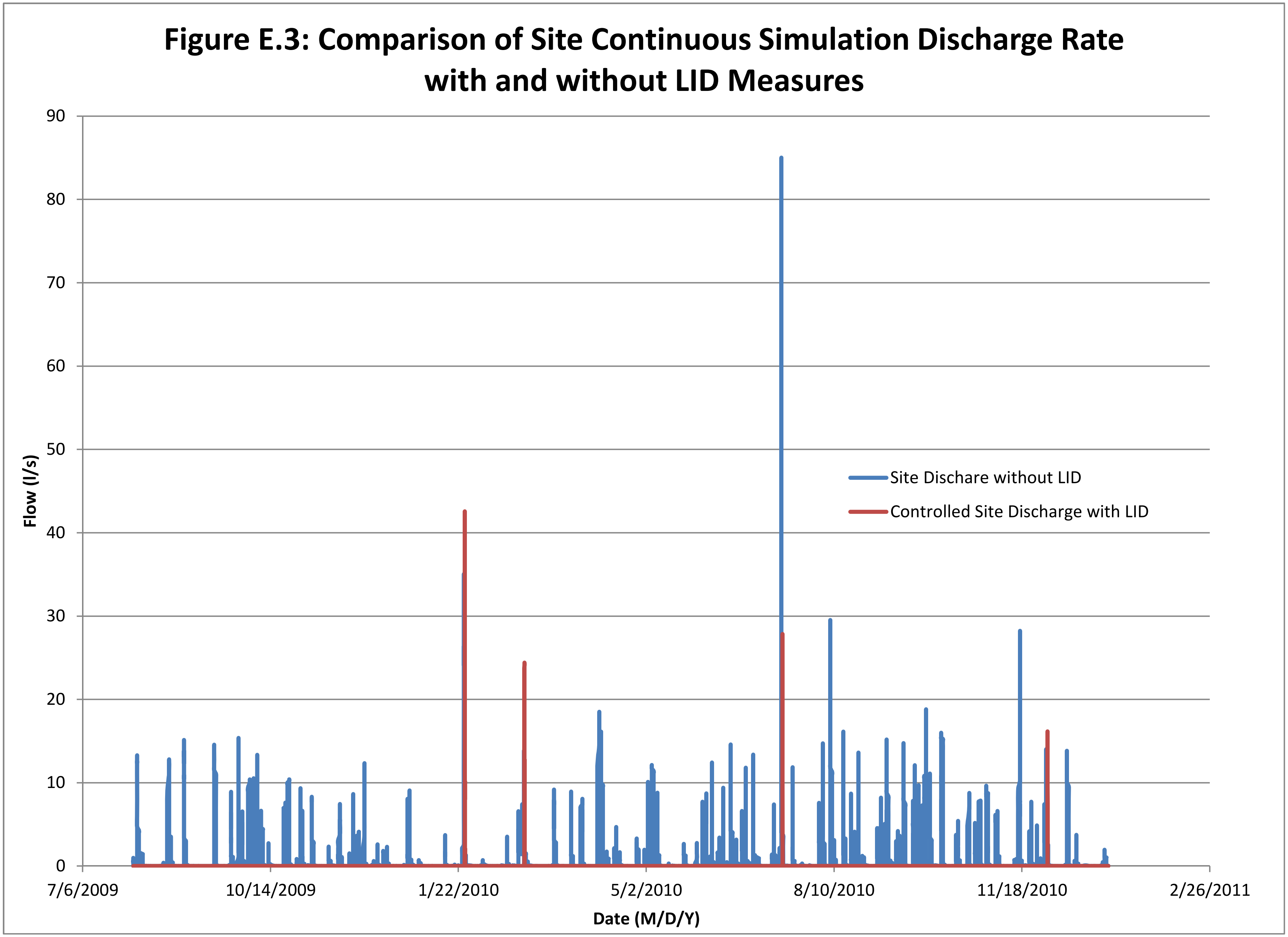
Figure E.3: Comparison of Site Continuous Simulation Discharge Rate with and without LID Measures
Flow (l/s)
0
10
20
30
40
50
60
70
80
90
7/6/2009
10/14/2009
1/22/2010
5/2/2010
8/10/2010
11/18/2010
2/26/2011
Date (M/D/Y)
Site Dischare without LID
Controlled Site Discharge with LID

Corrections to City PCSWMM drainage areas to remove site area

Existing Condition

	City Values		Site Area Removed		New Values	
area ID	Area	%IMP	Area	%IMP	Area	%IMP
PS037	11.723	5	2.048	0	9.68	6.06
PS020	23.05	18	0.763	0	22.29	18.62

Existing Carp River Erosion Frequency and Duration Analysis

Objective functions for Velocity (m/s)

Poole Creek Segment Model ID	**PC035**	**PC034**	**PC033**	**PC032**	**PC031**
25mm event Maximum Velocity(m/s):	0.916	1.107	0.7199	0.5083	1.055
Existing Conditions Carp River Model					
Maximum Velocity(m/s):	0.9175	1.109	0.7836	0.6452	1.198
Minimum Velocity(m/s):	0.5351	0.6875	0.2843	0.3674	0.4464
Mean Velocity(m/s):	0.6202	0.781	0.3699	0.3905	0.5565
Duration of Exceedances(h):	0.137	1.563	232.1	229.1	230.4
Number of Exceedances:	4	13	24	24	24
Carp River Model with Proposed Site Discharge					
Maximum Velocity(m/s):	0.9174	1.11	0.7838	0.6455	1.198
Minimum Velocity(m/s):	0.5351	0.6875	0.2843	0.3674	0.4464
Mean Velocity(m/s):	0.6202	0.7811	0.37	0.3906	0.5566
Duration of Exceedances(h):	0.183	0.4591	232.8	229.9	231.1
Number of Exceedances:	4	7	24	24	24
Increase with Proposed Development					
Maximum Flow(m^3/s):	-0.01%	0.09%	0.03%	0.05%	0.00%
Minimum Flow(m^3/s):	0.00%	0.00%	0.00%	0.00%	0.00%
Mean Flow(m^3/s):	0.00%	0.01%	0.03%	0.03%	0.02%
Duration of Exceedances(h):	33.58%	-70.63%	0.30%	0.35%	0.30%
Number of Exceedances:	0.00%	-46.15%	0.00%	0.00%	0.00%

Existing Carp River Erosion Frequency and Duration Analysis

Objective functions for Flow (m^3/s)

Poole Creek Reach Model ID	**PC031**	**PC032**	**PC033**	**PC034**	**PC035**
25mm event Maximum Flow(m^3/s):	3.022	3.022	3.022	3.021	3.021
Existing Carp River Model					
Maximum Flow(m^3/s):	8.746	8.746	8.746	8.745	8.744
Minimum Flow(m^3/s):	0.4995	0.4995	0.4995	0.4995	0.4995
Mean Flow(m^3/s):	0.8454	0.8453	0.8453	0.8453	0.8452
Duration of Exceedances(h):	231.3	230.7	230.7	230.7	230.6
Number of Exceedances:	24	24	24	24	24
Volume of Exceedances(m^3):	943400	943100	942600	942100	941500
Carp River Model with Proposed Site Discharge					
Maximum Flow(m^3/s):	8.756	8.757	8.756	8.755	8.754
Minimum Flow(m^3/s):	0.4995	0.4995	0.4995	0.4995	0.4995
Mean Flow(m^3/s):	0.846	0.8459	0.8459	0.8458	0.8458
Duration of Exceedances(h):	232.2	232	231.4	231.4	231.4
Number of Exceedances:	25	24	24	24	24
Volume of Exceedances(m^3):	950300	950000	949500	948900	948300
Increase with Proposed Development					
Maximum Flow(m^3/s):	0.11%	0.13%	0.11%	0.11%	0.11%
Minimum Flow(m^3/s):	0.00%	0.00%	0.00%	0.00%	0.00%
Mean Flow(m^3/s):	0.07%	0.07%	0.07%	0.06%	0.07%
Duration of Exceedances(h):	0.39%	0.56%	0.30%	0.30%	0.35%
Number of Exceedances:	4.17%	0.00%	0.00%	0.00%	0.00%
	0.73%	0.73%	0.73%	0.72%	0.72%

Appendix E LID DESIGN AND WATER BALANCE

E.1 LID DESIGN REPORT

5731 Hazeldean Road
Low Impact Development
(LID) Report

Prepared for:
The Wellings of Stittsville Inc. and
Extendicare (Canada) Inc.
5731 Hazeldean Road
Ottawa, ON

Prepared by:
Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo, ON N2L 0A4
Tel: (519) 579-4410
Fax: (519) 579-6733

1604-01195

December 16, 2016

Sign-off Sheet

This document entitled 5731 Hazeldean Road, Low Impact Development (LID) Report, was prepared by Stantec Consulting Ltd. for the account of The Wellings of Stittsville Inc. and Extendicare (Canada) Inc. The material in it reflects Stantec's best judgment in light of the information available to it at the time of preparation.

Prepared by ____________________________________
(signature)

Amber Garrett, B.Eng., EIT
Water Resources Engineering Intern, Community Development

Prepared by ____________________________________
(signature)

Jennifer Young, P.Eng.
Senior Water Resources Engineer, Community Development

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1.0 Introduction

Stantec Consulting Ltd. was retained by Nautical Lands Group to investigate a Low Impact Development (LID) based stormwater management design for the proposed development at 5731 Hazeldean Road in Stittsville, Ontario. The 2.98 ha site will include a 185-unit independent living apartment complex, a 256-unit long-term care facility, a mixed-use retail/office building, a park, as well as associated parking and landscaped areas.

The site is located at 5731 Hazeldean Road, at the northwest corner of the intersection of Huntmar Drive and Hazeldean Road. The site is undeveloped and partially wooded. The site is bounded to the north and west by Poole Creek and residential developments, to the east by vacant land and a future Keg Restaurant, and to the south by Hazeldean Road.

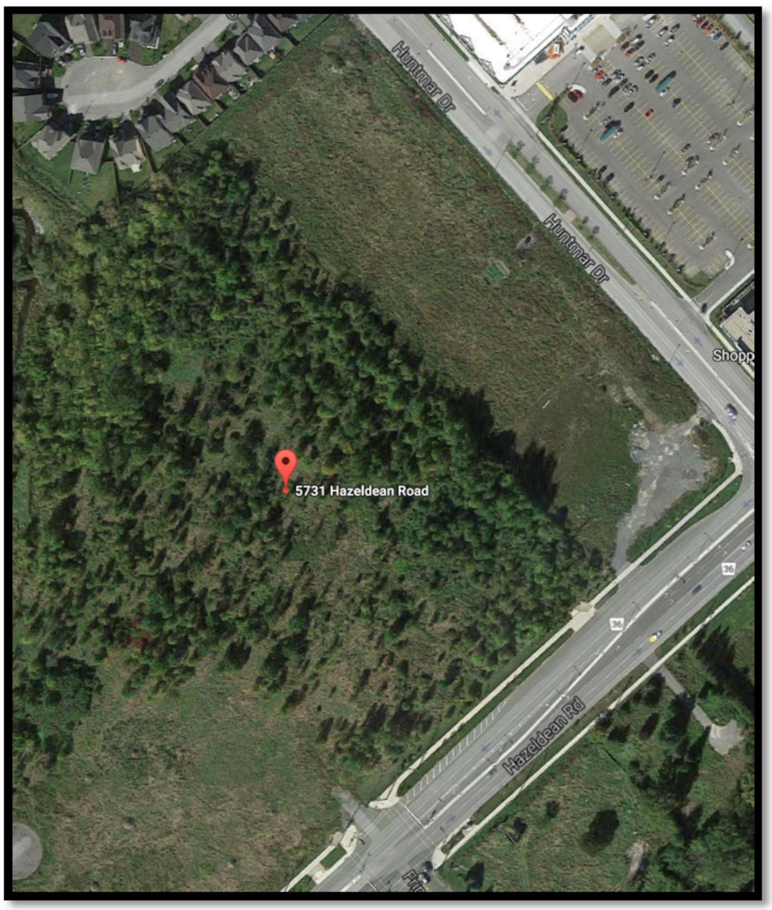


Figure 1: Aerial Site View

This report investigates the ability of the designed LID controls to mitigate peak flows and provide erosion protection for Poole Creek. The peak flows were designed to meet the pre-development conditions for up to the 100-year event. A continuous hydrologic model was used to determine erosion impacts post-development. The site will include a rainwater tank, a bioswale, and an infiltration gallery that will detain and infiltrate runoff prior to discharge.

Detention of roof water will occur via a 335 m^3 rainwater tank in the months of June through September for the purposes of onsite irrigation. An overflow is provided on the tank which will carry any overflow to the infiltration gallery for infiltration. A valved orifice will provided detention during the winter months, while allowing the facility to continue to drain to the infiltration gallery. The valve will be closed before May to allow the rainwater tank to fill for irrigation use.

Drainage from the parking lot is proposed to be directed to the northeast corner of the lot where a bioswale will provide treatment and infiltration for parking lot runoff. The bioswale will be planted and will provide conveyance to the infiltration gallery for any overflow or runoff that is not infiltrated.

The infiltration gallery will receive water directly from the centrally located landscaped areas. The infiltration gallery will also accept overflow from the rainwater tank and the bioswale for further infiltration.

2.0 Stormwater Management Design

2.1 INFILTRATION GALLERY, RAINWATER TANK, AND BIOSWALE SIZING

A green infrastructure water balance design spreadsheet was used to determine the runoff and infiltration for the site for the pre- and post-development conditions. This was used to and determine how the infiltration gallery, bioswale, and rain tank would perform during high flow events, and if together, they provide adequate peak flow control for discharge to Poole Creek.

The rainwater tank was sized using a design and costing tool developed by the Sustainable Technologies Evaluation Program (STEP) which takes into account impervious area that is draining to the tank, as well as other factors such as roof type, snowmelts, and irrigation requirements for water reuse. The input and output of the costing tool are appended for reference (Appendix A).

2.1.1 Green Infrastructure Water Balance Design Spreadsheet

The green infrastructure water balance design spreadsheet used for this analysis tracks the volume of water in each part of the system (runoff, rock trench conditions, and groundwater) during each time-step for the infiltration gallery, rain tank, bioswale, and directly off site. The water balance spreadsheet uses the rainfall, soil characteristics, and drainage areas to calculate the volume of water for each of the following, for every time-step:

Table 1: Design Spreadsheet Parameters

Bioswale	Rain Tank	Infiltration Gallery
• Rain water into bioswale • Volume into ponding • Beginning of time-step ponding volume • Volume out of ponding • Unsaturated runoff (overflows to infiltration gallery) • Rain into amended soil • Beginning of time-step amended soil water volume (initial value is set to field capacity) • Water from amended soil to trench • Water that stays in the amended soil • Beginning of time-step trench volume • Exfiltration from trench • Rock pit overflow to infiltration gallery	• Rain water into rain tank (from roof) • Rain tank wet use (winter months) • Rain tank dry use (summer months) • Beginning of time-step tank volume (set as empty) • Tank overflow to infiltration gallery	• Rain water into trench • Beginning of time-step trench water volume • Trench exfiltration • Depth of water in trench • Outflow from orifice 1 and 2 • Overflow drainflow

No initial abstractions or losses other than infiltration were assumed during the analysis of the scenarios. The initial condition of the amended soil water content was set to field capacity to represent a 'wet start' for the soil. It is expected that dry soils would have an increased capacity for capture above that shown in this analysis.

The volumes in each portion of the system are summed to give a total volume of water each component sees. For example, the total volume of drain flow for each time step is summed to determine the total volume of drain flow.

The bioswale contains a special soil mix, amended soil, which is topsoil with additional materials added to increase infiltration and capture. Typically, amended soils are sandier than topsoil and the amendment changes the typical soil characteristics such as porosity, field capacity, wilting point, and infiltration rate. Table 2 below shows the soil characteristics for both topsoil and amended soil.

Table 2: Typical Soil Characteristics

Soil Characteristic	Typical Topsoil[1]	Amended Soil[2]
Porosity	0.35	0.53
Field Capacity	0.15	0.32
Wilting Point	0.10	0.13
Infiltration rate (mm/hr.)	1.5-3.5*	30-70*

*This infiltration rate assumes mature lawns with well- established grass, bare topsoil rates may differ

[1]Typical values for sandy-loam, loam soils adapted from the BC Agricultural, Food, and Fisheries Ministry

[2]Typical amended soil values as determined by soil testing for the standard amended soil mixes used in B.C., TRCA, and Markham

2.1.2 Sizing

The post-development conditions assumed the roof and courtyards of the apartment and long-term care buildings was directly connected to the rainwater tank.

The groundwater levels across the site were monitored in piezometers installed in January 2016. The readings taken 10 to 15 days post installation indicated the site had a groundwater table between 1.16 m and 3.67 m. Due to the time of year, the groundwater may not have been stabilized at the time of these initial measurements. Subsequent monitoring in September 2016 and December 2016 indicate long term groundwater levels should be between 2.5 m and 4.0 m.

As infiltration testing was not completed prior to starting the LID design, a suitably low infiltration rate for the soil type was assumed. The preliminary sizing used 5 mm/hr as the infiltration rate. Once soils testing was completed, the measured saturated hydraulic conductivity (Ksat) rates were converted to infiltration rates and compared to the assumed infiltration rate.

The measured Ksat values were converted to infiltration rates using the following steps:

1. Conversion of Ksat rates from m/sec to cm/sec by multiplying by 100
2. Reducing the Ksat rates by an order of magnitude for safety, as recommended by Stantec's Hydrogeologist (example 1.6x10-5 cm/sec reduced to 1.6x10-6 cm/sec)
3. Convert to infiltration using the TRCA/CVC appendix C formula: $y = 6\mathrm{E} - 11x^{3.7363}$

Table 3 below shows the values calculated using this process

Table 3: Infiltration Testing Results

Location	Measure Ksat m/sec	Converted Ksat cm/sec	Reduce by Order of Magnitude	Infiltration Rate mm/hr
TP1	1.60E-07	1.60E-05	1.60E-06	15
TP2	2.20E-08	2.20E-06	2.20E-07	9
TP3	6.30E-07	6.30E-05	6.30E-06	22
TP4	1.60E-07	1.60E-05	1.60E-06	15

The assumed infiltration rate of 5 mm/hr. was kept as a conservative value for the design of the facility.

The inputs for the all the drainage areas, including the LID features, for the water balance can be seen in Table 4. The green infrastructure water balance design spreadsheet can be seen in Appendix B.

Table 4: Summary of Pre-Development Design Water Balance Inputs

Parameter	Pre-Development Site	Unit
Impervious Area	0	Sq. m
Pervious Area	29801	Sq. m
Total Area	29801	Sq. m
Soil Depth	300	mm
Soil Exfiltration Rate	5	mm/hr
Soil Porosity	0.35	
Soil Field Capacity	0.15	
Soil Wilting Point	0.1	
Soil Infiltration Rate	3.5	mm/hr

The inputs for the drainage area, including the LID features, for the water balance can be seen in Table 5. The green infrastructure water balance design spreadsheet can be seen in Appendix B.

Table 5: Summary of Post-Development Design Water Balance Inputs

Parameter	Bioswale	Infiltration Gallery	Rain Tank	Direct Off Site Flow	Unit
Impervious Area	240	8,743	10,071	1,300	Sq. m
Pervious Area	3116	6,331	0	0	Sq. m
Total Area	3556	15,074	10,071	1,300	Sq. m
Soil Depth	300	N/A	N/A	150	mm
Soil Exfiltration Rate	5	5	N/A	5	mm/hr.
Soil Porosity	0.53	0.35	N/A	0.35	
Soil Field Capacity	0.32	0.15	N/A	0.15	
Soil Wilting Point	0.13	0.1	N/A	0.1	
Soil Infiltration Rate	30	3.5	N/A	3.5	mm/hr.
Trench Surface Area	190	560.7	N/A	N/A	Sq. m
Trench Depth	0.7	1.9	N/A	N/A	mm
Trench Porosity	0.35	0.35	N/A	N/A	
Ponding Depth	0.075	N/A	N/A	N/A	mm
Volume Full	46.55	592.2	335	N/A	Cu. m

2.1.3 Results

The proposed LID measures partially infiltrate the 2-, 5-, 10-, 25-, 50-, and 100-year 12-hour events while controlling the flow from site similar to the pre-development flow.

Table 6 summarizes the pre- and post-development modelled conditions.

Table 6: Pre-Development and Post-Development Site Flow and Runoff Volumes

Storm Event[1]	Pre-Development Conditions		Post-Development Conditions	
	Peak Flow (m^3/s)	Runoff Volume (m^3)	Peak Flow (m^3/s)[2]	Runoff Volume (m^3)
2 Year	0.44	616	0.02	472
5 Year	0.60	906	0.18	707
10 Year	0.71	1125	0.40	992
25 Year	0.84	1400	0.67	1349
50 Year	0.93	1593	0.85	1584
100 Year	1.02	1796	1.05	1853

[1] 12-hour SCS Type II
[2] Includes drain flow from infiltration gallery and uncontrolled runoff offsite

The post-development volumes and flows account for drain flow and overflow from the infiltration gallery as well as uncontrolled flows from the remaining impervious areas that drain directly to Poole Creek. Overflow from the bioswale and the rain tank are not included as they are already accounted for as an input to the infiltration gallery. Drain times for the infiltration gallery and bioswale for the modelled events is included in Appendix B.

Table 7 shows the design event infiltration and flow volumes for each LID control measure.

Table 7: Event Infiltration and Drain Flow Volumes

Storm Event	Bioswale		Rain Tank	Infiltration Gallery		Direct Off Site Runoff	Total Site Runoff, Infiltration, and Reuse		
	Infiltration Volume (m^3)	Drainflow Volume[2] (m^3)	Drainflow Volume[2] (m^3)	Infiltration Volume (m^3)	Runoff Volume (m^3)	Runoff Volume (m^3)	Infiltration Volume (m^3)	Runoff Volume (m^3)	Reused Volume[3] (m^3)
2 Year	59.1	85.1	97.5	612.0	218.6	55.9	671.2	274.4	335.0
5 Year	59.9	133.5	244.7	613.8	632.6	74.9	673.7	707.5	335.0
10 Year	60.1	165.4	341.4	614.4	905.3	87.4	674.5	992.6	335.0
25 Year	60.3	205.5	462.3	615.3	1246.3	103.0	675.6	1349.3	335.0
50 Year	60.1	323.0	541.3	614.8	1470.7	113.2	675.0	1583.9	335.0
100 Year	60.4	262.2	632.7	615.5	1728.2	125.0	675.9	1853.2	335.0

[1] 12-hour SCS Type II
[2] This volume is conveyed to the infiltration gallery for further infiltration
[3] Water reuse from rain tank for irrigation onsite from June-September

The recommend LID measures capture from 1007 m3 of the 2-year event (79%) and 1011 m3 of the 100-year event (35%) while keeping peak flows at pre-development levels.

2.2 DIFFERENCES BETWEEN GREEN INFRASTRUCTURE DESIGN SPREADSHEET AND PCSWMM MODEL

The green infrastructure water balance design spreadsheet (GIWB) was used in conjunction with the existing PCSWMM model for the area provided by the City of Ottawa. The reductions in flows and volumes are not exactly the same between the two models due to differences within the methods used for calculation. The GIWB does not include any abstractions on the runoff; including evaporation, depression storage or infiltration. The GIWB assumes the entire area's runoff contributes to the LID/GI facility and then models how the water moves through the facility by tracking the volume for each time step. This results in higher flows in both the pre-and post-development scenarios. Despite these differences the storage calculations for the site were within 10% of each other. The larger storage conditions of the two models were used for the site design.

The continuous model for evaluating the erosion used a slightly different methodology. The attenuated storage hydrograph from the GIWB (volume in storage in each time step) was subtracted from the initial continuous rain depth for each time step. The resulting rainfall represents the runoff from site and was run though the PCSWMM model generates exceedance duration curves to evaluate the erosion in the creek.

3.0 Summary

In summary, the stormwater management strategy for the site consists of the following elements:

- Quantity control to be achieved through infiltration gallery, rainwater harvesting tank and bioretention (bioswale). Quantity control is provided to up to the 100-year event and the infiltration gallery, harvesting tank, and bioretention are designed to detain, retain, and infiltrate the post-development flow to pre-development rates up to the 100-year event.
- The GIWB and the PCSWMM model results are in agreement and both show the site can outlet to Poole Creek.

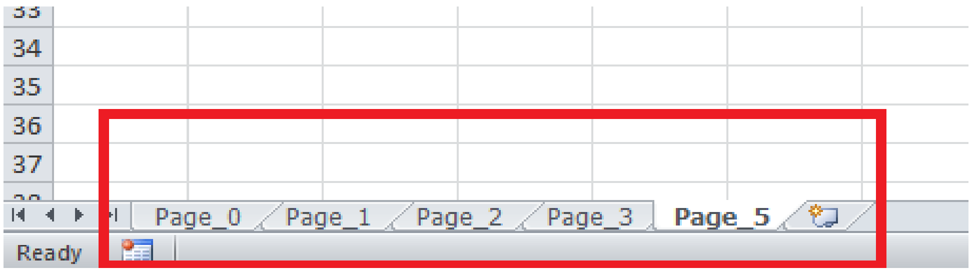
APPENDIX A

Rainwater Tank Costing and Design Tool

Rainwater Harvesting Design & Costing Tool Report

How to View the Design & Costing Tool Report

This report consists of several pages or "tabs". To navigate the pages, click on the tabs located at the bottom of the Excel workbook.   The report pages are marked "Page_1", "Page_2", etc., and the page tabs will appear as follows:



Printing the Report

To print the entire report:

For users of Microsoft Excel 2003 (or earlier versions) click on the 'File' drop-down menu item, and then click on Print. Under the "Print what" heading, change "Active sheet(s)" to "Entire workbook". Select the desired printer and click the OK button. For users of Microsoft Excel 2010 click 'File' (Microsoft Excel 2007 users click on the Office Button in the top-left corner of the screen) and then click on Print. Under the "Settings" heading change "Print Active Sheets" to "Print Entire Workbook". Select the desired printer and click the OK button.

To print just one page of the report:

Select the desired report page by clicking on the appropriate tab at the bottom of the screen. For users of Microsoft Excel 2003 (or earlier versions) click on the 'File' drop-down menu item, and then click on Print.   Select the desired printer and click on the "OK" button. For users of Microsoft Excel 2010 click 'File' (Microsoft Excell 2007 users click on the Office Button in the top-left corner of the screen) and then click on Print. Select the desired printer and click the OK button.

Saving the Report

Once you have viewed the report, be sure to save the workbook if you wish to view the report in the future. To save the file in Microsoft Excel 2003 (or earlier versions), click on the 'File' drop-down menu item, and click on 'Save as' and specify the desired file name and location. In Microsoft Excel 2010 click on 'File' (or click on the Office Button in the top-left corner of the screen in Microsoft Excel 2007), and click on 'Save as' and specify the desired file name and location.

Rainwater Harvesting Design & Costing Tool Report

Project Details

Project name:	Hazeldean
Project number:	1.6E+08
Project details:	

Building Details

Province:	Ontario (Eastern)		
City:	Ottawa		
Annual rainfall characteristics:	527.3	mm	(Minimum on record)
	687.2	**mm**	**(Typical year - Median)***
	911.8	mm	(Maximum on record)

Building type:	Institutional
Number of occupants:	500
Days occupied per week:	7

Total building roof surface area:	10,071.0	m^2
Rainwater catchment area:	10,071.0	m^2
Proportion of roof surface collected:	100%	

Catchment Surface Details

Roofing material:	Asphalt Flat Roof	
Initial loss factor:	1.00	mm
Continuous loss factor:	20.0%	

Pre-storage Treatment Details

Pre-storage treatment method:	N/A	
Initial loss factor:	0.00	mm
Continuous loss factor:	0.0%	

Snowfall/Snowmelt Contribution Details

Snowfall/Snowmelt loss factor:	75.0%

*Unless otherwise stated, all figures and charts provided in this report are based upon the data generated during a "typical year" (the median annual rainfall on record) for the selected city.

Rainwater Demand

Indoor Fixtures

Fixture	Fixture Type	Water Usage	Unit	Water Usage Duration	Units	Number of Occupants	Uses Per Occupant Per day	Daily Water Demand (L/day)
Toilet (male)	N/A	0.0	L/flush	0	Flush	0.0	0.0	0.0
Toiet (female)	N/A	0.0	L/flush	0	Flush	0.0	0.0	0.0
Urinal	N/A	0.0	L/flush	0	Flush	0.0	0.0	0.0
Laundry	N/A	0.0	L/load	0	Load	0.0	0.0	0.0
Dishwasher	N/A	0.0	L/load	0	Load	0.0	0.0	0.0
Lavatory Faucets	N/A	0.0	L/min	0	Minutes	0.0	0.0	0.0
Shower	N/A	0.0	L/min	0	Minutes	0.0	0.0	0.0
Other	N/A	0.0	Litres	0	Day	0.0	0.0	0.0

Total Indoor Rainwater Demand: 0 Litres/day

Daily Rainwater Demand (Occupancy Adjustment): 0 Litres/day

(Building occupied 7 of 7 days per week)

Outdoor Fixtures - Hose Watering & Basic Irrigation System

Irrigation Season:	Hose watering:	N/A	-	N/A
	Irrigation system:	June	-	September

Fixture	Fixture Type	Water Usage	Unit	Water Usage Duration /Area	Units	Irrigation Efficiency (%)	Uses per Day	Daily Water Demand (L/day)
Garden hose	N/A	0.0	L/min	0.0	Minutes	N/A	0.0	0.0
Irrigation system	25 mm [1 in.] cov	25.4	L/m2	6331.0	m2	45.0%	0.1	35607.4

Total Outdoor Rainwater Demand: 35,607 Litres/day*

*(peak volume during irrigation season)

Rainwater Demand

Outdoor Fixtures - Advanced Irrigation System

Irrigation Season:	N/A	-	N/A

Irrigation Controller:	N/A
Control Factor (CF):	0
Evapotranspiration Rate (ET):	0 mm/month
Number of Times Irrigated per Week:	0

Landscape/Zone	Area (m^2)	Species Factor (Ks)	Micro-climate Factor (Type)	Micro-climate Factor (Kmc)	Irrigation Type	Irrigation Efficiency (IE) (%)	Daily Water Demand (L/day)
N/A	0.0	0.0	N/A	0.0	N/A	0.0%	0.0
N/A	0.0	0.0	N/A	0.0	N/A	0.0%	0.0
N/A	0.0	0.0	N/A	0.0	N/A	0.0%	0.0
N/A	0.0	0.0	N/A	0.0	N/A	0.0%	0.0
N/A	0.0	0.0	N/A	0.0	N/A	0.0%	0.0
N/A	0.0	0.0	N/A	0.0	N/A	0.0%	0.0

Total Irrigation System Rainwater Demand:	**0 Litres/day**

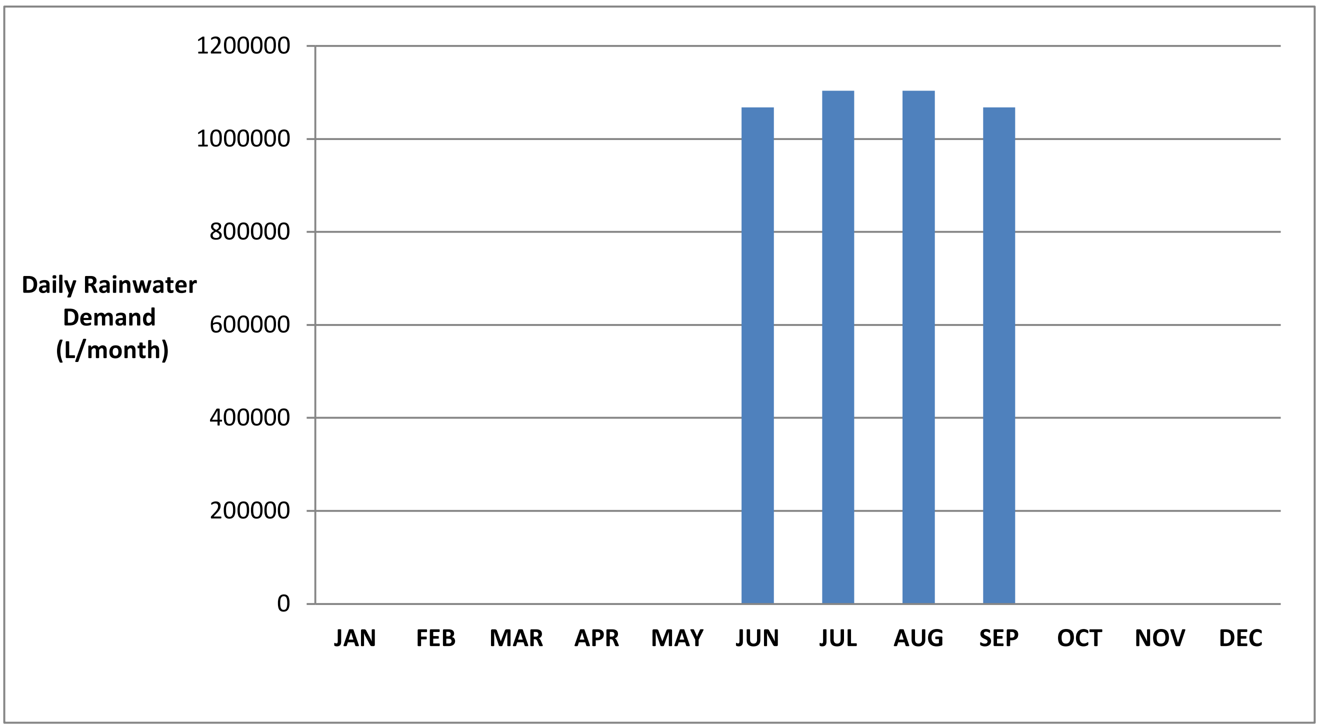
Rainwater Demand

Daily Rainwater Demand

Indoor Rainwater Demand:	0 Litres/day
Outdoor Rainwater Demand:	35,607 Litres/day*
Total Rainwater Demand:	35,607 Litres/day*

*(peak volume during irrigation season)

Monthly Rainwater Demand



Annual Rainwater Demand

Indoor Rainwater Demand	0.0 m^3/year
Outdoor Rainwater Demand	4,344.1 m^3/year
Total Rainwater Demand	4,344.1 m^3/year

(1 m^3 = 1,000 L)

Tank Sizing & Analysis - Analyze User Specified Tank Size(s)

Tanks Analyzed

Number of Tank Sizes Analyzed:	1 Tanks

Tank Size(s)

1. Tank Volume:	335,000 Litres
2. Tank Volume:	0 Litres
3. Tank Volume:	0 Litres
4. Tank Volume:	0 Litres
5. Tank Volume:	0 Litres

Tank Sizing Design Factor

Tank Unused Volume ("Dead space"):	15.0%

Tank Analysis Details

For each tank size specified, a 3-page analysis report has been generated. Please refer to the following report pages for details.

Tank Performance Details - Rainwater Usage (Water Savings)

Tank Performance Summary

User Specified Tank Size	335,000 Litres
Annual Rainwater Use	2476.2 m^3/yr
Annual Rainwater Demand	4344.1 m^3/yr
Proportion of Demand Met	57%

Rainwater Usage (Water Savings) for Smaller & Larger Tank Sizes

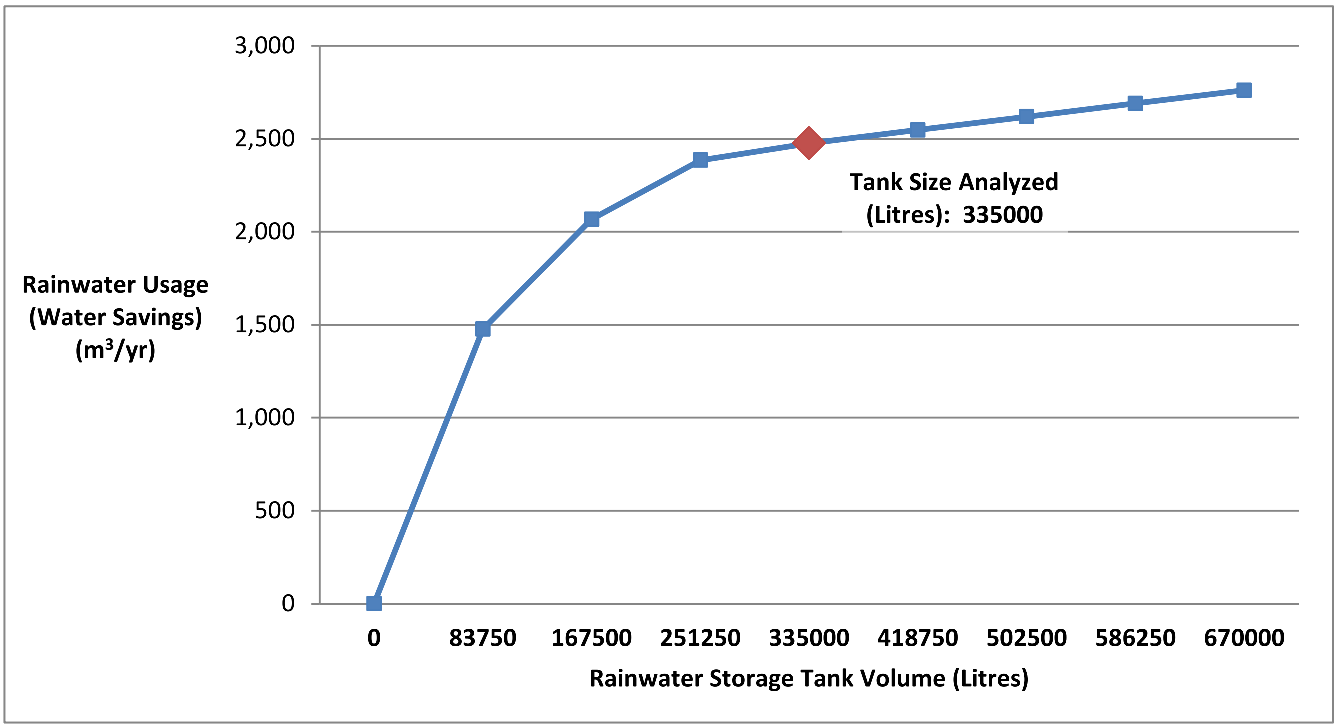


Chart values based upon a typical year for the selected city.

Rainwater Usage (Water Savings) for Different Rainfall Amounts

Type of Year	Annual Rainfall (mm)	Rainwater Use (m^3/yr)	Rainwater Demand Met (%)
Dry	527.3	2,026.3	46.6%
Moderately Dry	623.8	2,024.5	46.6%
Typical	687.2	2,476.2	57.0%
Moderately Wet	776.7	2,567.7	59.1%
Wet	911.8	3,376.3	77.7%

Tank Performance Analysis - Rainwater Deficit (Top-up Requirements)

Tank Performance Summary

User Specified Tank Size	335,000 Litres
Annual Rainwater Use	2476.2 m^3/yr
Annual Rainwater Demand	4344.1 m^3/yr
Annual Rainwater Supply Deficit	1867.9 m^3/yr
Annual no. of Dry Days (Days Top-up Required)	66 Days

Rainwater Usage (Water Savings) & Deficit (Top-up Requirements)

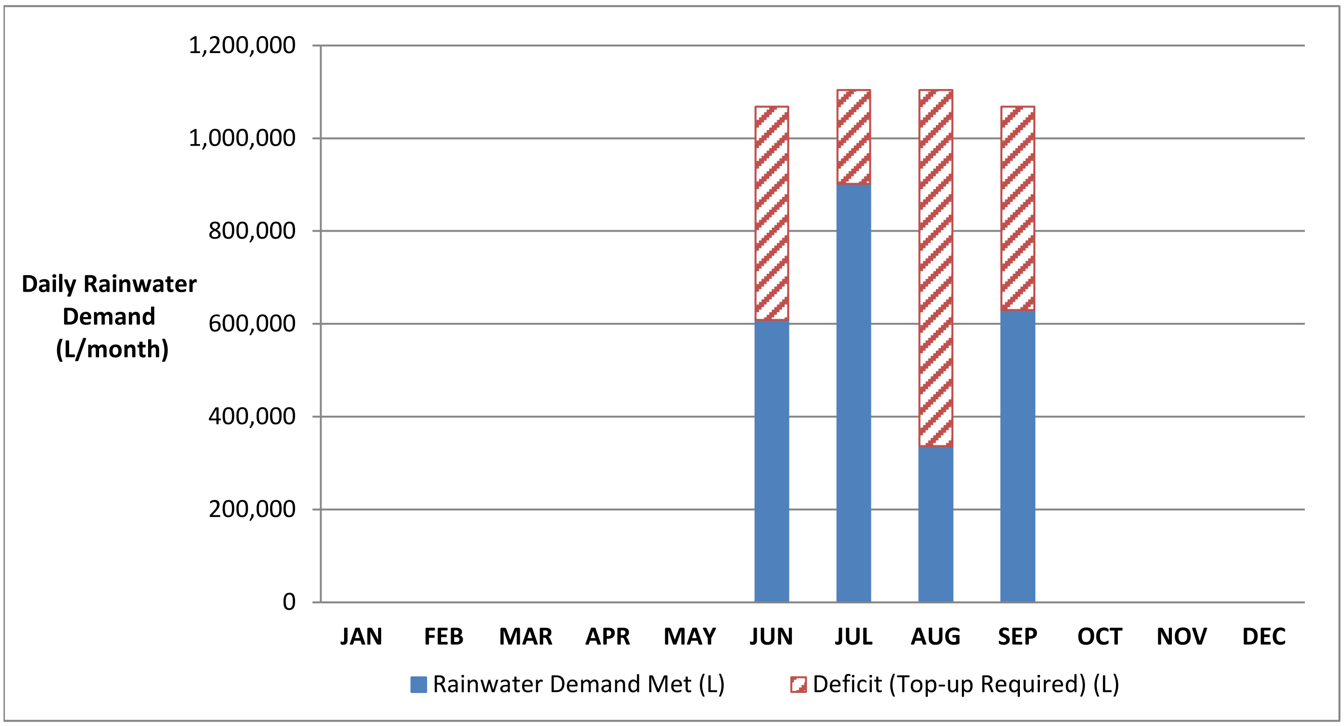


Chart values based upon a typical year for the selected city.

Rainwater Deficit (Top-up Requirements) for Different Rainfall Amounts

Type of Year	Annual Rainfall (mm)	Rainwater Use (m^3/yr)	Rainwater Deficit/Top-up Required (m^3/yr)	Number of Days with Rainwater Deficit
Dry	527.3	2,026.3	2,317.8	77
Moderately Dry	623.8	2,024.5	2,319.6	75
Typical	687.2	2,476.2	1,867.9	66
Moderately Wet	776.7	2,567.7	1,776.4	60
Wet	911.8	3,376.3	967.8	35

Tank Performance Analysis - Overflow Analysis

Tank Performance Summary

User Specified Tank Size	335,000 Litres
Annual Rainwater Use	2476.2 m^3/yr
Annual Overflow from Tank	2,617.5 m^3/yr
Percent of Rainwater Collected that is Used	49%
Annual no. of Overflow Events	36 Events

Overflow Analysis

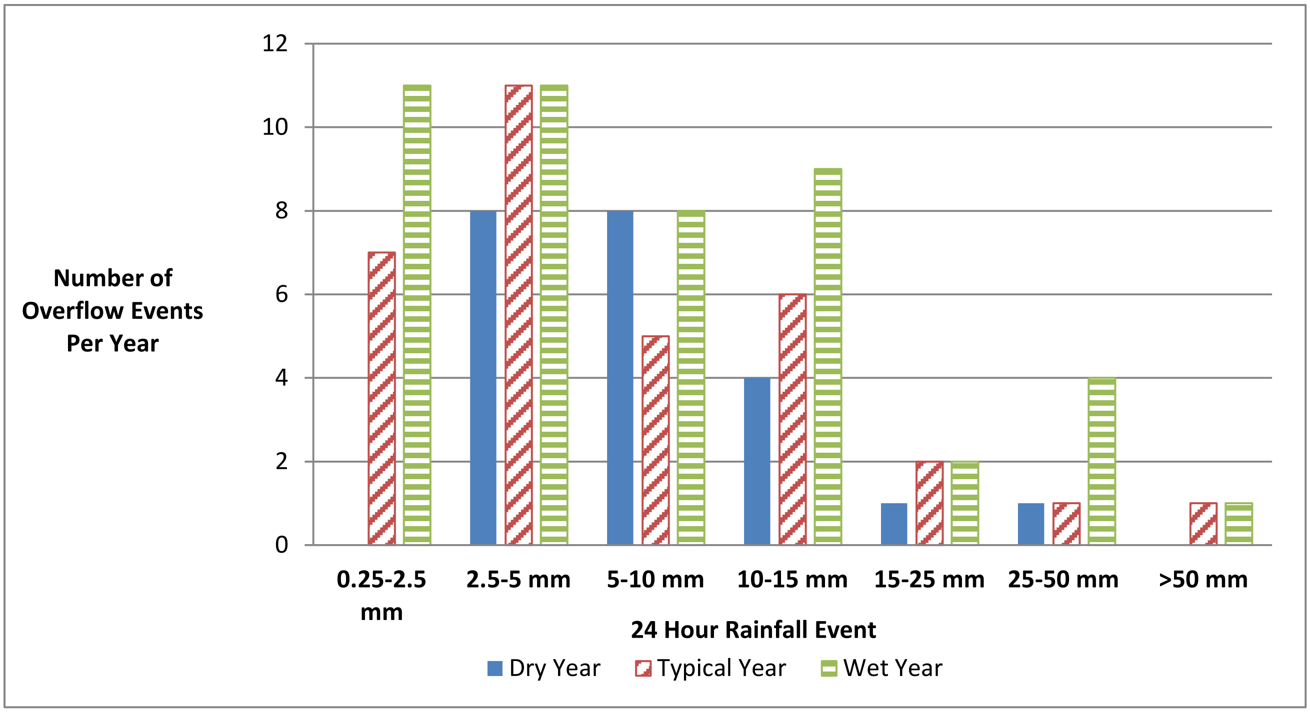


Chart values based upon a typical year for the selected city.

Rainwater Deficit (Top-up Requirements) for Different Rainfall Amounts

Type of Year	Annual Rainfall (mm)	Rainwater Use (m^3/yr)	Rainwater Overflow (m^3/yr)	Proportion of Rainwater Collected that is Used	Number of Overflow Events
Dry	527.3	2,026.3	1,952.4	50.9%	29
Moderately Dry	623.8	2,024.5	2,705.1	42.8%	37
Typical	687.2	2,476.2	2,617.5	48.6%	36
Moderately Wet	776.7	2,567.7	3,219.7	44.4%	52
Wet	911.8	3,376.3	3,514.9	49.0%	49

APPENDIX B

Green Infrastructure Water Balance Design Spreadsheet

Input for 25 mm Event

Area to Bioswale (Incl. BS)			Cistern			Infiltration Gallery			Directly Connected Uncontrolled Flow		
Paved + non rain garden pervious Area	3166	sq.m	Impervious area:	10071	sq.m	Area to Gallery	15074		Area offsite	1300	
Raingarden Area	190	sq.m			sq.m	Lawn Area over trench	0	sq.m	Pervious area	0	sq.m
Total area:	3356	sq.m	Total area:	10071	sq.m	Total area:	15074	sq.m	Total area:	1300	sq.m
Trench surf. area:	190	sq.m				Trench exfiltration. area:	480.6	sq.m	Trench exfiltration. area:		sq.m
Trench depth:	0.7	m	Watered Area	0	sq.m	Trench depth:	1.9	m	Trench depth:		m
Trench porosity:	0.35		Cistern Drain Time	2	days	Trench porosity:	0.95		Trench porosity:		
Trench full:	46.55	cu.m	RB / Cistern Volume	335	cu.m	Trench full:	507.6	cu.m	Trench full:		cu.m
Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:		cu.m
Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	0	mm/hr	Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	5	mm/hr
Soil depth:	300	mm	Soil depth:	0	mm	Soil depth:	0	mm	Soil depth:	150	mm
Soil porosity:	0.53		Soil porosity:	0		Soil porosity:	0.35		Soil porosity:	0.35	
Soil field cap:	0.32		Soil field cap:	0		Soil field cap:	0.15		Soil field cap:	0.15	
Soil wilt point:	0.13		Soil wilt point:	0		Soil wilt point:	0.1		Soil wilt point:	0.1	
Soil infil. rate	30	mm/hr	Soil infil. rate	0	mm/hr	Soil infil. rate	3.5	mm/hr	Soil infil. rate	3.5	mm/hr
Soil wilt point vol:	7.41	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m
Soil porosity vol:	30.21	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m
Soil field cap vol:	18.24	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m
Soil initial vol:	18.24	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m
Pond Depth	0.075	m									
Ponding Volume	14.3										

Output for 25 mm Event

Summary	Bioswale	Cistern	Infiltration Gallery	Directly offsite	Total
Total evaporation	0.00	0.00	0.00		0.00
Total exfiltration	60.37	0.00	527.11		587.49
Total drainflow	262.20	0.00	1851.66		2113.87
Total runoff	0.00	667.66	0.00	124.96	792.61
Total Reused		335.37			335.37
Sum	322.58	1003.02	2378.78	124.96	3829.33
Total rainfall	322.58	968.02	2378.78	124.96	3794.33
% Treated	100%	31%	100%	0%	79%
% untreated	0%	69%	0%	100%	21%
% Captured	19%	33%	22%	0%	24%
EIA	81%	69%	78%	100%	77%
	* Runoff directed to underdrain and is counted in that sum				

Input for 2-year Event

Area to Bioswale (Incl. BS)			Cistern			Infiltration Gallery			Directly Connected Uncontrolled Flow		
Paved + non rain garden pervious Area	3166	sq.m		10071	sq.m	Area to Gallery	15074		Area offsite	1300	
Raingarden Area	190	sq.m			sq.m	Lawn Area over trench	0	sq.m	Pervious area	0	sq.m
Total area:	3356	sq.m	Total area:	10071	sq.m	Total area:	15074	sq.m	Total area:	1300	sq.m
Trench surf. area:	190	sq.m				Trench exfiltration. area:	560.7	sq.m	Trench exfiltration. area:		sq.m
Trench depth:	0.7	m	Watered Area	0	sq.m	Trench depth:	1.9	m	Trench depth:		m
Trench porosity:	0.35		Cistern Drain Time	2	days	Trench porosity:	0.95		Trench porosity:		
Trench full:	46.55	cu.m	RB / Cistern Volume	335	cu.m	Trench full:	592.2	cu.m	Trench full:		cu.m
Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:		cu.m
Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	0	mm/hr	Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	5	mm/hr
Soil depth:	300	mm	Soil depth:	0	mm	Soil depth:	0	mm	Soil depth:	150	mm
Soil porosity:	0.53		Soil porosity:	0		Soil porosity:	0.35		Soil porosity:	0.35	
Soil field cap:	0.32		Soil field cap:	0		Soil field cap:	0.15		Soil field cap:	0.15	
Soil wilt point:	0.13		Soil wilt point:	0		Soil wilt point:	0.1		Soil wilt point:	0.1	
Soil infil. rate	30	mm/hr	Soil infil. rate	0	mm/hr	Soil infil. rate	3.5	mm/hr	Soil infil. rate	3.5	mm/hr
Soil wilt point vol:	7.41	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m
Soil porosity vol:	30.21	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m
Soil field cap vol:	18.24	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m
Soil initial vol:	18.24	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m
Pond Depth	0.075	m									
Ponding Volume	14.3										

Output for 2-year Event

Summary	Bioswale	Cistern	Infiltration Gallery	Directly offsite	Total
Total evaporation	0.00	0.00	0.00		0.00
Total exfiltration	59.14	0.00	612.04		671.17
Total drainflow	85.12	0.00	218.55		218.55
Total runoff	0.00	97.53	0.00	55.88	55.88
Total Reused		335.37			335.37
Sum	144.25	432.89	830.58	55.88	1280.97
Total rainfall	144.25	432.89	830.58	55.88	1280.97
% Treated	100%	77%	100%	0%	96%
% untreated	0%	23%	0%	100%	4%
% Captured	41%	77%	74%	0%	79%
EIA	59%	23%	26%	100%	21%
	* Runoff directed to underdrain and is counted in that sum				

Input for 5-year Event

Area to Bioswale (Incl. BS)			Cistern			Infiltration Gallery			Directly Connected Uncontrolled Flow		
Paved + non rain garden pervious Area	3166	sq.m	Impervious area:	10071	sq.m	Area to Gallery	15074		Area offsite	1300	
Raingarden Area	190	sq.m			sq.m	Lawn Area over trench	0	sq.m	Pervious area	0	sq.m
Total area:	3356	sq.m	Total area:	10071	sq.m	Total area:	15074	sq.m	Total area:	1300	sq.m
Trench surf. area:	190	sq.m				Trench exfiltration. area:	560.7	sq.m	Trench exfiltration. area:		sq.m
Trench depth:	0.7	m	Watered Area	0	sq.m	Trench depth:	1.9	m	Trench depth:		m
Trench porosity:	0.35		Cistern Drain Time	2	days	Trench porosity:	0.95		Trench porosity:		
Trench full:	46.55	cu.m	RB / Cistern Volume	335	cu.m	Trench full:	592.2	cu.m	Trench full:		cu.m
Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:		cu.m
Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	0	mm/hr	Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	5	mm/hr
Soil depth:	300	mm	Soil depth:	0	mm	Soil depth:	0	mm	Soil depth:	150	mm
Soil porosity:	0.53		Soil porosity:	0		Soil porosity:	0.35		Soil porosity:	0.35	
Soil field cap:	0.32		Soil field cap:	0		Soil field cap:	0.15		Soil field cap:	0.15	
Soil wilt point:	0.13		Soil wilt point:	0		Soil wilt point:	0.1		Soil wilt point:	0.1	
Soil infil. rate	30	mm/hr	Soil infil. rate	0	mm/hr	Soil infil. rate	3.5	mm/hr	Soil infil. rate	3.5	mm/hr
Soil wilt point vol:	7.41	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m
Soil porosity vol:	30.21	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m
Soil field cap vol:	18.24	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m
Soil initial vol:	18.24	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m
Pond Depth	0.075	m									
Ponding Volume	14.3										

Output for 5-year Event

Summary	Bioswale	Cistern	Infiltration Gallery	Directly offsite	Total
Total evaporation	0.00	0.00	0.00		0.00
Total exfiltration	59.85	0.00	613.83		673.68
Total drainflow	133.46	0.00	632.61		632.61
Total runoff	0.00	244.72	0.00	74.88	74.88
Total Reused		335.37			335.37
Sum	193.31	580.09	1246.44	74.88	1716.54
Total rainfall	193.31	580.09	1246.44	74.88	1716.54
% Treated	100%	58%	100%	0%	96%
% untreated	0%	42%	0%	100%	4%
% Captured	31%	58%	49%	0%	59%
EIA	69%	42%	51%	100%	41%
	* Runoff directed to underdrain and is counted in that sum				

Input for 10-year Event

Area to Bioswale (Incl. BS)			Cistern			Infiltration Gallery			Directly Connected Uncontrolled Flow		
Paved + non rain garden pervious Area	3166	sq.m	Impervious area:	10071	sq.m	Area to Gallery	15074		Area offsite	1300	
Raingarden Area	190	sq.m			sq.m	Lawn Area over trench	0	sq.m	Pervious area	0	sq.m
Total area:	3356	sq.m	Total area:	10071	sq.m	Total area:	15074	sq.m	Total area:	1300	sq.m
Trench surf. area:	190	sq.m				Trench exfiltration. area:	560.7	sq.m	Trench exfiltration. area:		sq.m
Trench depth:	0.7	m	Watered Area	0	sq.m	Trench depth:	1.9	m	Trench depth:		m
Trench porosity:	0.35		Cistern Drain Time	2	days	Trench porosity:	0.95		Trench porosity:		
Trench full:	46.55	cu.m	RB / Cistern Volume	335	cu.m	Trench full:	592.2	cu.m	Trench full:		cu.m
Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:		cu.m
Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	0	mm/hr	Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	5	mm/hr
Soil depth:	300	mm	Soil depth:	0	mm	Soil depth:	0	mm	Soil depth:	150	mm
Soil porosity:	0.53		Soil porosity:	0		Soil porosity:	0.35		Soil porosity:	0.35	
Soil field cap:	0.32		Soil field cap:	0		Soil field cap:	0.15		Soil field cap:	0.15	
Soil wilt point:	0.13		Soil wilt point:	0		Soil wilt point:	0.1		Soil wilt point:	0.1	
Soil infil. rate	30	mm/hr	Soil infil. rate	0	mm/hr	Soil infil. rate	3.5	mm/hr	Soil infil. rate	3.5	mm/hr
Soil wilt point vol:	7.41	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m
Soil porosity vol:	30.21	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m
Soil field cap vol:	18.24	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m
Soil initial vol:	18.24	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m
Pond Depth	0.075	m									
Ponding Volume	14.3										

Output for 10-year Event

Summary	Bioswale	Cistern	Infiltration Gallery	Directly offsite	Total
Total evaporation	0.00	0.00	0.00		0.00
Total exfiltration	60.09	0.00	614.38		674.47
Total drainflow	165.42	0.00	905.29		905.29
Total runoff	0.00	341.35	0.00	87.35	87.35
Total Reused		335.37			335.37
Sum	225.51	676.72	1519.67	87.35	2002.48
Total rainfall	225.51	676.72	1519.67	87.35	2002.48
% Treated	100%	50%	100%	0%	96%
% untreated	0%	50%	0%	100%	4%
% Captured	27%	50%	40%	0%	50%
EIA	73%	50%	60%	100%	50%
	* Runoff directed to underdrain and is counted in that sum				

Input for 25-year Event

Area to Bioswale (Incl. BS)			Cistern			Infiltration Gallery			Directly Connected Uncontrolled Flow		
Paved + non rain garden pervious Area	3166	sq.m	Impervious area:	10071	sq.m	Area to Gallery	15074		Area offsite	1300	
Raingarden Area	190	sq.m			sq.m	Lawn Area over trench	0	sq.m	Pervious area	0	sq.m
Total area:	3356	sq.m	Total area:	10071	sq.m	Total area:	15074	sq.m	Total area:	1300	sq.m
Trench surf. area:	190	sq.m				Trench exfiltration. area:	560.7	sq.m	Trench exfiltration. area:		sq.m
Trench depth:	0.7	m	Watered Area	0	sq.m	Trench depth:	1.9	m	Trench depth:		m
Trench porosity:	0.35		Cistern Drain Time	2	days	Trench porosity:	0.95		Trench porosity:		
Trench full:	46.55	cu.m	RB / Cistern Volume	335	cu.m	Trench full:	592.2	cu.m	Trench full:		cu.m
Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:		cu.m
Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	0	mm/hr	Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	5	mm/hr
Soil depth:	300	mm	Soil depth:	0	mm	Soil depth:	0	mm	Soil depth:	150	mm
Soil porosity:	0.53		Soil porosity:	0		Soil porosity:	0.35		Soil porosity:	0.35	
Soil field cap:	0.32		Soil field cap:	0		Soil field cap:	0.15		Soil field cap:	0.15	
Soil wilt point:	0.13		Soil wilt point:	0		Soil wilt point:	0.1		Soil wilt point:	0.1	
Soil infil. rate	30	mm/hr	Soil infil. rate	0	mm/hr	Soil infil. rate	3.5	mm/hr	Soil infil. rate	3.5	mm/hr
Soil wilt point vol:	7.41	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m
Soil porosity vol:	30.21	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m
Soil field cap vol:	18.24	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m
Soil initial vol:	18.24	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m
Pond Depth	0.075	m									
Ponding Volume	14.3										

Output for 25-year Event

Summary	Bioswale	Cistern	Infiltration Gallery	Directly offsite	Total
Total evaporation	0.00	0.00	0.00		0.00
Total exfiltration	60.33	0.00	615.28		675.60
Total drainflow	205.47	0.00	1246.31		1246.31
Total runoff	0.00	462.26	0.00	102.96	102.96
Total Reused		335.37			335.37
Sum	265.80	797.62	1861.59	102.96	2360.24
Total rainfall	265.80	797.62	1861.59	102.96	2360.24
% Treated	100%	42%	100%	0%	96%
% untreated	0%	58%	0%	100%	4%
% Captured	23%	42%	33%	0%	43%
EIA	77%	58%	67%	100%	57%
	* Runoff directed to underdrain and is counted in that sum				

Input for 50-year Event

Area to Bioswale (Incl. BS)			Cistern			Infiltration Gallery			Directly Connected Uncontrolled Flow		
Paved + non rain garden pervious Area	3166	sq.m	Impervious area:	10071	sq.m	Area to Gallery	15074		Area offsite	1300	
Raingarden Area	190	sq.m			sq.m	Lawn Area over trench	0	sq.m	Pervious area	0	sq.m
Total area:	3356	sq.m	Total area:	10071	sq.m	Total area:	15074	sq.m	Total area:	1300	sq.m
Trench surf. area:	190	sq.m				Trench exfiltration. area:	560.7	sq.m	Trench exfiltration. area:		sq.m
Trench depth:	0.7	m	Watered Area	0	sq.m	Trench depth:	1.9	m	Trench depth:		m
Trench porosity:	0.35		Cistern Drain Time	2	days	Trench porosity:	0.95		Trench porosity:		
Trench full:	46.55	cu.m	RB / Cistern Volume	335	cu.m	Trench full:	592.2	cu.m	Trench full:		cu.m
Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:		cu.m
Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	0	mm/hr	Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	5	mm/hr
Soil depth:	300	mm	Soil depth:	0	mm	Soil depth:	0	mm	Soil depth:	150	mm
Soil porosity:	0.53		Soil porosity:	0		Soil porosity:	0.35		Soil porosity:	0.35	
Soil field cap:	0.32		Soil field cap:	0		Soil field cap:	0.15		Soil field cap:	0.15	
Soil wilt point:	0.13		Soil wilt point:	0		Soil wilt point:	0.1		Soil wilt point:	0.1	
Soil infil. rate	30	mm/hr	Soil infil. rate	0	mm/hr	Soil infil. rate	3.5	mm/hr	Soil infil. rate	3.5	mm/hr
Soil wilt point vol:	7.41	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m
Soil porosity vol:	30.21	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m
Soil field cap vol:	18.24	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m
Soil initial vol:	18.24	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m
Pond Depth	0.075	m									
Ponding Volume	14.3										

Output for 50-year Event

Summary	Bioswale	Cistern	Infiltration Gallery	Directly offsite	Total
Total evaporation	0.00	0.00	0.00		0.00
Total exfiltration	60.14	0.00	614.84		674.98
Total drainflow	232.01	0.00	1470.74		1470.74
Total runoff	0.00	541.34	0.00	113.17	113.17
Total Reused		335.37			335.37
Sum	292.15	876.71	2085.58	113.17	2594.25
Total rainfall	292.15	876.71	2085.58	113.17	2594.25
% Treated	100%	38%	100%	0%	96%
% untreated	0%	62%	0%	100%	4%
% Captured	21%	38%	29%	0%	39%
EIA	79%	62%	71%	100%	61%
	* Runoff directed to underdrain and is counted in that sum				

Input for 100-year Event

Area to Bioswale (Incl. BS)			Cistern			Infiltration Gallery			Directly Connected Uncontrolled Flow		
Paved + non rain garden pervious Area	3166	sq.m	Impervious area:	10071	sq.m	Area to Gallery	15074		Area offsite	1300	
Raingarden Area	190	sq.m			sq.m	Lawn Area over trench	0	sq.m	Pervious area	0	sq.m
Total area:	3356	sq.m	Total area:	10071	sq.m	Total area:	15074	sq.m	Total area:	1300	sq.m
Trench surf. area:	190	sq.m				Trench exfiltration. area:	560.7	sq.m	Trench exfiltration. area:		sq.m
Trench depth:	0.7	m	Watered Area	0	sq.m	Trench depth:	1.9	m	Trench depth:		m
Trench porosity:	0.35		Cistern Drain Time	2	days	Trench porosity:	0.95		Trench porosity:		
Trench full:	46.55	cu.m	RB / Cistern Volume	335	cu.m	Trench full:	592.2	cu.m	Trench full:		cu.m
Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:	0	cu.m	Trench initial vol:		cu.m
Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	0	mm/hr	Subsoil exfil. rate:	5	mm/hr	Subsoil exfil. rate:	5	mm/hr
Soil depth:	300	mm	Soil depth:	0	mm	Soil depth:	0	mm	Soil depth:	150	mm
Soil porosity:	0.53		Soil porosity:	0		Soil porosity:	0.35		Soil porosity:	0.35	
Soil field cap:	0.32		Soil field cap:	0		Soil field cap:	0.15		Soil field cap:	0.15	
Soil wilt point:	0.13		Soil wilt point:	0		Soil wilt point:	0.1		Soil wilt point:	0.1	
Soil infil. rate	30	mm/hr	Soil infil. rate	0	mm/hr	Soil infil. rate	3.5	mm/hr	Soil infil. rate	3.5	mm/hr
Soil wilt point vol:	7.41	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m	Soil wilt point vol:	0	cu.m
Soil porosity vol:	30.21	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m	Soil porosity vol:	0	cu.m
Soil field cap vol:	18.24	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m	Soil field cap vol:	0	cu.m
Soil initial vol:	18.24	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m	Soil initial vol:	0	cu.m
Pond Depth	0.075	m									
Ponding Volume	14.3										

Output for 100-year Event

Summary	Bioswale	Cistern	Infiltration Gallery	Directly offsite	Total
Total evaporation	0.00	0.00	0.00		0.00
Total exfiltration	60.37	0.00	615.54		675.92
Total drainflow	262.20	0.00	1728.23		1728.23
Total runoff	0.00	632.66	0.00	124.96	124.96
Total Reused		335.37			335.37
Sum	322.58	968.02	2343.78	124.96	2864.47
Total rainfall	322.58	968.02	2343.78	124.96	2864.47
% Treated	100%	35%	100%	0%	96%
% untreated	0%	65%	0%	100%	4%
% Captured	19%	35%	26%	0%	35%
EIA	81%	65%	74%	100%	65%

* Runoff directed to underdrain and is counted in that sum

E.2 GROUNDWATER MOUNDING CALCULATIONS

Groundwater Mounding Calculations - 10mm event during seasonally high groundwater level conditions

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.

Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values					
0.0030	***R***	**Recharge (infiltration) rate (feet/day)**			
0.100	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**			
0.03	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***			
88.560	**x**	**1/2 length of basin (x direction, in feet)**			
55.760	**y**	**1/2 width of basin (y direction, in feet)**			
2.000	**t**	**duration of infiltration period (days)**			
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**			

Conversion Table

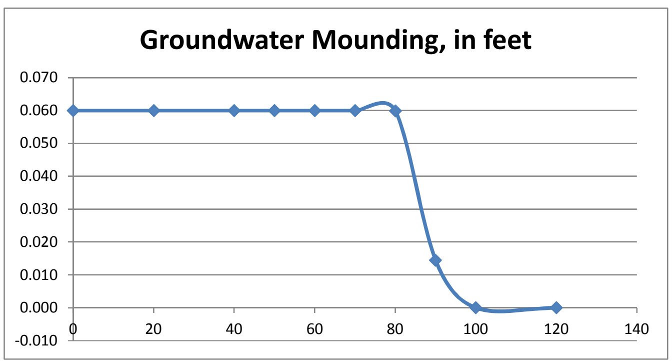
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

10.060	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.060	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.060	**0**
0.060	**20**
0.060	**40**
0.060	**50**
0.060	**60**
0.060	**70**
0.060	**80**
0.015	**90**
0.000	**100**
0.000	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Groundwater Mounding Calculations - 100-yr event during long-term groundwater level conditions

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.

Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values				
0.0030	***R***	**Recharge (infiltration) rate (feet/day)**		
0.100	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**		
0.03	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***		
88.560	**x**	**1/2 length of basin (x direction, in feet)**		
55.760	**y**	**1/2 width of basin (y direction, in feet)**		
9.000	**t**	**duration of infiltration period (days)**		
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**		

Conversion Table

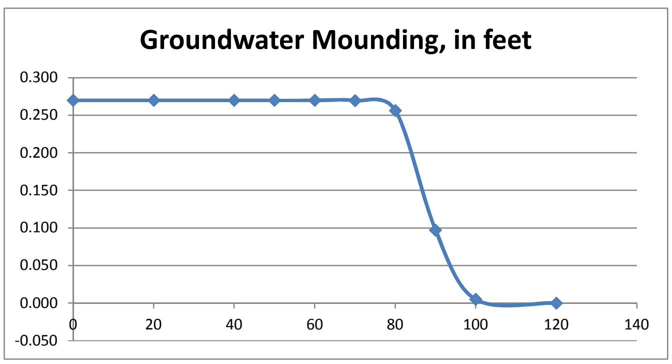
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

10.270	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.270	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.270	**0**
0.270	**20**
0.270	**40**
0.270	**50**
0.270	**60**
0.270	**70**
0.257	**80**
0.097	**90**
0.005	**100**
0.000	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Appendix F GEOTECHNICAL INVESTIGATION

Geotechnical
Engineering

Environmental
Engineering

Hydrogeology

Geological
Engineering

Materials Testing

Building Science

Archaeological Services

patersongroup

Geotechnical Investigation

Proposed Mixed Use Development
5731 Hazeldean Road
Ottawa, Ontario

Prepared For

Nautical Lands Group

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February 5, 2016

Report PG3710-1

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APPENDICES

1.0 Introduction

Paterson Group (Paterson) was commissioned by Nautical Lands Group to conduct a geotechnical investigation for the proposed mixed use development to be located at 5731 Hazeldean Road in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2).

The objectives of the current investigation were to:

- ❏ determine the subsurface conditions by means of boreholes.
- ❏ provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

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

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

The proposed development will consist of four multi-storey buildings with mixed use. The proposed buildings will include two 4 storey retirement buildings along the south-west property line and the north-east property line. Also, a two storey office building in the south corner and a two storey retail building in the east corner. One level of underground parking is expected to be constructed at the proposed development. At-grade parking areas, access lanes, and landscaped areas are also anticipated as part of the development.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the investigation was carried out from January 13, 2016 to January 18, 2016. At that time, 25 boreholes were drilled to a maximum depth of 6.7 m. The borehole locations were distributed in a manner to provide general coverage of the subject site. The locations of the boreholes are shown on Drawing PG3710-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were drilled using a track-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel with the direction of a senior engineer. The drilling procedure consisted of augering to the required depths at the selected locations, sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were recovered from a 50 mm diameter split-spoon or the auger flights. The split-spoon and auger samples were classified on site and placed in sealed plastic bags. All samples were transported to our laboratory. The depths at which the split-spoon and auger samples were recovered from the boreholes are presented as SS and AU, respectively, on the Soil Profile and Test Data sheets.

Standard Penetration Tests (SPT) were conducted and recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sample 300 mm into the soil after the initial penetration of 150 mm using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength tests were conducted in cohesive soils with a field vane apparatus.

The overburden thickness was evaluated by a dynamic cone penetration test (DCPT) at some borehole locations. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed in the boreholes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1.

Groundwater

Flexible polyethylene standpipes were installed in 14 boreholes to permit groundwater results subsequent to the sampling program completion.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of this report at which time the samples will be discarded unless otherwise directed.

3.2 Field Survey

The borehole locations were selected by Paterson and surveyed by Annis, O'Sullivan, Vollebekk LTD. The locations and ground surface elevation at the boreholes are presented on Drawing PG3710-1 - Test Hole Location Plan in Appendix 2.

3.3 Analytical Testing

One soil sample was submitted for analytical testing to assess the potential for exposed ferrous metals and the sulphate potential against subsurface concrete structures. The results are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

Generally, the subject site is grass and tree covered, relatively flat and approximately at grade with adjacent roadways and properties. Poole Creek Ravine runs across the north-west corner of the site.

4.2 Subsurface Profile

Generally, the subsurface profile at the boreholes consists of a topsoil layer followed by a stiff to very stiff brown silty clay layer, which is underlain by loose to compact sandy silt and a compact to dense glacial till. A layer of firm silty clay was encountered below the stiff brown silty clay layer in BH 5, BH 6, BH 7, BH 10, BH 11, BH 12 and BH 14 at an approximate elevation of 99.50 m and below.

Practical refusal to DCPT was encountered at 8.71 and 10.01 m in BH 1 and BH 6, respectively. Also, practical refusal to auger was encountered in BH 7, BH 14 BH 16 to BH 21 and BH 23 to BH 25 at depths ranging depth 2.8 m to 5.9 m.

Specific details of the soil profile at each test hole location are presented on the Soil Profile and Test Data sheets provided in Appendix 1.

Based on available geological mapping, the subject site consists of interbedded dolostone and limestone of the Gull River formation and an approximate drift thickness of 2 to 15 m.

4.3 Groundwater

The measured groundwater levels at the borehole locations are presented in Table 1. Groundwater readings could be influenced by surface water infiltrating the backfilled boreholes. Also, groundwater levels are subject to seasonal fluctuations and could vary at the time of construction.

Table 1 - Groundwater Elevation Summary

Test Hole Number	Ground Elevation, m	Groundwater Levels, m		Recording Date
		Depth	Elevation	
BH 1	102.93	1.16	101.77	January 28, 2016
BH 3	103.07	DRY	n/a	January 28, 2016
BH 4	103.15	DRY	n/a	January 28, 2016
BH 6	103.25	3.06	100.19	January 28, 2016
BH 7	102.91	3.52	99.39	January 28, 2016
BH 9	103.12	1.43	101.69	January 28, 2016
BH 11	103.23	2.39	100.84	January 28, 2016
BH 13	103.14	4.53	98.58	January 28, 2016
BH 14	103.04	3.63	99.41	January 28, 2016
BH 16	103.19	3.67	99.52	January 28, 2016
BH 18	103.40	1.23	102.17	January 28, 2016
BH 21	103.14	1.83	101.31	January 28, 2016
BH 23	103.28	1.54	101.74	January 28, 2016
BH 25	103.52	2.95	100.57	January 28, 2016

Note: Groundwater levels are subject to seasonal fluctuations and therefore levels could differ at the time of construction. The borehole locations were selected by Paterson and surveyed by Annis, O'Sullivan, Vollebekk LTD.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed mixed use development. The proposed buildings will be founded on shallow foundations placed on the native stiff silty clay, glacial till or bedrock bearing surface.

Due to the presence of the silty clay layer, the subject site will be subjected to grade raise restrictions. If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill and/or other measures could reduce the risks of unacceptable long-term post construction total and differential settlements.

Depending on the extent of the underground parking garage and potential grade raise, the top portion of the bedrock may be encountered during excavation and construction. All contractors should be prepared to remove some bedrock within the southwest portion of the subject site. If a contractor requires more information on the bedrock quality, additional boreholes could be drilled into the bedrock to determine characteristics.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil, deleterious fill and soils containing significant amounts of organics, should be stripped from under any buildings and other settlement sensitive structures. All bearing surfaces and subgrade soils should be protected during construction to ensure an undisturbed surface is maintained during site preparation activities.

Fill Placement

Fill placed for grading beneath the structure(s) or other settlement sensitive areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in maximum 300 mm thick lifts and compacted to 98% of standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be placed as general landscaping fill where surface settlement is a minor concern. The backfill materials should be spread in thin lifts and at a minimum compacted by the tracks of the spreading equipment to minimize voids. If the non-specified backfill is to be placed to increase the subgrade level for areas to be paved, the fill should be compacted in maximum 300 mm lifts and compacted to 95% of SPMDD. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Shallow Foundation

Using continuously applied loads, footings for the proposed buildings can be designed with the following bearing resistance values presented in Table 2.

Table 2 - Bearing Resistance Values

Bearing Surface	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)
Stiff to Very Stiff Silty Clay	150	250
Firm Silty Clay	75	125
Compact to Dense Glacial Till	150	250

Note: Strip footings, up to 2 m wide, and pad footings, up to 3 m wide, placed over an undisturbed, silty clay bearing surface can be designed using the abovenoted bearing resistance values. The firm silty clay bearing resistance values should be considered for footings placed below an elevation of approximately 99.50 m within the northeastern portion of the subject site.

The bearing resistance values are provided on the assumption that the footings are 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.

Bearing resistance values for footing design should be confirmed at the time of construction.

The above-noted bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

For the parking garage structure, footings may be founded partially on bedrock on the west portion and on firm silty clay on the east portion. Concrete filled trenches that extend through the silty clay to the dense glacial till deposit. Provided the trenches can be completed with stable excavations and in dry condition, the bearing resistance value will be 150 kPa (SLS) and 250 kPa (ULS) for the concrete fill trench footings founded on the dense glacial till.

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 an engineered fill, stiff silty clay or glacial till above the groundwater table when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1.5H:1V passing through in situ soil of the same or higher bearing capacity as the bearing medium soil.

Footings placed on a clean surface sounded bedrock surface can be designed using a factored bearing resistance value at ultimate limit states (ULS) of **1,000 kPa** incorporating a geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS and a bearing resistance value at serviceability limit states (SLS) of **500 kPa**.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Footings bearing on an acceptable bedrock bearing surface and designed for the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

Permissible Grade Raise Restriction

Based on the current borehole hole information, a permissible grade raise restriction of **1 m** is recommended for the subject site. A post-development groundwater lowering of 0.5 m was assumed.

If higher grade raises and/or higher loading conditions are required, post construction settlements can be reduced by several methods. The following options can be considered:

- ❏ preloading and surcharging
- ❏ lightweight fill (LWF)

5.4 Design for Earthquakes

Based on current information, the foundations for the proposed buildings can be designed using a seismic site response **Class D** as defined in the Ontario Building Code 2012 (OBC 2012; Table 4.1.8.4.A). A higher site class, such as Class C, may be applicable for foundation design. However, a site specific seismic shear wave velocity test is recommended to confirm the higher site class. Based on the long-term groundwater level, undrained shear strength values noted throughout the silty clay deposit and depth of the silty clay/clayey silt deposit, the underlying soils are not considered to be susceptible to liquefaction.

5.5 Basement Slab

With the removal of all topsoil and deleterious fill, containing organic matter, within the proposed building footprint, the undisturbed native soil surface is considered acceptable subgrade to commence backfilling for floor slab construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. The upper 200 mm of sub-slab fill is recommended to consist of 19 mm clear crushed stone.

The subgrade is expected to be susceptible to disturbance by construction traffic (labourers and equipment). A mud slab or granular pad, approved by the geotechnical consultant at the time of construction, should be considered to ensure that disturbance does not occur during construction activities.

5.6 Basement Wall Design

There are several combinations of backfill materials and retained soils that could be applicable for the proposed structure's basement walls. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a dry unit weight of 20 kN/m^3.

The foundation wall is anticipated to be provided with a perimeter drainage system; therefore, the retained soils should be considered drained. For the undrained conditions, the applicable effective unit weight of the retained soil can be designed with13 kN/m^3. A hydrostatic pressure should be added to the total static earth pressure when calculating the effective unit weight. The total earth pressure (P_{AE}) includes both the static earth pressure component (P_o) and the seismic component (ΔP_{AE}).

Two distinct conditions, static and seismic, should be reviewed for design calculations. The parameters for design calculations for the two conditions are presented below.

Static Conditions

The static horizontal earth pressure (p_o) could be calculated with a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil, 0.5
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure with a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above formula for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure should only be applicable for static analyses and not be calculated in conjunction with the seismic loading case. Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Conditions

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) could be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45 - a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. The vertical seismic coefficient is assumed to be zero. The earth force component (P_o) under seismic conditions could be calculated using $P_o = 0.5\ K_o\ \gamma\ H^2$, where K_o = 0.5 for the soil conditions presented above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

5.7 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car only parking areas and access lanes, if required.

Table 3 - Recommended Pavement Structure - Car Only Parking Areas

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 - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil

Table 4 - Recommended Pavement Structure
Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil

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 sub-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 98% of the SPMDD.

Pavement Design over Parking Garage

All pavement designs overtop of the parking garage area should be approved by the structural engineer to ensure loads are acceptable with the parking garage structure design.

The current details for above the parking garage are unknown. However, upon request, Paterson can provide details and information if hardscaping is expected to be placed over the proposed parking garage structure.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on 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 impervious nature of the subgrade materials consideration should be provided to installing subdrains during the pavement construction. The subdrains should extend in four orthogonal directions and longitudinally when placed along a curb. The clear crushed stone surrounding the drainage lines or the pipe, should be wrapped with suitable filter cloth. The subdrain inverts should be approximately 300 mm below subgrade level and placed in accordance with City of Ottawa standard drawing R1. The subgrade surface should be shaped to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Water Infiltration Control Measures at Founding Level

Most of the lower parking level is anticipated to be founded on a silty clay or glacial till layer. At the time of construction, an inspection is recommended to be completed by the geotechnical engineer to determine if any significant groundwater infiltration is noted through the subsurface profile, at the time of construction. If any significant water infiltration from excavation side walls or excavation base is observed, a waterproofing membrane will be recommended to reduce the volume of water infiltration to allow for a relatively dry excavation base.

Underfloor Drainage

Underfloor drainage is recommended to control water infiltration due to potential groundwater infiltration at the proposed founding elevation. For design purposes, Paterson recommends, a 150 mm in diameter perforated pipes be placed at 6 m centres. The spacing of the underfloor drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

Foundation Drainage

A perimeter foundation drainage system is recommended to be provided for proposed structures. 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, 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 freedraining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for placement as backfill unless a composite drainage system (such as system Platon or Miradrain G100N) connected to a drainage system is provided.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be protected against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone, or a combination of soil cover and foundation insulation should be provided.

Exterior unheated footings, such as isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

The parking garage should not require protection against frost action due to the founding depth. Unheated structures, such as the access ramp wall footings, may be required to be insulated against the deleterious effect of frost action. A minimum of 2.1 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with foundation insulation, should be provided.

6.3 Excavation Side Slopes

Temporary Side Slopes

The temporary excavation side slopes should either be excavated to acceptable slopes or retained by shoring systems from the beginning of the excavation until the structure is backfilled.

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsurface soil is considered to be mainly 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 maintain safe working distance 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.

A trench box is recommended to be installed at all times to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by “cut and cover” methods and excavations should not be remain exposed for extended periods of time.

Temporary Shoring

Temporary shoring may be required to complete the excavation of the overburden soil where insufficient room is available for open cut methods. The shoring requirements should be reviewed by the contractor completing the excavation work and designed by a structural engineer, specializing in shoring design. The shoring will depend on the depth of the excavation, the proximity of the adjacent structures and the elevation of the adjacent building foundations, roadways and underground services. Additional recommendations and parameters can be provided upon request.

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.

A minimum of a 150 mm of OPSS Granular A should be placed for pipe bedding for sewer and water pipes for a soil subgrade. The bedding thickness should be increased to 300 mm for areas where the subgrade consists of bedrock. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A. The bedding and cover materials should be placed in maximum 300 mm thick lifts compacted to a minimum of 95% of the SPMDD.

The site excavated material may be placed above cover material if the excavation operations are completed in dry weather conditions and the site excavated material is approved by the geotechnical consultant. All cobbles greater than 200 mm in the longest dimension should be removed prior to the site materials being reused.

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 reduce differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD. Within the frost zone (1.8 m below finished grade), non frost susceptible materials should be used when backfilling trenches below the original bedrock level.

If the trench excavations are within the silty clay layer only, clay seals should be provided in the service trenches to reduce long-term lowering of the groundwater level. The seals should be a minimum of 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. Generally, 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, roadway intersections and at a maximum distance of every 50 m in the service trenches.

6.5 Groundwater Control

Groundwater Control for Building Construction

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.

Infiltration levels are anticipated to be low to moderate through the excavation face, depending on the local groundwater table and the glacial till gradation throughout the excavation surface. The groundwater infiltration should be controllable with open sumps and pumps.

A temporary MOE permit to take water (PTTW) may be required for this project if more than 50,000 L/day are to be pumped during the construction phase. A minimum of four to five months should be allocated for completion of the application and issuance of the permit by the MOE.

6.6 Winter Construction

Precautions must be provided if winter construction is considered for this project.

Where excavations are completed in proximity of existing structures which may be adversely affected due to the freezing conditions. In particular, where a shoring system is constructed, the soil behind the shoring system will be subjected to freezing conditions and could result in heaving of the structure(s) placed within or above frozen soil. Provisions in the contract documents should be provided to protect the excavation walls from freezing, if applicable.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. The excavation base 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.

Trench excavations and pavement construction are difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be considered if such activities are to be completed during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The analytical testing results are presented in Table 5 along with industry standards for the applicable threshold values. The results are indicative that Type 10 Portland cement (Type GU, or normal cement) would be appropriate for this site.

Table 5 - Corrosion Potential

Parameter	Laboratory Results	Threshold	Commentary
	BH 16 - SS 4		
Chloride	<5 µg/g	Chloride content greater than 400 mg/g	Negligible concern
pH	7.63	pH value less than 5.0	Neutral Soil
Resistivity	65.5 ohm.m	Resistivity greater than 1,500 ohm.cm	Low to Moderate Corrosion Potential
Sulphate	15 µg/g	Sulphate value greater than 1 mg/g	Negligible Concern

7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- ❑ Review detailed grading plan(s) from a geotechnical perspective.
- ❑ Review groundwater conditions at the time of construction to determine if waterproofing is required.
- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials used.
- ❑ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❑ Observation of all subgrades prior to backfilling.
- ❑ Field density tests to determine the level of compaction achieved.
- ❑ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that the construction work has been conducted in general accordance with the above recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations provided in the report are in accordance with Paterson's present understanding of the project. Paterson request permission to review the recommendations when the drawings and specifications are completed.

A geotechnical investigation is a limited sampling of a site. Should any conditions encountered during construction differ from the borehole locations, Paterson requests immediate notification to permit reassessment of the recommendations.

The recommendations provided should only be used by the design professionals associated with this project. The recommendations are not intended for contractors bidding on or constructing the project. The latter should evaluate the factual information provided in the report. The contractor should also determine the suitability and completeness for the intended construction schedule and methods. Additional testing may be required for the contractors purpose.

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 Nautical Lands Group, or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
J. A. FORSYTH
100176378
PROVINCE OF ONTARIO

Cameron P. Benn, B.Eng.

Joe Forsyth, P.Eng.

Report Distribution:

- ❑ Nautical Lands Group (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TEST RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG3710**

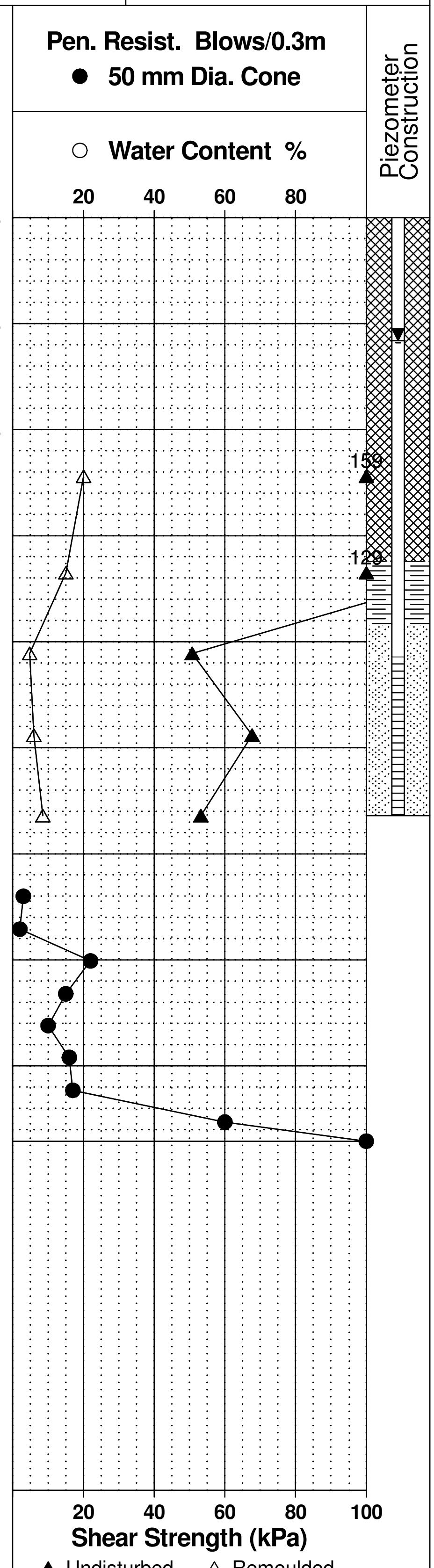
REMARKS

HOLE NO. **BH 1**

BORINGS BY CME 55 Power Auger

DATE January 18, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	102.93
TOPSOIL — 0.20							
Very loose, brown **SANDY SILT,** some clay — 1.07		SS	1	83	2	1	101.93
Very stiff to stiff, brown **SILTY CLAY,** some sand - grey by 3.7m depth — 6.10		SS	2	100	2	2	100.93
						3	99.93
						4	98.93
						5	97.93
Dynamic Cone Penetration Test commenced at 6.10m depth — 8.71						6	96.93
						7	95.93
						8	94.93
End of Borehole Practical refusal to DCPT at 8.71m depth (GWL @ 1.16m-Jan. 28, 2016)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

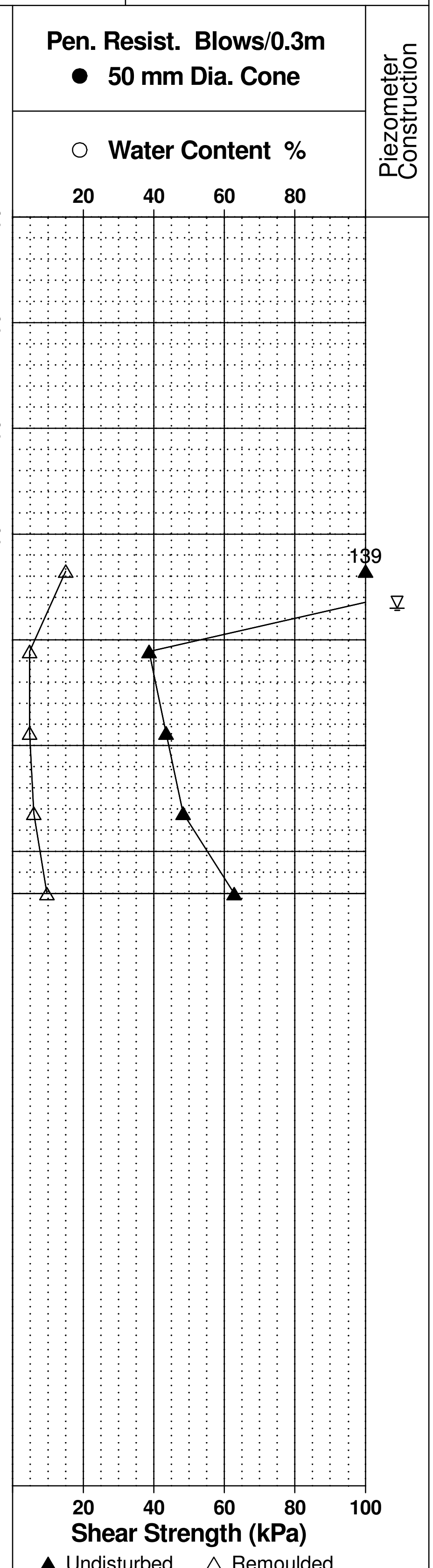
FILE NO. PG3710

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** January 18, 2016

SOIL DESCRIPTION	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.02
TOPSOIL 0.25							
Very stiff to stiff, brown **SILTY CLAY,** some sand		SS	1	17	5	1	102.02
		SS	2	100	3	2	101.02
		SS	3	100	4	3	100.02
- firm to stiff and grey by 3.7m depth						4	99.02
						5	98.02
6.40						6	97.02
End of Borehole (GWL at 3.7m depth based on field observations)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

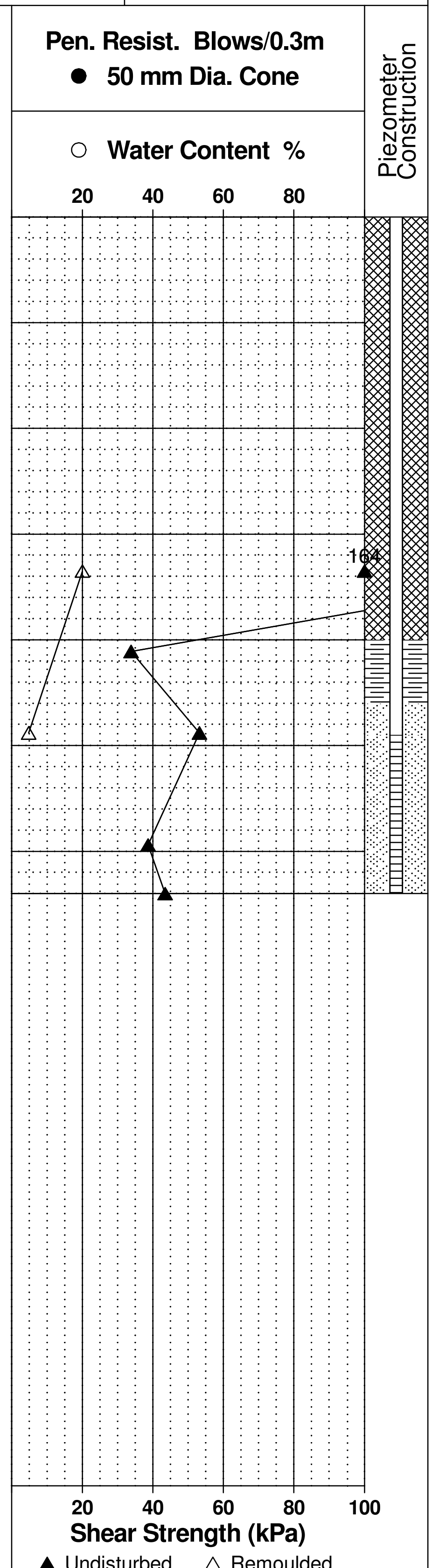
FILE NO. PG3710

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger   **DATE** January 18, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.07
TOPSOIL 0.28							
Loose, brown **SANDY SILT,** trace clay 1.27		SS	1	71	5	1	102.07
		SS	2	100	4	2	101.07
		SS	3	100	4		
Very stiff to stiff, brown **SILTY CLAY,** some sand						3	100.07
- firm and grey by 3.7m depth						4	99.07
						5	98.07
6.40						6	97.07
End of Borehole							
(BH dry - Jan. 28, 2016)							



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SOIL PROFILE AND TEST DATA

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Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

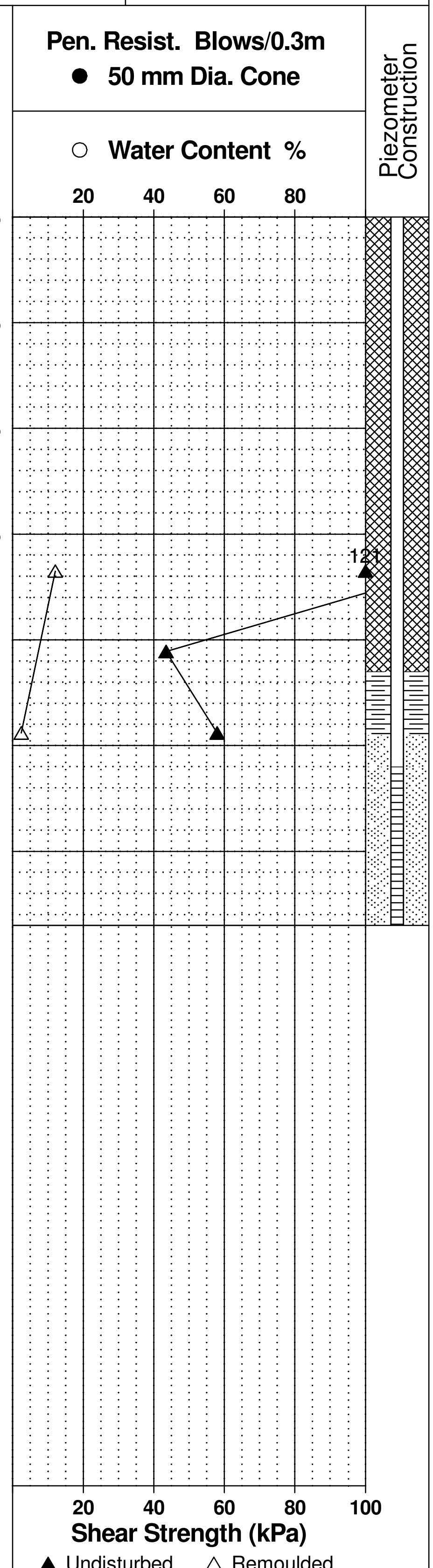
FILE NO. PG3710

REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** January 18, 2016

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.15
TOPSOIL 0.25	AU	1				
Very stiff to stiff, brown **SILTY CLAY,** some sand	SS	2	100	4	1	102.15
	SS	3	100	5	2	101.15
	SS	4	100	3	3	100.15
- grey by 4.0m depth					4	99.15
					5	98.15
	SS	5	100	1	6	97.15
6.70	SS	6	100	1		
End of Borehole						
(BH dry - Jan. 28, 2016)						



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SOIL PROFILE AND TEST DATA

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Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH 5

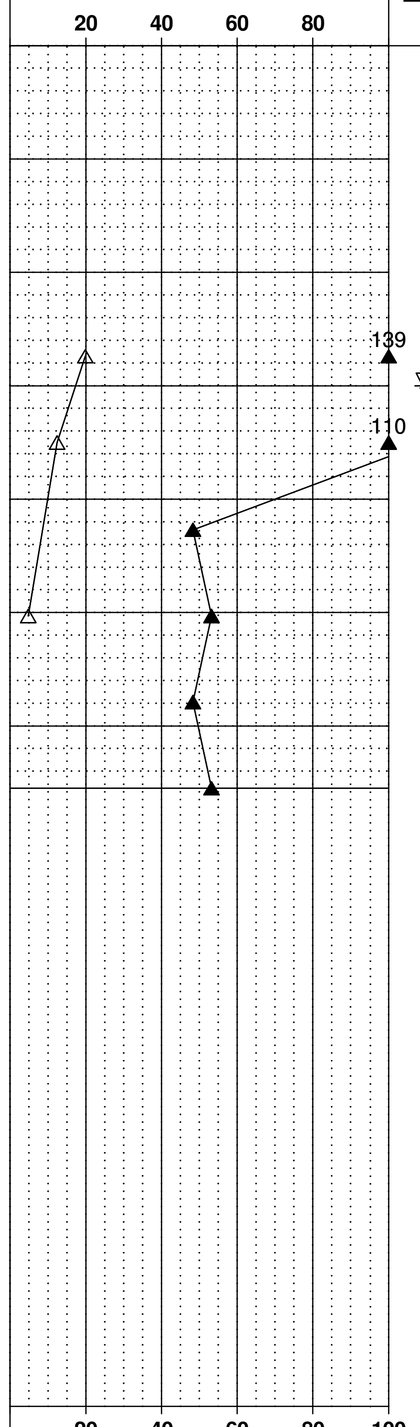
BORINGS BY CME 55 Power Auger **DATE** January 15, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.25					
Very stiff to stiff, brown **SILTY CLAY,** some sand		SS	1	25	3
		SS	2	100	3
- firm to stiff and grey by 4.3m depth					
6.55					
End of Borehole					
(GWL at 3.0m depth based on field observations)					

DEPTH (m)	ELEV. (m)
0	103.22
1	102.22
2	101.22
3	100.22
4	99.22
5	98.22
6	97.22

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %

Piezometer Construction



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH 6

BORINGS BY CME 55 Power Auger

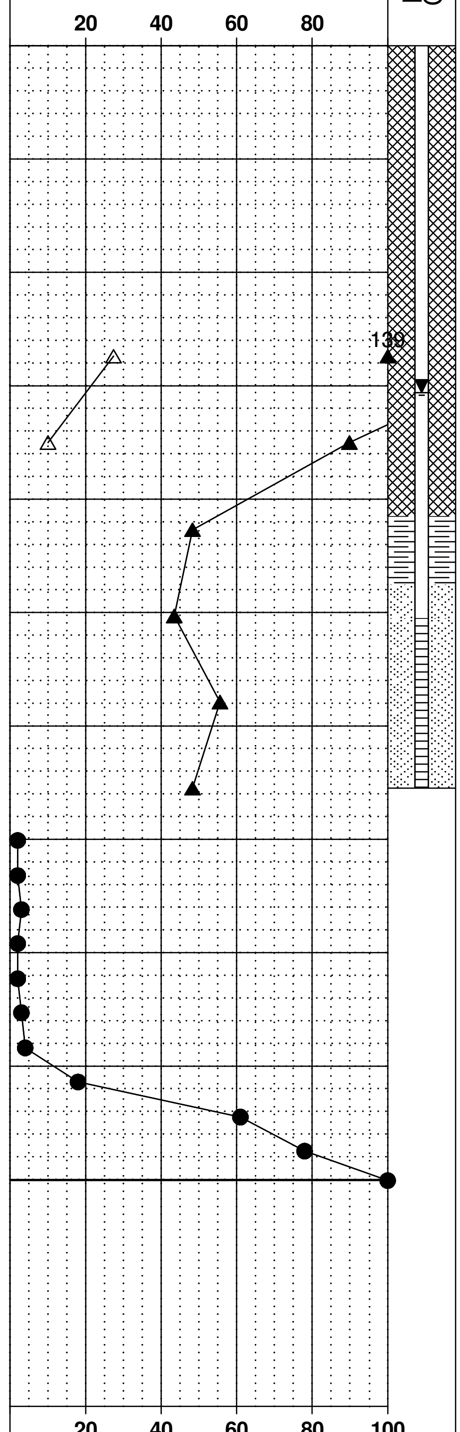
DATE January 15, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.25						0	103.25
		SS	1	100	7	1	102.25
		SS	2	100	4	2	101.25
Very stiff to stiff, brown **SILTY CLAY,** some sand						3	100.25
						4	99.25
- firm and grey by 4.3m depth						5	98.25
6.55						6	97.25
Dynamic Cone Penetration Test commenced at 6.55m depth						7	96.25
						8	95.25
						9	94.25
10.01						10	93.25
End of Borehole							
Practical refusal to DCPT at 10.01m depth							
(GWL @ 3.06m-Jan. 28, 2016)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

Piezometer Construction



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH 7

BORINGS BY CME 55 Power Auger **DATE** January 14, 2016

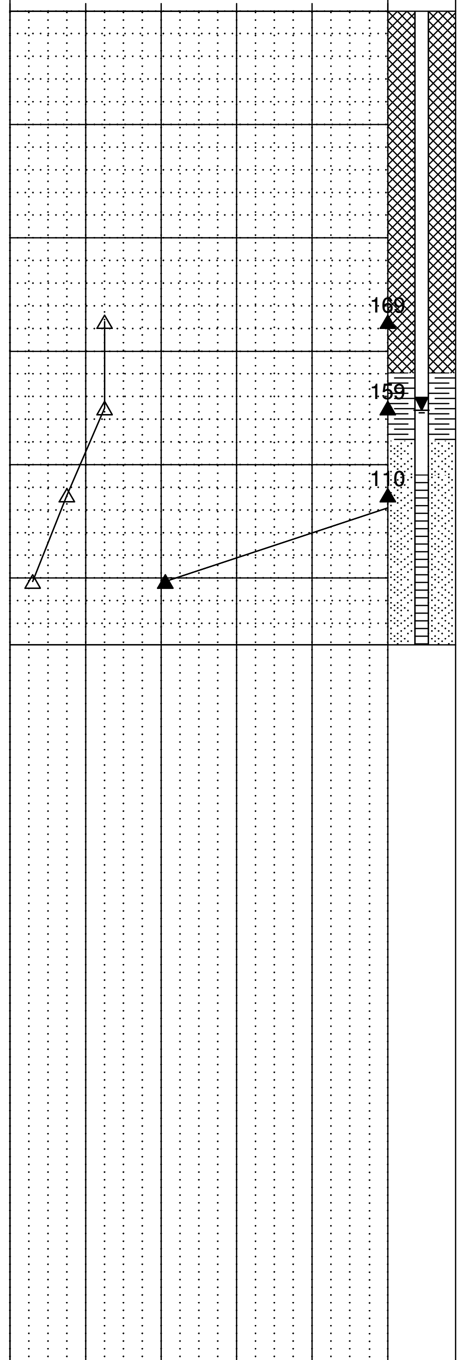
SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	102.91
TOPSOIL 0.46							
Very stiff to stiff, brown **SILTY CLAY,** some sand		SS	1	100	4	1	101.91
		SS	2	100	4	2	100.91
						3	99.91
						4	98.91
- firm and grey by 4.9m depth		G	3			5	97.91
5.59		SS	4	90	50+		
End of Borehole Practical refusal to augering at 5.59m depth (GWL @ 3.52m-Jan. 28, 2016)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction



20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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Proposed Retirement & Commercial Development
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FILE NO. PG3710

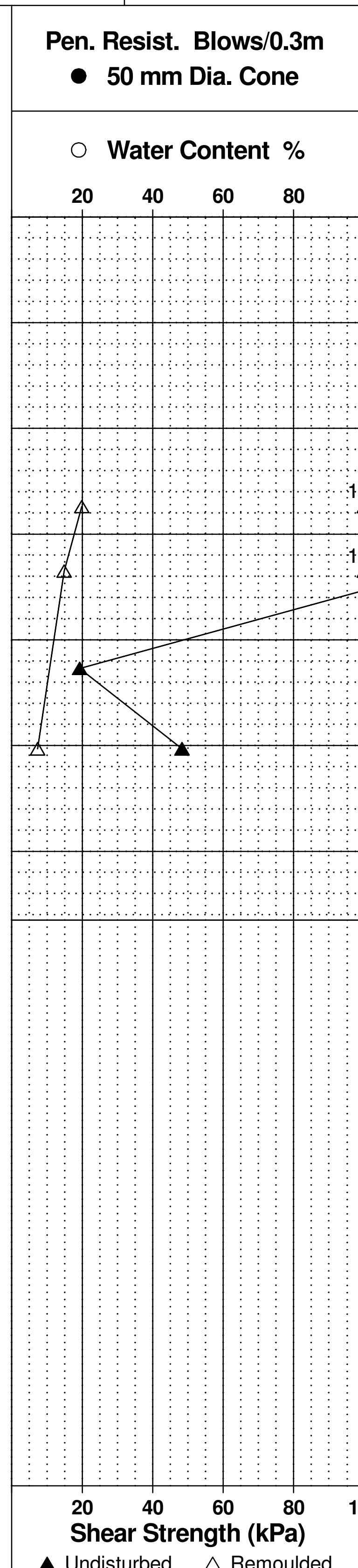
REMARKS

HOLE NO. BH 8

BORINGS BY CME 55 Power Auger

DATE January 14, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.01
TOPSOIL 0.30							
		SS	1	100	3	1	102.01
		SS	2	100	4		
						2	101.01
Very stiff to stiff, brown **SILTY CLAY,** some sand							
						3	100.01
		G	3				
- soft to firm and grey by 4.0m depth		G	4			4	99.01
		G	5				
5.33						5	98.01
Loose, grey **SILT** 5.64		SS	6	83	4		
GLACIAL TILL: Dense, grey silty sand, some gravel and clay						6	97.01
6.65		SS	7	91	36		
End of Borehole							
(GWL @ 3.7m depth based on field observations)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH 9

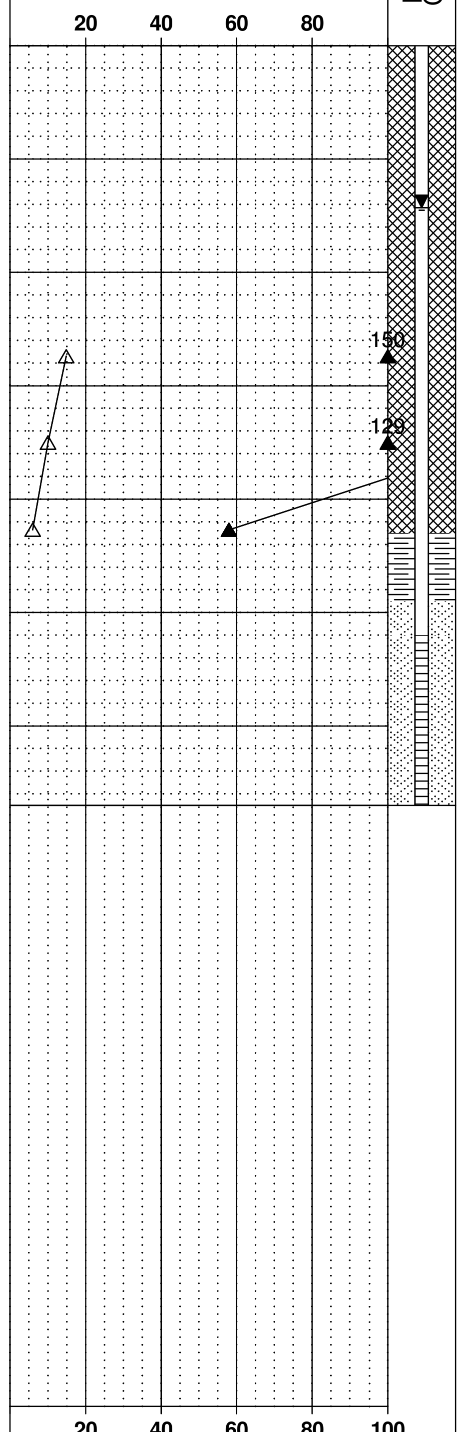
BORINGS BY CME 55 Power Auger **DATE** January 15, 2016

SOIL DESCRIPTION	Depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.25				
Very stiff to stiff, brown **SILTY CLAY,** some sand		SS	1	100	3
		SS	2	100	4
	4.40				
Compact, grey **SILT**		SS	3	58	10
	5.18				
GLACIAL TILL: Loose to compact, grey clayey sand with silt and gravel		SS	4	100	3
		SS	5	67	13
	6.70				
End of Borehole					
(GWL @ 1.43m-Jan. 28, 2016)					

DEPTH (m)	ELEV. (m)
0	103.12
1	102.12
2	101.12
3	100.12
4	99.12
5	98.12
6	97.12

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

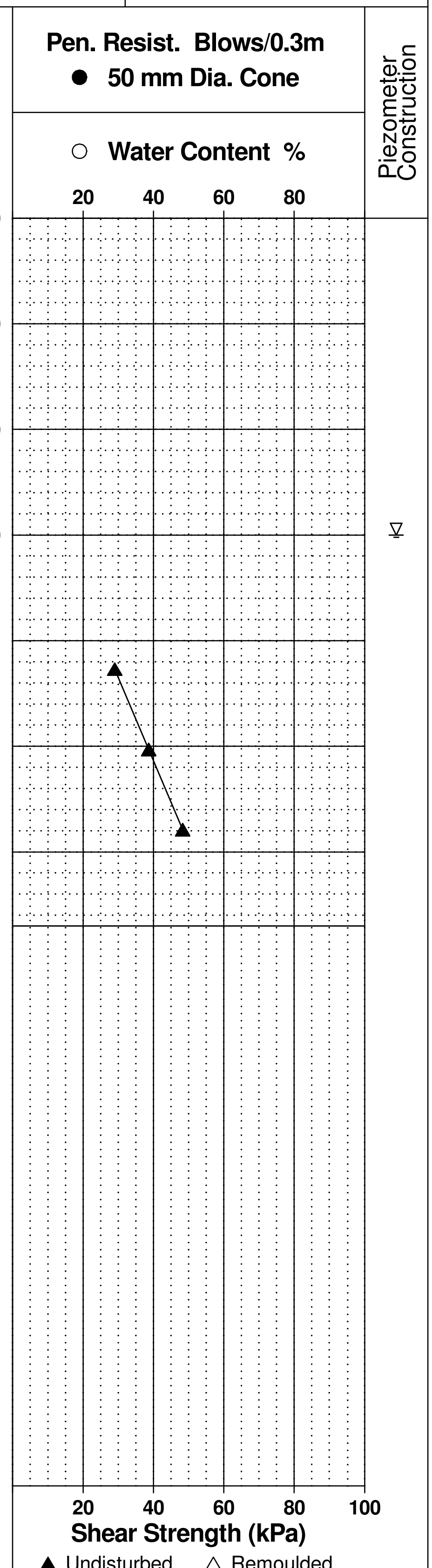
HOLE NO. BH10

BORINGS BY CME 55 Power Auger **DATE** January 15, 2016

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.30				
Loose, brown **SANDY SILT,** some clay	1.50	SS	1	75	6
Interlayered brown **SANDY SILT** and brown **CLAYEY SILT**	3.70	SS	2	92	4
		SS	3	100	3
		SS	4	100	3
Firm to stiff, grey **SILTY CLAY,** some sand	5.79				
GLACIAL TILL: Compact, grey silty sand with some clay and gravel	6.70	SS	5	100	18
End of Borehole					

(GWL @ 3.0m depth based on field observations)

DEPTH (m)	ELEV. (m)
0	103.09
1	102.09
2	101.09
3	100.09
4	99.09
5	98.09
6	97.09



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SOIL PROFILE AND TEST DATA

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FILE NO. PG3710

REMARKS

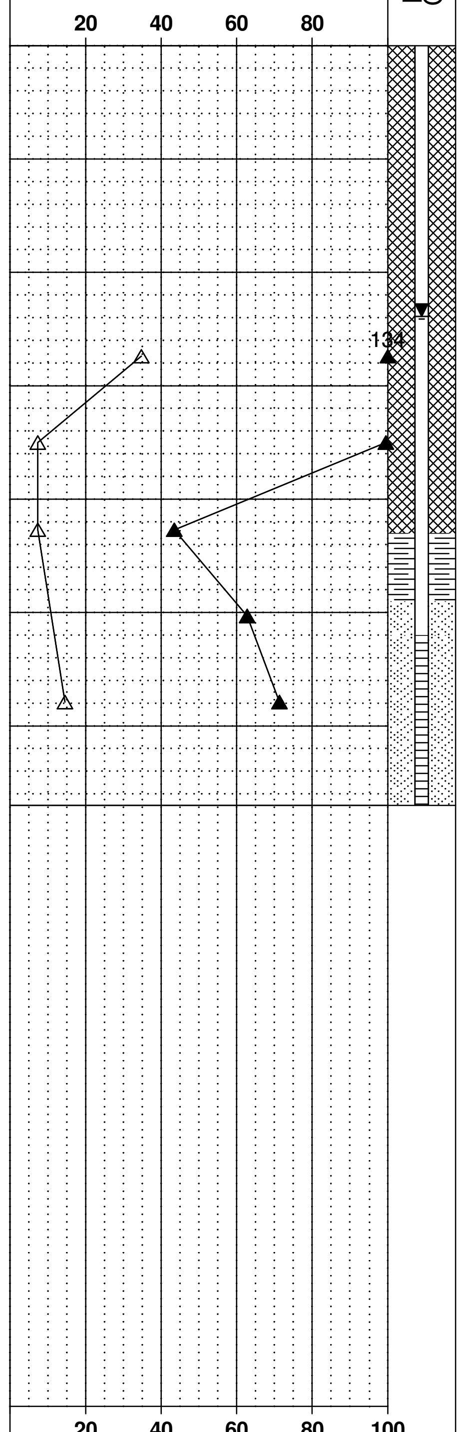
HOLE NO. BH11

BORINGS BY CME 55 Power Auger **DATE** January 15, 2016

SOIL DESCRIPTION	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.23
TOPSOIL 0.38							
Very stiff to stiff, brown **SILTY CLAY,** some sand		SS	1	100	3	1	102.23
		SS	2	100	4	2	101.23
						3	100.23
- firm to stiff and grey by 4.2m depth						4	99.23
5.80						5	98.23
						6	97.23
GLACIAL TILL: Compact, grey silty sand with clay and gravel 6.70		SS	3	83	18		
End of Borehole							
(GWL @ 2.39m-Jan. 28, 2016)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

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FILE NO. PG3710

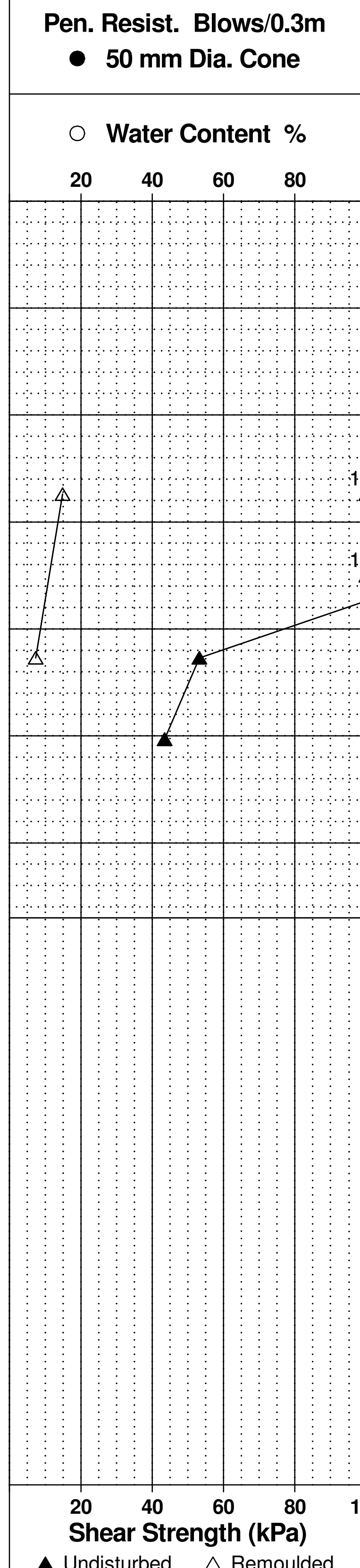
REMARKS

HOLE NO. BH12

BORINGS BY CME 55 Power Auger

DATE January 15, 2016

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.21
TOPSOIL	0.30						
Brown **SILTY CLAY,** some sand	0.76						
Very loose, brown **SANDY SILT,** some clay		SS	1	83	4	1	102.21
	2.30	SS	2	100	3	2	101.21
Very stiff to stiff, brown **SILTY CLAY,** some sand						3	100.21
- firm and grey by 4.5m depth						4	99.21
						5	98.21
	6.00	SS	3	75	13	6	97.21
GLACIAL TILL: Loose, grey clayey silty sand with gravel	6.70	SS	4	100	4		
End of Borehole							
(GWL @ 3.7m depth based on field observations)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

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FILE NO. PG3710

REMARKS

HOLE NO. BH13

BORINGS BY CME 55 Power Auger

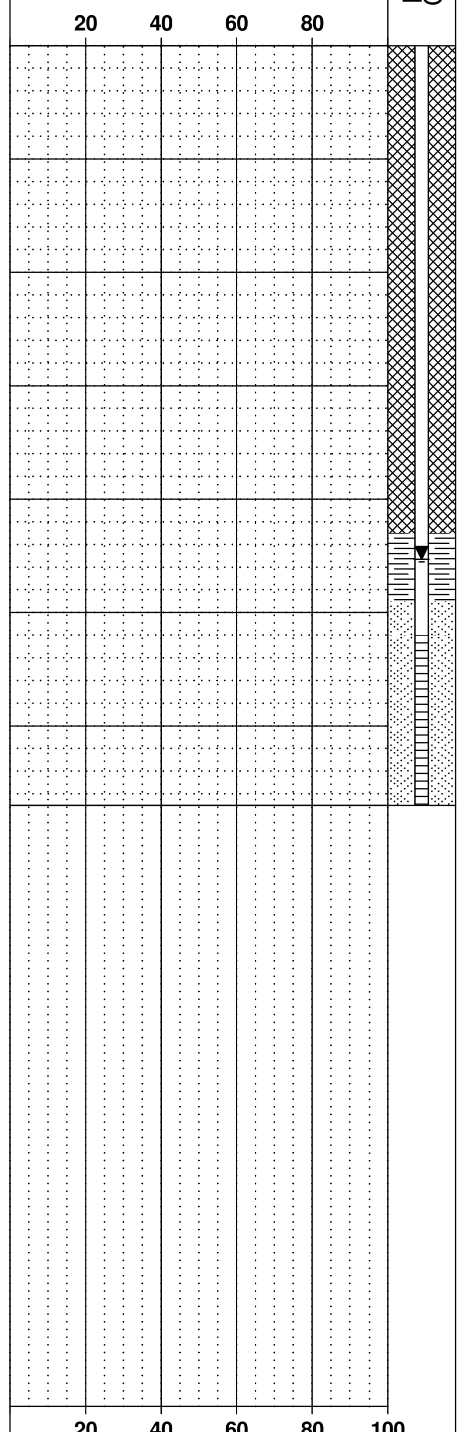
DATE January 14, 2016

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.30				
Brown **SILTY CLAY**		SS	1	100	3
	2.20	SS	2	100	4
Compact, brown **SANDY SILT,** some clay		SS	3	100	15
	3.66	SS	4	100	17
Compact, grey **SILT**	4.27	SS	5	67	10
GLACIAL TILL: Loose to compact, grey silty sand with clay and gravel		SS	6	58	8
	6.70	SS	7	50	19
End of Borehole					
(GWL @ 4.53m-Jan. 28, 2016)					

DEPTH (m)	ELEV. (m)
0	103.14
1	102.14
2	101.14
3	100.14
4	99.14
5	98.14
6	97.14

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %

Piezometer Construction



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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FILE NO. PG3710

REMARKS

HOLE NO. BH14

BORINGS BY CME 55 Power Auger **DATE** January 14, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.04
TOPSOIL 0.36							
		SS	1	100	4	1	102.04
		SS	2	92	4	2	101.04
Very stiff to stiff, brown **SILTY CLAY,** some sand						3	100.04
- firm to stiff and grey by 4.3m depth						4	99.04
5.10						5	98.04
GLACIAL TILL: Compact, grey silty sand, some clay and gravel		SS	3	75	26		
6.04						6	97.04

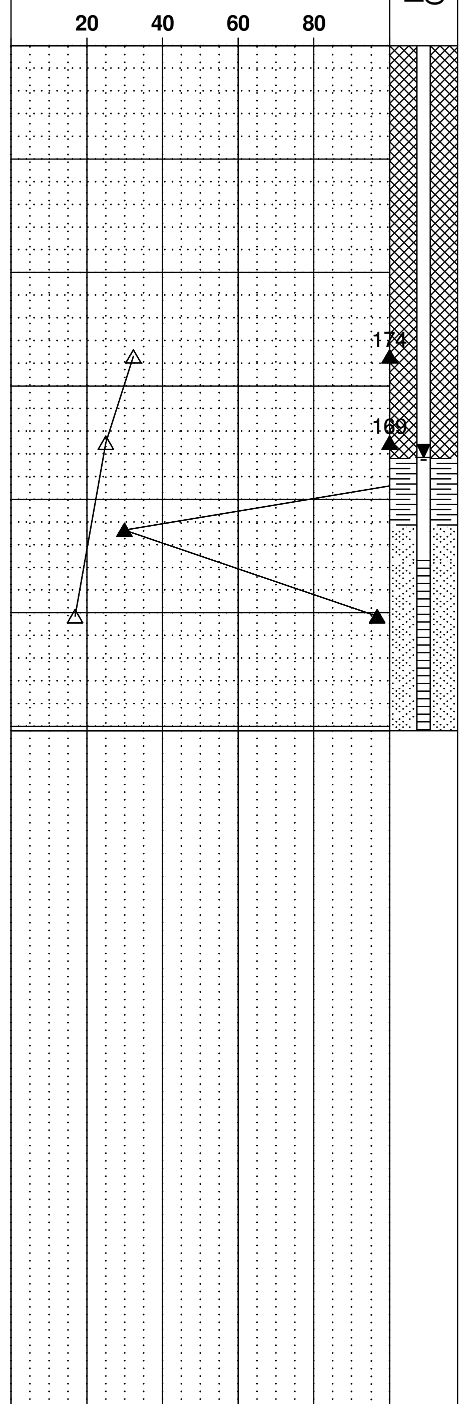
End of Borehole

Practical refusal to augering at 6.04m depth

(GWL @ 3.63m-Jan. 28, 2016)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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FILE NO. PG3710

REMARKS

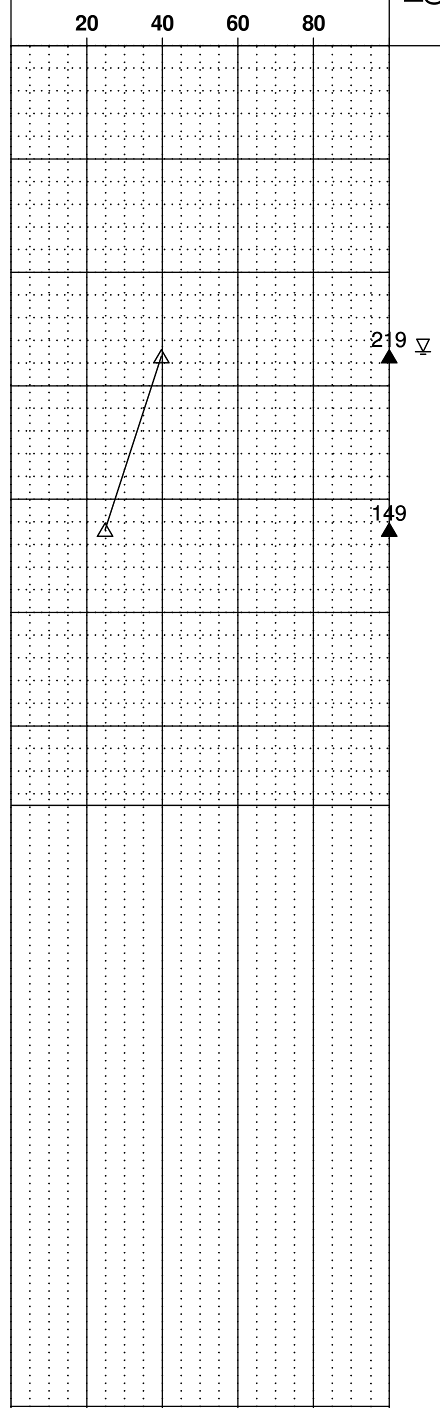
HOLE NO. BH15

BORINGS BY CME 55 Power Auger

DATE January 14, 2016

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.02
TOPSOIL	0.30						
Brown **SILTY CLAY,** some sand	0.76						
Loose, brown **SILTY SAND,** some clay	1.50	SS	1	100	4	1	102.02
Hard to very stiff, brown **SILTY CLAY,** some sand		SS	2	100	4	2	101.02
		SS	3	100	5	3	100.02
	4.50					4	99.02
GLACIAL TILL: Dense, grey silty sand with clay and gravel		SS	4	88	50+	5	98.02
		SS	5	33	31	6	97.02
	6.70	SS	6	100	39		
End of Borehole							
(GWL @ 2.7m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

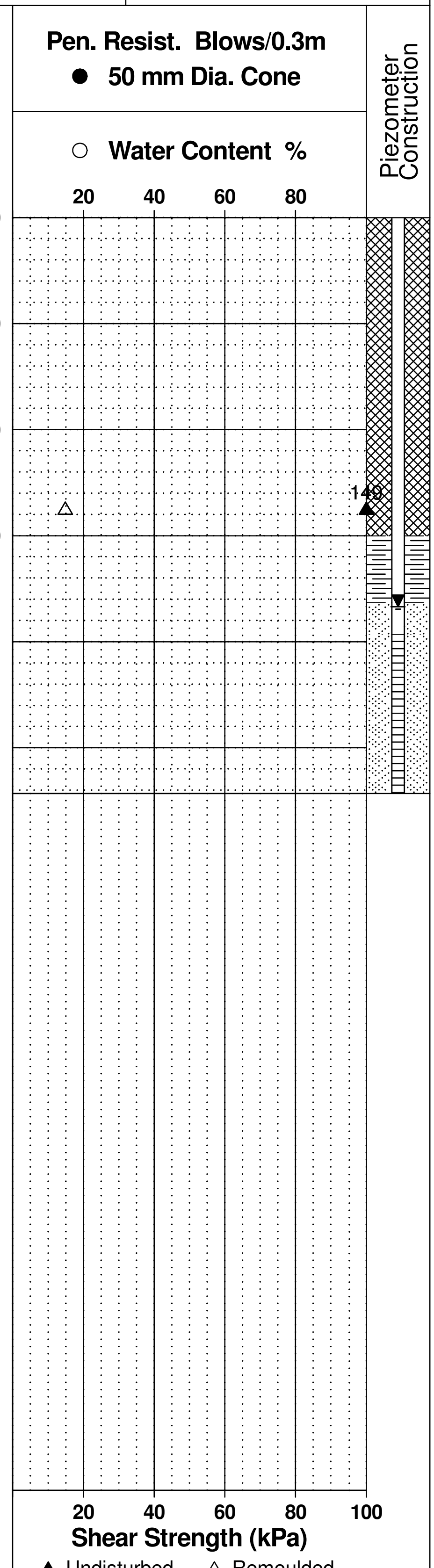
REMARKS

HOLE NO. BH16

BORINGS BY CME 55 Power Auger

DATE January 14, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.19
TOPSOIL 0.20							
Very stiff to stiff, brown **SILTY CLAY,** some sand		SS	1	100	3	1	102.19
		SS	2	100	3	2	101.19
3.00						3	100.19
Loose, brown **SANDY SILT,** some clay		SS	3	92	9		
4.20		SS	4	92	5	4	99.19
GLACIAL TILL: Compact to dense, grey silty sand, some clay and gravel		SS	5	75	16	5	98.19
5.43		SS	6	0	50+		
End of Borehole							
Practical refusal to augering at 5.43m depth							
(GWL @ 3.67m-Jan. 28, 2016)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

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FILE NO. PG3710

REMARKS

HOLE NO. BH17

BORINGS BY CME 55 Power Auger

DATE January 14, 2016

SOIL DESCRIPTION	Layer bottom depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.15
TOPSOIL	0.20						
Very stiff to stiff, brown **SILTY CLAY**		SS	1	100	5	1	102.15
	2.20	SS	2	100	4	2	101.15
Compact, brown **SANDY SILT,** some clay	3.05	SS	3	100	16	3	100.15
GLACIAL TILL: Compact to dense, grey silty sand with clay and gravel		SS	4	100	10		
		SS	5	67	26	4	99.15
	4.72	SS	6	100	50+		

End of Borehole

Practical refusal to augering at 4.72m depth

(GWL @ 2.0m depth based on field observations)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH18

BORINGS BY CME 55 Power Auger **DATE** January 13, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	103.40		
TOPSOIL 0.20									
Very stiff, brown **SILTY CLAY,** some sand		SS	1	100	9	1	102.40		
1.50									
Compact, brown **SANDY SILT,** some clay		SS	2	100	11	2	101.40		
		SS	3	100	11				
2.84									
End of Borehole									
Practical refusal to augering at 2.84m depth									
(GWL @ 1.23m-Jan. 28, 2016)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH19

BORINGS BY CME 55 Power Auger **DATE** January 13, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.30
TOPSOIL 0.25							
Very stiff to stiff, brown **SILTY CLAY,** some sand		SS	1	75	4	1	102.30
		SS	2	100	3	2	101.30
3.00		SS	3	100	14	3	100.30
GLACIAL TILL: Brown silty sand with clay and gravel 3.28		SS	4	67	50+		

End of Borehole

Practical refusal to augering at 3.28m depth

(GWL @ 2.4m depth based on field observations)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE January 13, 2016

FILE NO. PG3710

HOLE NO. BH20

SOIL DESCRIPTION	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.04
TOPSOIL 0.20							
		SS	1	75	3	1	102.04
Very stiff to stiff, brown **SILTY CLAY,** some sand		SS	2	100	4	2	101.04
		SS	3	100	4	3	100.04
3.50		SS	4	100	4		
GLACIAL TILL: Loose to dense, brown silty sand with clay and gravel		SS	5	100	8	4	99.04
4.95		SS	6	53	50+		

End of Borehole

Practical refusal to augering at 4.95m depth

(GWL @ 3.7m depth based on field observations)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

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Proposed Retirement & Commercial Development
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FILE NO. PG3710

REMARKS

HOLE NO. BH21

BORINGS BY CME 55 Power Auger **DATE** January 13, 2016

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.14
TOPSOIL 0.25						
Very stiff, brown **SILTY CLAY,** some sand	SS	1	100	4	1	102.14
	SS	2	100	4	2	101.14
	SS	3	100	3	3	100.14
	SS	4	0	16		
4.50	SS	5	17	12	4	99.14
GLACIAL TILL: Dense, grey silty and with clay and gravel	SS	6	58	36	5	98.14
5.51	SS	7	100	50+		

End of Borehole

Practical refusal to augering at 5.51m depth

(GWL @ 1.83m-Jan. 28, 2016)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH22

BORINGS BY CME 55 Power Auger

DATE January 13, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	103.24		
TOPSOIL 0.25									
Very stiff, brown **SILTY CLAY,** some sand		SS	1	100	4	1	102.24		
		SS	2	100	3				
2.20						2	101.24		
Loose, brown **SILT,** some to trace clay		SS	3	100	6				
						3	100.24		∇
3.50		SS	4	100	5				
GLACIAL TILL: Compact to very dense, grey silty sand, some clay and gravel		SS	5	33	20	4	99.24		
		SS	6	92	48	5	98.24		
		SS	7	100	60	6	97.24		
6.30		SS	8	100	50+				
End of Borehole (GWL @ 3.0m depth based on field observations)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH23

BORINGS BY CME 55 Power Auger

DATE January 13, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	103.28		
TOPSOIL 0.25									
		SS	1	100	4	1	102.28		
Very stiff, brown **SILTY CLAY,** some sand		SS	2	100	3	2	101.28		
3.00		SS	3	100	34	3	100.28		
Dense, grey **SILTY SAND,** some clay 3.20		SS	4	80	50+				

End of Borehole

Practical refusal to augering at 3.20m depth

(GWL @ 1.54m-Jan. 28, 2016)

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH24

BORINGS BY CME 55 Power Auger **DATE** January 13, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.30
TOPSOIL 0.20							
Very stiff, brown **SILTY CLAY**		SS	1	100	6	1	102.30
2.20		SS	2	100	5	2	101.30
GLACIAL TILL: Dense, grey silty sand with clay and gravel 3.05		SS	3	100	50+	3	100.30

End of Borehole

Practical refusal to augering at 3.05m depth

(GWL @ 2.7m depth based on field observations)

Note: Additional borehole was drilled 2.5m off of BH 24 to confirm practical refusal.

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Retirement & Commercial Development
5731 Hazeldean Road, Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG3710

REMARKS

HOLE NO. BH25

BORINGS BY CME 55 Power Auger

DATE January 13, 2016

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.52
TOPSOIL — 0.25	AU	1				
Very stiff, brown **SILTY CLAY,** some sand — 1.50	SS	2	50	6	1	102.52
GLACIAL TILL: Dense, brown silty sand with clay and gravel	SS	3	75	44	2	101.52
	SS	4	83	31	3	100.52
	SS	5	83	32		
3.86	SS	5	33	50+		

End of Borehole

Practical refusal to augering at 3.86m depth

(GWL @ 2.95m-Jan. 28, 2016)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	‘N’ Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	‘N’ Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu	-	Uniformity coefficient = $D60 / D10$

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

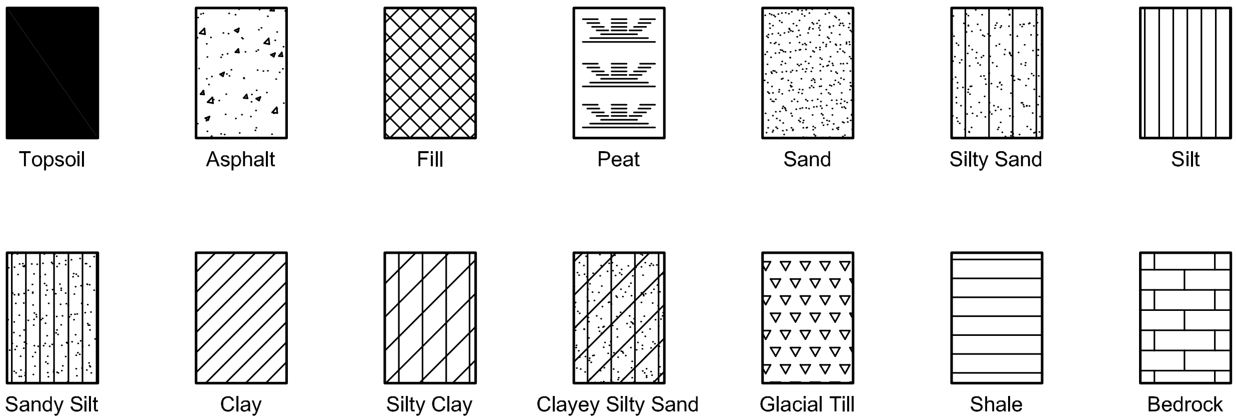
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

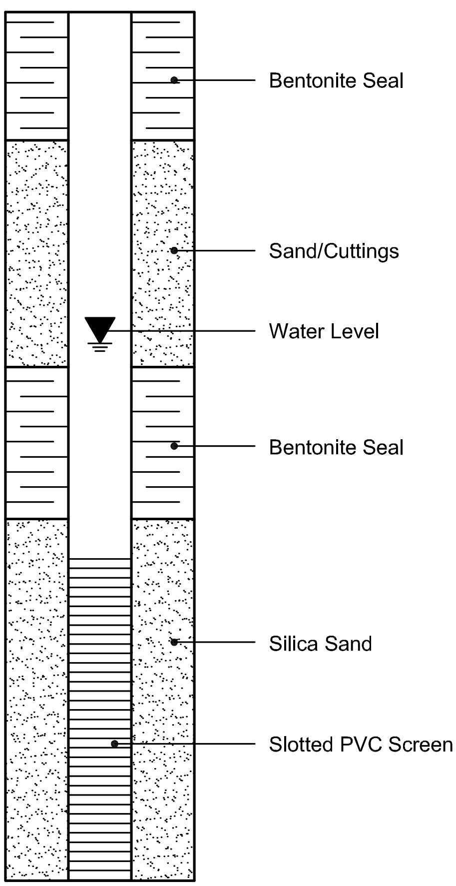
SYMBOLS AND TERMS (continued)

STRATA PLOT

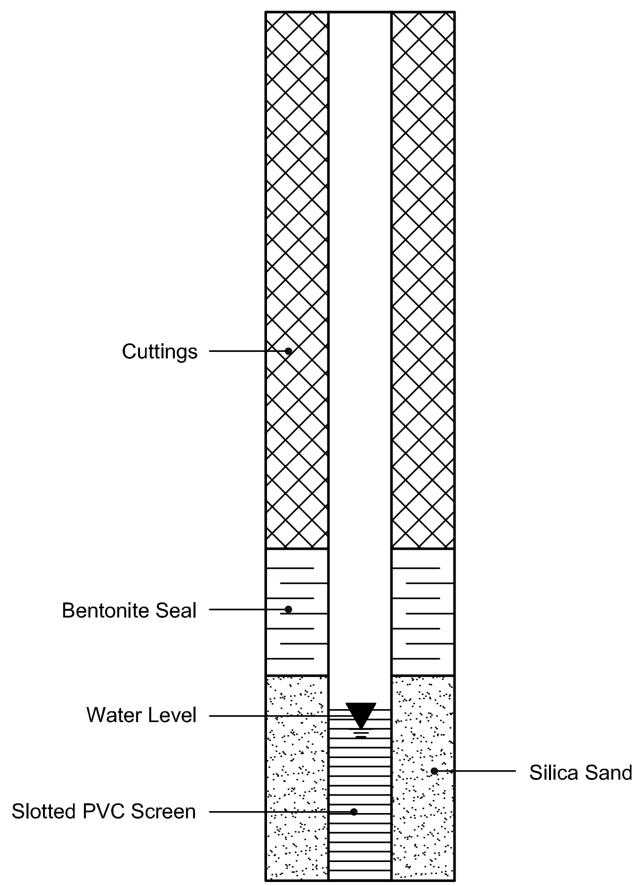


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



PARACEL LABORATORIES LTD.

Order #: 1604086

Certificate of Analysis

Client: **Paterson Group Consulting Engineers**

Client PO: 18948

Report Date: 22-Jan-2016

Order Date: 18-Jan-2016

Project Description: PG3710

	Client ID:	BH16 SS4	-	-	-
	Sample Date:	18-Jan-16	-	-	-
	Sample ID:	1604086-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	77.8	-	-	-
General Inorganics					
pH	0.05 pH Units	7.63	-	-	-
Resistivity	0.10 Ohm.m	65.5	-	-	-
Anions					
Chloride	5 ug/g dry	<5	-	-	-
Sulphate	5 ug/g dry	15	-	-	-

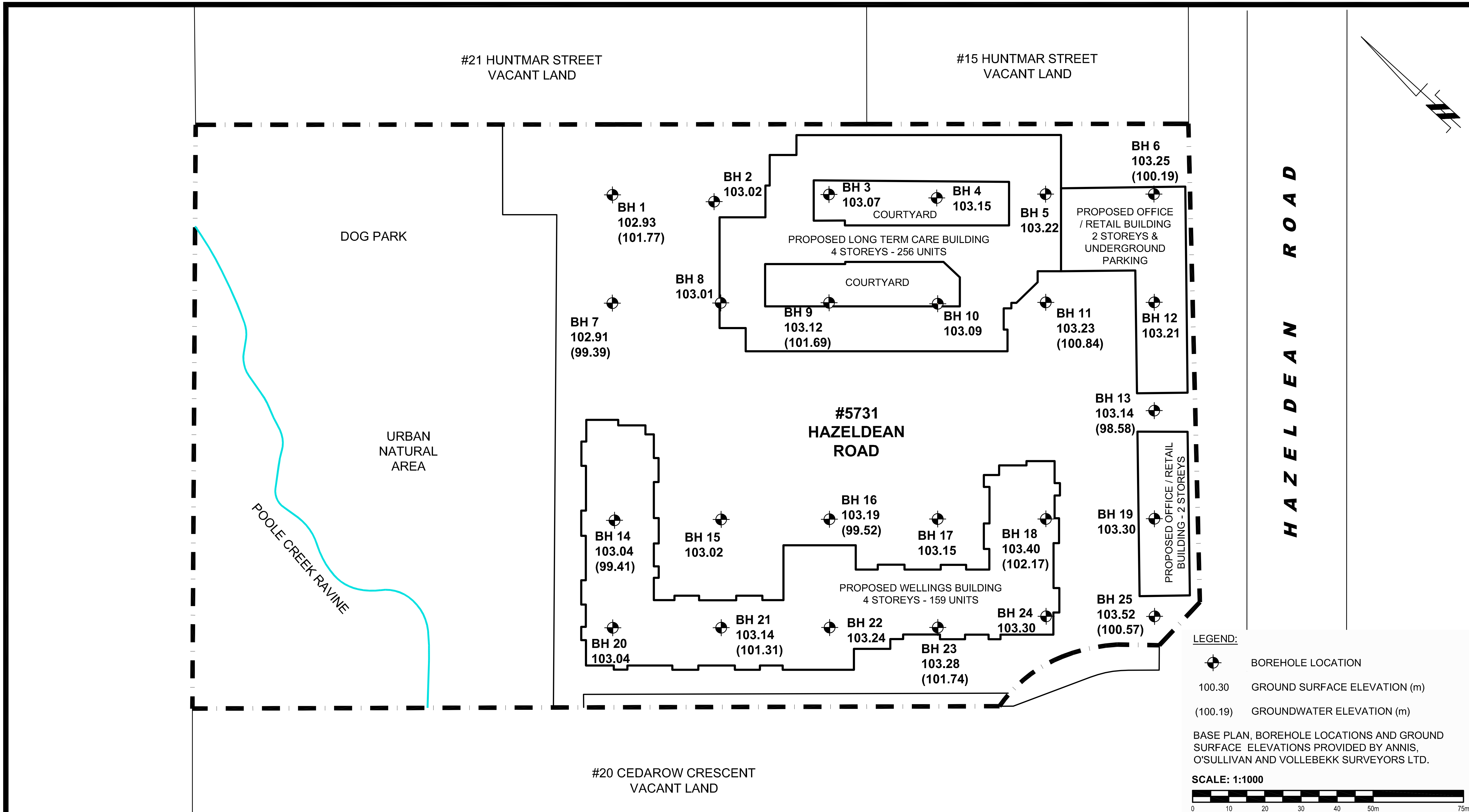
APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG3710-1 - TEST HOLE LOCATION PLAN

FIGURE 1

KEY PLAN



patersongroup
consulting engineers

154 Colonnade Road South
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NO.	REVISIONS	DATE	INITIAL

NAUTICAL LANDS GROUP
GEOTECHNICAL INVESTIGATION
PROPOSED RETIREMENT & COMMERCIAL DEVELOPMENT - 5731 HAZELDEAN ROAD
OTTAWA, ONTARIO

Title:
TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 1/2016
Drawn by: CPB	Report No.: PG3710-1
Checked by: CPB	Dwg. No.: PG3710-1
Approved by: DG	Revision No.: 0

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patersongroup **memorandum**

consulting engineers

to:	Nautical Lands Group - **Mr. Jim Gowland** - JGowland@NauticalLandsGroup.com
re:	Permeameter Test Program and Water Level Measurements **Proposed Mixed Use Development** **5731 Hazeldean Road - Ottawa**
date:	September 6, 2016
file:	PG3710-MEMO.01
from:	Michael Killam

Further to your request, Paterson Group (Paterson) conducted a permeameter test investigation for the proposed mixed use development to be located at 5731 Hazeldean Road, Ottawa. The purpose of the investigation was to provide hydraulic conductivity values to be encountered within the subsoils of the proposed infiltration system at the aforementioned site. The memo should be read in conjunction with Paterson report PG3710-REP.01.

Proposed Project

It is our understanding that the proposed development will consist of four mixed use, multi-storey buildings with one level of underground parking. At-grade parking areas, access lanes and landscaped areas are also anticipated as part of the development.

Field Investigation

Field Program

The field program conducted by Paterson for the investigation was completed on March 1, 2016. At that time, four (4) test pits were excavated to 2 m below existing grade followed by permeameter testing over a depth of 0.3 m below the base of the excavation at each test hole location. The test hole locations were selected by Stantec and distributed in a manner to provide general coverage of the proposed infiltration system to be located along the east property boundary. The test hole locations are presented on Drawing PG3710-1 - Test Hole Location Plan attached to this report.

In-Situ Testing

Permeameter testing was conducted using a Pask (Constant Head Well) Permeameter. An 83 mm hole was excavated using a Riverside/Bucket auger to a depth of 0.3 m below the base of the 2 m excavation at each location. All soil from the auger flights were visually inspected and initially classified on site. The permeameter reservoir was filled with water and inverted into the hole, ensuring it was relatively vertical and rests on the bottom of the hole. The water level of the reservoir was monitored at 1 minute intervals until the rate of fall out of the permeameter reached equilibrium, known as *quasi "steady state"* flow rate. Quasi steady state flow can be considered to have been obtained after measuring 3 to 5 consecutive rate of fall readings with identical values. The values for the steady state rate of fall were recorded for each location.

Field Observations

Surface Conditions

Generally, the ground surface across the subject site is grass and tree covered, relatively flat and approximately at grade with the adjacent roadways and properties. Poole Creek ravine runs within the west portion of the subject site.

Subsurface Profile

Generally, the subsurface profile at the test pits located along the east property boundary consists of a topsoil layer followed by compact clayey silt layer, which is underlain by a stiff to very stiff brown silty clay. Permeameter testing for TP1, TP2, and TP 4 were carried out in stiff to very stiff brown silty clay, while TP 3 was conducted in the clayey silt layer.

Groundwater

Groundwater infiltration was not present in the test pits at the time of excavation. On September 1, 2016, groundwater levels were re-measured in piezometers installed at select borehole locations. Groundwater levels are subject to seasonal fluctuations and, therefore, the groundwater levels could vary at the time of development.

Table 1 - Groundwater Level Readings

Borehole Number	Ground Elevation (m)	Groundwater Levels		Recording Date
		Depth (m)	Elevation (m)	
BH 1	102.93	3.93	99.00	September 1, 2016
BH 3	103.07	Dry to 1.31	Dry to 101.76	September 1, 2016
BH 4	103.15	1.46	101.69	September 1, 2016
BH 6	103.25	2.58	100.67	September 1, 2016
BH 7	102.91	2.89	100.02	September 1, 2016
BH 9	103.12	3.59	99.53	September 1, 2016
BH 11	103.23	3.17	100.06	September 1, 2016
BH 13	103.14	2.53	100.61	September 1, 2016
BH 14	104.04	-	Not Found	September 1, 2016
BH16	103.19	-	Not Found	September 1, 2016
BH 18	103.40	2.65	100.75	September 1, 2016
BH21	103.14	-	Not Found	September 1, 2016

BH 23	103.28	2.80	100.48	September 1, 2016
BH 25	103.52	1.90	101.62	September 1, 2016

Results

A total of 4 constant head Pask permeameter tests were conducted along the east property boundary to verify the existing hydraulic conductivities of the soils below the proposed infiltration system at the subject site. The permeameter test locations were selected by Stantec in a manner to provide general coverage of the proposed infiltration system. Preparation and testing of this investigation are in accordance with the Canadian Standards Association (CSA) B65-12 - Annex E. The hydraulic conductivity (K_{fs}) values for each test hole location is presented in Table 2.

Hydraulic conductivity values were determined using Engineering Technologies Canada (ETC) Ltd. reference tables provided in the most recent ETC Pask Permeameter User Guide dated March 2016.

Table 2 - Hydraulic Conductivity Values			
Test hole Number	**18T UTM**		**K_{fs} (m/sec)**
	Easting (m)	**Northing (m)**	
TP 1	428366	5014794	1.60E-07
TP 2	428332	5014832	2.20E-08
TP 3	428290	5014878	6.30E-07
TP 4	428263	5014890	1.60E-07

The values measured within the test hole are consistent with similar material Paterson has encountered on other sites and typical values for clayey silt and silty clay. These values typically range from 1 x 10^{-6} to 1 x 10^{-9} m/sec due to the variability of the material encountered.

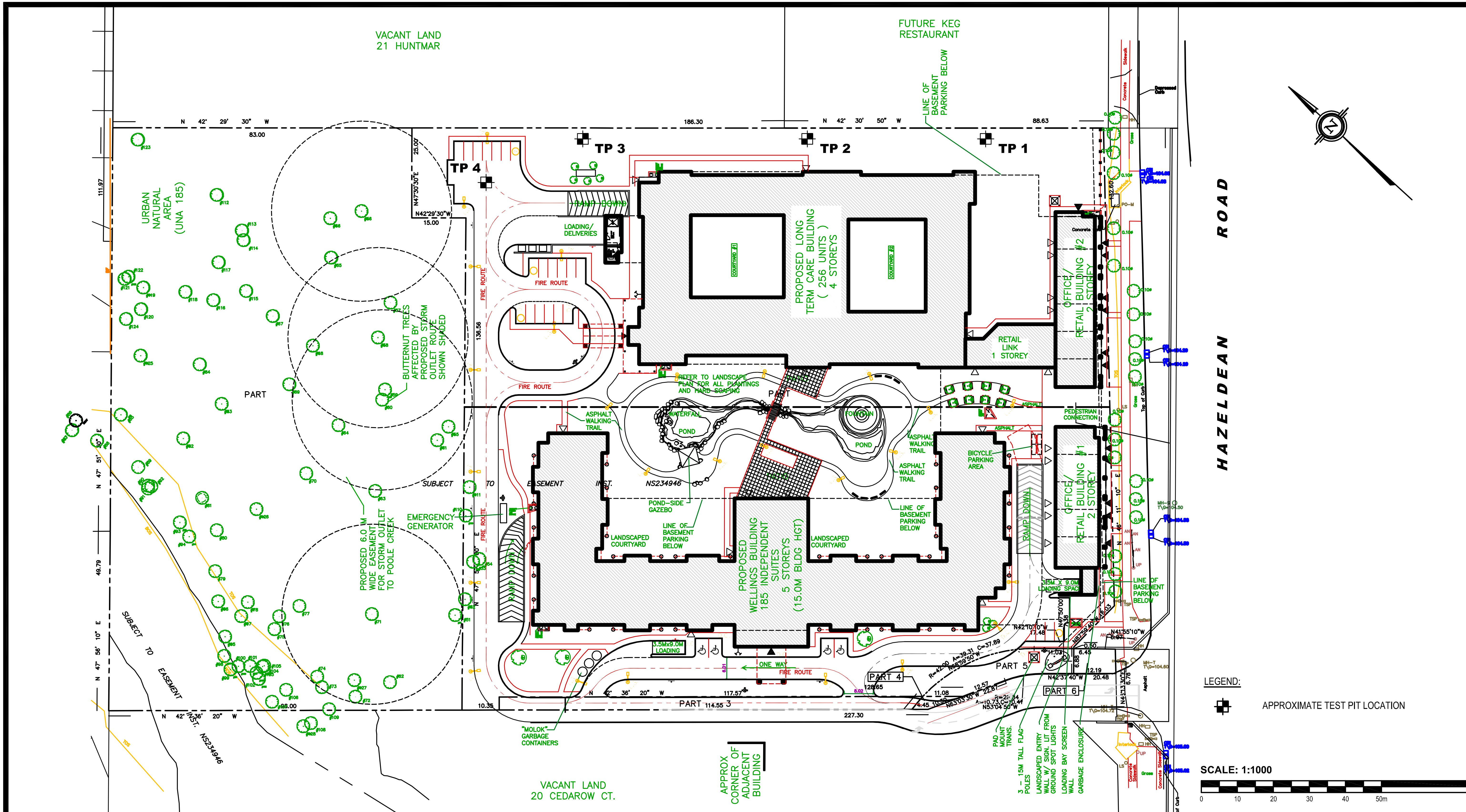
We trust that this information satisfies your requirements.

Paterson Group Inc.

Michael Killam, P.Eng.

LICENSED PROFESSIONAL ENGINEER
Sept.6/16
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.



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NO.	REVISIONS	DATE	INITIAL

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NAUTICAL LANDS GROUP
PERMEAMETER TEST INVESTIGATION
5731 HAZELDEAN ROAD
OTTAWA, ONTARIO

Title:
PERMEAMETER LOCATION PLAN

Scale: 1:1000	Date: 09/2016
Drawn by: MPG	Report No.: PG3710-MEMO.01
Checked by: NZ	Dwg. No.: PG3710-2
Approved by: MK	Revision No.: 0

memorandum

to:	Nautical Lands Group - **Mr. Jim Gowland** - jgowland@nauticallandsgroup.com
cc:	Nautical Lands Group - **Mr. Mark Williams** - mwilliams@nauticallandsgroup.com
re:	Slope Stability Review for Storm Outlet Structure - Poole Creek **Proposed Mixed Use Development - 5731 Hazeldean Road - Ottawa**
date:	January 24, 2017
file:	PG3710-MEMO.03

Further to your request and authorization, Paterson Group (Paterson) prepared the current report to summarize our slope stability review findings for the stormwater outlet structure along Poole Creek. The memorandum report also provides design and construction recommendations from a geotechnical perspective.

1.0 Background Information

Paterson reviewed the following drawings prepared by Novatech Engineering Limited for our study:

- ❑ Grading Plan - Project Number 105093-09, Drawing No. 105093-GR, Revision 7 dated September 12, 2011.
- ❑ General Plan of Services - Project Number 105093-09, Drawing No. 105093-GP, Revision 7 dated September 12, 2011.

Based on the aforementioned drawings, it is our understanding that the stormwater outlet structure is to be located near the northeast corner of 20 Cedarow Court and extends through the south valley corridor wall of Poole Creek. It is further understood that the stormwater outlet structure will consist of a 675 mm diameter outlet pipe connected to an approximately 2 m high concrete headwall with an associated rip-rap channel to direct stormwater to Poole Creek located at the bottom of the valley corridor. It is expected that the storm outlet pipe will be installed using conventional “cut and cover” methods using a trench box.

On January 19, 2017, Paterson Group (Paterson) completed a site visit to review the existing site conditions at the location of the proposed stormwater outlet structure. The south valley wall, where the stormwater outlet structure will be constructed, consists of an approximately 3 m high slope, which is grass covered with some brush and mature tree cover. The subject slope was noted to be shaped to an approximate 2.5H:1V profile and no signs of surficial erosion were observed along the subject slope.

Based on available information, the subsoils profile along the subject slope is anticipated to consist of a stiff silty clay underlain by a glacial till deposit followed by bedrock.

2.0 Slope Stability Review

From a geotechnical perspective, the existing slope at the location of the proposed stormwater outlet channel is considered stable. Based on our review, the slope has an overall global slope stability factor of safety of greater than 1.5 under static conditions and a factor of safety of greater than 1.1 under seismic conditions.

To maintain the overall long-term stability of the existing slope at the proposed stormwater outlet structure, the following design and construction recommendations should be adhered to:

- The outlet structure headwall should be designed by a structural engineer specializing in these works. The design should include a free draining backfill with a drainage pipe along the toe of the wall with a positive outlet to permit drainage for any surface water that could become trapped behind the headwall structure.

- The site excavated material may be placed above the pipe cover material if the excavation operations are completed in dry weather conditions and the site excavated material is approved by the geotechnical consultant. If present, all cobbles greater than 200 mm in the longest dimension should be removed prior to the site materials being reused.

- The service trench backfill along the subject slope should consist of a relatively dry, workable brown silty clay approved by the geotechnical consultant at the time of construction. The material should be placed in maximum 225 mm thick loose lifts compacted to a minimum 95% SPMDD using a sheepsfoot roller and shaped to a 2.5H:1V profile to match the existing slope face. The reinstated area should be capped with a minimum 150 mm thick layer of topsoil mixed with a hardy grass seed covered with an erosion control blanket to minimize surficial erosion.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Jan. 24-2017
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Richard Groniger, C. Tech.

David J. Gilbert, P.Eng.

patersongroup
consulting engineers

memorandum

to:	Nautical Lands Group - **Mr. Jim Gowland** - jgowland@nauticallandsgroup.com
cc:	Nautical Lands Group - **Mr. Mark Williams** - mwilliams@nauticallandsgroup.com
re:	Grading Plan Review **Proposed Mixed Use Development - 5731 Hazeldean Road - Ottawa**
date:	January 19, 2017
file:	PG3710-MEMO.02
from:	Richard Groniger

Further to your request and authorization, Paterson Group (Paterson) prepared the current report to summarize our grading plan review findings for the aforementioned site. The following memorandum should be read in conjunction with Paterson Report PG3710-1 Revision 1 dated May 10, 2016.

Grading Plan Review

Paterson reviewed the following grading plan prepared by Stantec for the aforementioned site:

❑ Grading Plan - Project Number 160401195, Drawing No. GP-1, Sheet No. 4 of 7, Revision 3 dated December 16, 2016.

Based on our review of the aforementioned grading plan, the proposed grade raises are in compliance with our permissible grade raise recommendations. Therefore, no lightweight fill (LWF) will be required based on the current grading design.

We trust that this information satisfies your immediate requirements.

Best Regards,

Paterson Group Inc.

Richard Groniger, C. Tech.

LICENSED PROFESSIONAL ENGINEER
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David J. Gilbert, P.Eng.

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Kingston - Ontario - K7L 1H3
Tel: (613) 542-7381

patersongroup **memorandum**

consulting engineers

to:	Nautical Lands Group - **Mr. Jim Gowland** - jgowland@nauticallandsgroup.com
re:	Groundwater Assessment - Low Impact Development (LID) Design **Proposed Mixed Use Development** **5731 Hazeldean Road - Ottawa**
date:	January 25, 2017
file:	PG3710-MEMO.04
from:	Richard Groniger

Further to your request and authorization, Paterson Group (Paterson) prepared the following memo to provide our current groundwater information for the aforementioned site. The current memo should be read in conjunction with Report PG3710-1 Revision 1 dated May 10, 2016.

1.0 Background Information

The field portion of our geotechnical investigation was completed on January 13, 2016 to January 18, 2016. At that time, a total of twenty-five (25) boreholes were extended across the site to provide general coverage of the proposed development. A total of 112 representative soils samples were recovered from the site and visually examined in our laboratory for review.

Based on the subsoil information recovered from the test holes, the majority of the site (specifically within the north and west portion of the site) consists of a silty clay deposit, which extends to greater than 5 m below the existing ground surface. The remainder of the site (southwest portion of the site) consists of a relatively thin layer of weathered, brown silty clay crust overlying a sandy silt and/or glacial till which in turn is overlying relatively shallow bedrock.

Based on the ground surface elevations at the test hole locations, the site and regional topography slopes gradually down in a north to northeast direction toward Poole Creek which borders the north property boundary.

2.0 Groundwater Levels

Long Term Groundwater Level

As part of the field investigation and laboratory review, the long term groundwater level was determined based on the observed colouring, consistency and moisture levels of the recovered soil samples. Using these soils sample observations to accurately describe the long term groundwater conditions at the subject site, the site should be segregated into two parcels for discussion purposes. The first larger parcel (Parcel A), where a relatively deep silty clay deposit was encountered, encompasses the north and east portion of the site (BH 1 to BH 15, BH 20 and BH 21). The second parcel (Parcel B), where a thin silty clay layer followed by a more permeable sandy silt and/or glacial till followed by a relatively shallow bedrock is present, is located within the southwest portion (BH 16 to BH 19 and BH 22 to BH 25). The long-term groundwater levels noted at the borehole locations are presented in Tables 1 and 2 on the following pages.

Seasonally High Groundwater Level

Seasonally high groundwater levels generally occur in March and April during spring conditions, specifically during heavy rain events in conjunction with increased temperatures and spring thaw. Based on our experience in the Ottawa area and in the immediate area of the subject site, we have provided the following general estimate for the seasonally high groundwater level. Generally, for deep silty clay deposits within the Ottawa area and similarly to Parcel A of the subject site, the seasonally high groundwater level is estimated to be **0.5 m** above the long term groundwater level. For Parcel B where the overburden generally consists of a sandy silt to glacial will with relatively shallow bedrock, the seasonally high groundwater level is estimated to be **1.0 m** above the long term groundwater level. The seasonally high groundwater level at the borehole locations based on these observations is presented in Tables 1 and 2.

Table 1 - Parcel A - Long Term and Seasonally High Groundwater Level					
Borehole Number	Ground Elevation (m)	Long-Term Groundwater Levels		Seasonally High Groundwater Level	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
BH 1	102.93	3.70	99.23	3.20	99.73
BH 2	103.02	3.70	99.32	3.20	99.82
BH 3	103.07	3.70	99.37	3.20	99.87
BH 4	103.15	3.70	99.45	3.20	99.95
BH 5	103.22	3.70	99.52	3.20	100.02
BH 6	103.25	3.70	99.55	3.20	100.05
BH 7	102.91	4.50	98.41	4.00	98.91
BH 8	103.01	3.70	99.31	3.20	99.81
BH 9	103.12	3.70	99.42	3.20	99.92
BH10	103.09	3.70	99.39	3.20	99.89
BH 11	103.23	3.70	99.53	3.20	100.03
BH 12	103.21	3.70	99.51	3.20	100.01
BH 13	103.14	3.70	99.44	3.20	99.94
BH 14	103.04	3.70	99.34	3.20	99.84
BH 15	103.02	3.70	99.32	3.20	99.82
BH 20	103.40	4.60	98.80	4.10	99.30
BH 21	103.14	3.80	99.34	3.30	99.84
Note: The borehole locations were selected in the field by Paterson and surveyed by Annis, O'Sullivan, Vollebekk Ltd. and are reference to geodetic datum.					

Table 2 - Parcel B - Long Term and Seasonally High Groundwater Level					
Borehole Number	Ground Elevation (m)	Long-Term Groundwater Levels		Seasonally High Groundwater Level	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
BH 16	103.19	3.70	99.49	2.70	100.49
BH 17	103.15	2.30	100.85	1.30	101.85
BH 18	103.40	2.40	101.00	1.40	102.00
BH 19	103.30	2.40	100.90	1.40	101.90
BH 22	103.24	3.00	100.24	2.00	101.24
BH 23	103.28	3.00	100.28	2.00	101.28
BH 24	103.30	2.70	100.60	1.70	101.60
BH 25	103.52	3.80	99.72	2.80	100.72
Note: The borehole locations were selected in the field by Paterson and surveyed by Annis, O'Sullivan, Vollebekk Ltd. and are reference to geodetic datum.					

Groundwater Flow Direction

Based on the current groundwater levels information from the existing boreholes, the general groundwater flow direction is in a north direction toward Poole Creek.

Post-Development Groundwater Lowering

For design purposes, a post-development long term groundwater lowering of **0.5 m** and **1.0 m** can be assumed for Parcel A and Parcel B, respectively.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Jan.25-2017
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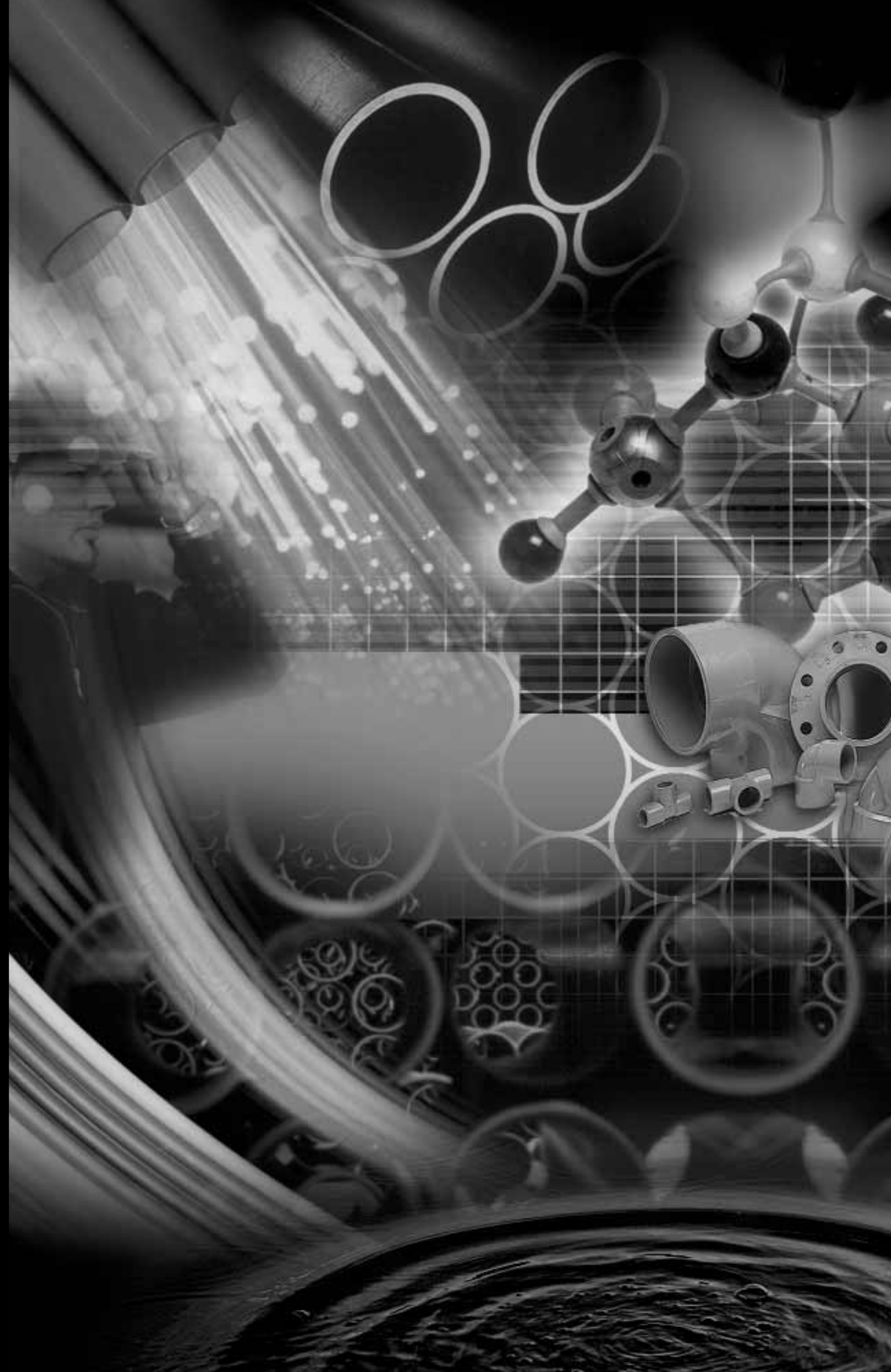
PROVINCE OF ONTARIO

Richard Groniger, C. Tech.

David J. Gilbert, P.Eng.

Appendix G PRODUCT SPECIFICATIONS

Volume III: TEMPEST™ INLET CONTROL DEVICES



Municipal Technical Manual Series

FIRST EDITION

LMF (Low to Medium Flow) ICD

HF (High Flow) ICD

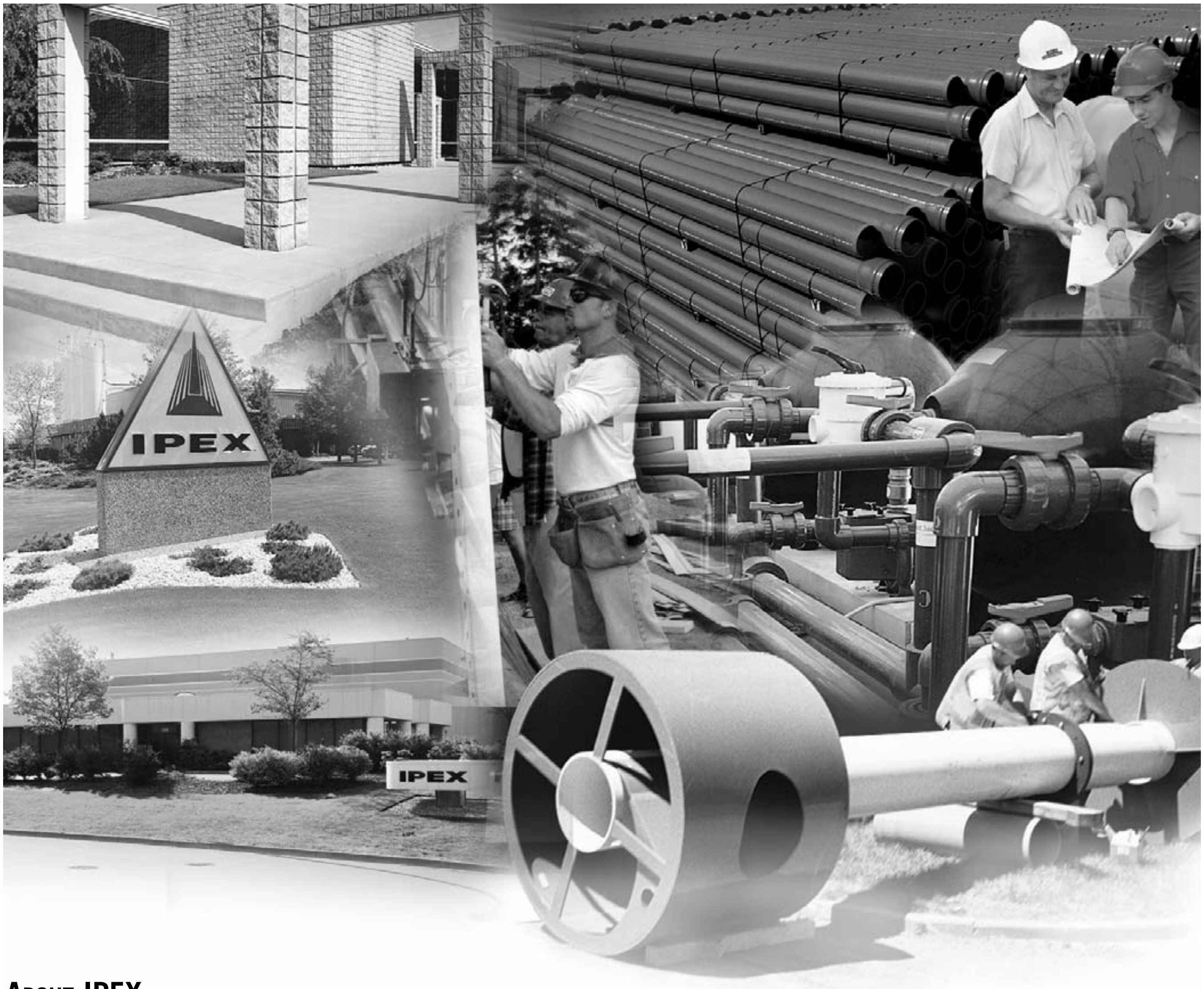
MHF (Medium to High Flow) ICD

IPEX

IPEX Tempest™
Inlet Control Devices

Municipal Technical Manual Series

Vol. I, 1st Edition



About IPEX

At IPEX, we have been manufacturing non-metallic pipe and fittings since 1951. We formulate our own compounds and maintain strict quality control during production. Our products are made available for customers thanks to a network of regional stocking locations throughout North America. We offer a wide variety of systems including complete lines of piping, fittings, valves and custom-fabricated items.

More importantly, we are committed to meeting our customers' needs. As a leader in the plastic piping industry, IPEX continually develops new products, modernizes manufacturing facilities and acquires innovative process technology. In addition, our staff take pride in their work, making available to customers their extensive thermoplastic knowledge and field experience. IPEX personnel are committed to improving the safety, reliability and performance of thermoplastic materials. We are involved in several standards committees and are members of and/or comply with the organizations listed on this page.

For specific details about any IPEX product, contact our customer service department.

CONTENTS

TEMPEST INLET CONTROL DEVICES Technical Manual

PRODUCT INFORMATION: TEMPEST LOW, MEDIUM FLOW (LMF) ICD

Purpose

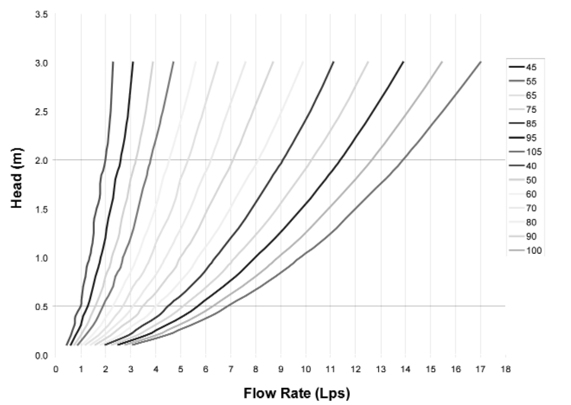
To control the amount of storm water runoff entering a sewer system by allowing a specified flow volume out of a catch basin or manhole at a specified head. This approach conserves pipe capacity so that catch basins downstream do not become uncontrollably surcharged, which can lead to basement floods, flash floods and combined sewer overflows.

Product Description

Our LMF ICD is designed to accommodate catch basins or manholes with sewer outlet pipes 6" in diameter and larger. Any storm sewer larger than 12" may require custom modification. However, IPEX can custom build a TEMPEST device to accommodate virtually any storm sewer size.

Available in 14 preset flow curves, the LMF ICD has the ability to provide flow rates: 2lps – 17lps (31gpm – 270gpm)

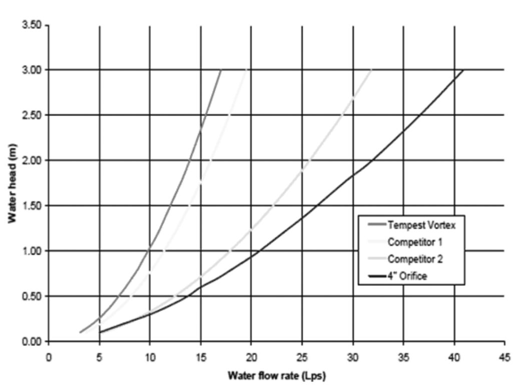
LMF 14 Preset Flow Curves



Product Function

The LMF ICD vortex flow action allows the LMF ICD to provide a narrower flow curve using a larger orifice than a conventional orifice plate ICD, making it less likely to clog. When comparing flows at the same head level, the LMF ICD has the ability to restrict more flow than a conventional ICD during a rain event, preserving greater sewer capacity.

LMF Flow vs. ICD Alternatives



Product Construction

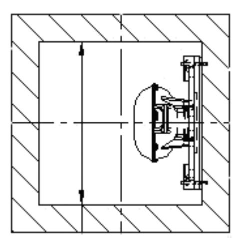
Constructed from durable PVC, the LMF ICD is light weight 8.95 Kg (19.7 lbs).

Product Applications

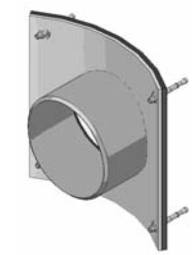
Will accommodate both square and round applications:

Square Application

Universal
Mounting Plate



Round Application

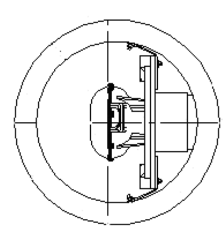


Spigot CB
Wall Plate

+

Universal
Mounting
Plate Hub
Adapter

=



NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

PRODUCT INSTALLATION

Instructions to assemble a TEMPEST LMF ICD into a Square Catch Basin:

STEPS:

1. Materials and tooling verification:
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level, and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers, (4) nuts, universal mounting plate, ICD device.
2. Use the mounting wall plate to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a minimum of 1-1/2" depth up to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you will hit the anchors with the hammer. Remove the nuts the ends of the anchors
5. Install the universal mounting plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the wall mounting plate and the catch basin wall.
6. From the ground above using a reach bar, lower the ICD device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the universal mounting plate and has created a seal.

WARNING

- Verify that the outlet pipe doesn’t protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- Call your IPEX representative for more information or if you have any questions about our products.

Instructions to assemble a TEMPEST LMF ICD into a Round Catch Basin:

STEPS:

1. Materials and tooling verification.
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers and (4) nuts, spigot CB wall plate, universal mounting plate hub adapter, ICD device.
2. Use the spigot catch basin wall plate to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to sure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a depth between 1-1/2" to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you will hit the anchors with the hammer. Remove the nuts from the ends of the anchors
5. Install the CB spigot wall plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between CB the spigot wall plate and the catch basin wall.
6. Apply solvent cement on the hub of universal mounting plate, hub adapter and the spigot of spigot CB wall plate slide the hub over the spigot. Make sure the universal mounting plate is at the horizontal and its hub is completely inserted onto the spigot. Normally, the corners of the universal mounting plate hub adapter should touch the catch basin wall.
7. From ground above using a reach bar, lower the ICD device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the mounting plate and has created a seal.

WARNING

- Verify that the outlet pipe doesn’t protrude into the catch basin. If it does, cut back the pipe flush to the catch basin wall.
- The solvent cement which is used in this installation is to be approved for PVC.
- The solvent cement should not be used below 0°C (32°F) or in a high humidity environment. Refer to the IPEX solvent cement guide to confirm the required curing time or visit the IPEX Online Solvent Cement Training Course available at www.ipexinc.com.
- Call your IPEX representative for more information or if you have any questions about our products.

PRODUCT TECHNICAL SPECIFICATION

General

Inlet control devices (ICD's) are designed to provide flow control at a specified rate for a given water head level and also provide odour and floatable control. All ICD's will be IPEX Tempest or approved equal.

All devices shall be removable from a universal mounting plate. An operator from street level using only a T-bar with a hook will be able to retrieve the device while leaving the universal mounting plate secured to the catch basin wall face. The removal of the TEMPEST devices listed above must not require any unbolting or special manipulation or any special tools.

High Flow (HF) Sump devices will consist of a removable threaded cap which can be accessible from street level with out entry into the catchbasin (CB). The removal of the threaded cap shall not require any special tools other than the operator's hand.

ICD's must have no moving parts.

Materials

ICD's are to be manufactured from Polyvinyl Chloride (PVC) or Polyurethane material, designed to be durable enough to withstand multiple freeze-thaw cycles and exposure to harsh elements.

The inner ring seal will be manufactured using a Buna or Nitrile material with hardness between Duro 50 and Duro 70.

The wall seal is to be comprised of a 3/8" thick Neoprene Closed Cell Sponge gasket which is attached to the back of the wall plate.

All hardware will be made from 304 stainless steel.

Dimensioning

The Low Medium Flow (LMF), High Flow (HF) and the High Flow (HF) Sump shall allow for a minimum outlet pipe diameter of 200mm with a 600mm deep Catch Basin sump.

Installation

Contractor shall be responsible for securing, supporting and connecting the ICD's to the existing influent pipe and catchbasin/manhole structure as specified and designed by the Engineer.

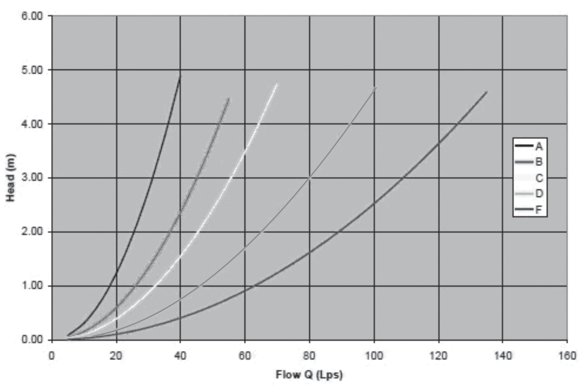
PRODUCT INFORMATION: TEMPEST HF & MHF ICD

Product Description

Our HF, HF Sump and MHF ICD is designed to accommodate catch basins or manholes with sewer outlet pipes 6" in diameter or larger. Any storm sewer larger than 12" may require custom modification. However, IPEX can custom build a TEMPEST device virtually to accommodate any storm sewer size.

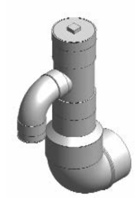
Available in 5 preset flow curves, these ICDs have the ability to provide constant flow rates: 9lps (143 gpm) and greater

HF & MHF Preset Flow Curves

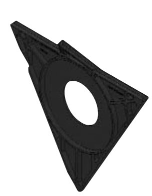


Product Function

TEMPEST HF (High Flow): designed to manage moderate to higher flows between 15 L/s (240 gpm) or greater and prevents the propagation of odour and floatables. With this device, the cross-sectional area of the device is larger than the orifice diameter and has been designed to limit head losses. The HF ICD can also be ordered without flow control when only odour and floatable control is required.



TEMPEST HF (High Flow) Sump: The height of a sewer outlet pipe in a catch basin is not always conveniently located. At times it may be located very close to the catch basin floor, not providing enough sump for one of the other TEMPEST ICDs with universal back plate to be installed. In these applications, a HF Sump is offered. The HF Sump offers the same features and benefits as the HF ICD; however, is designed to raise the outlet in a square or round catch basin structure. When installed, the HF sump is fixed in place and not easily removed. Any required service to the device is performed through a clean-out located in the top of the device which can be often accessed from ground level.



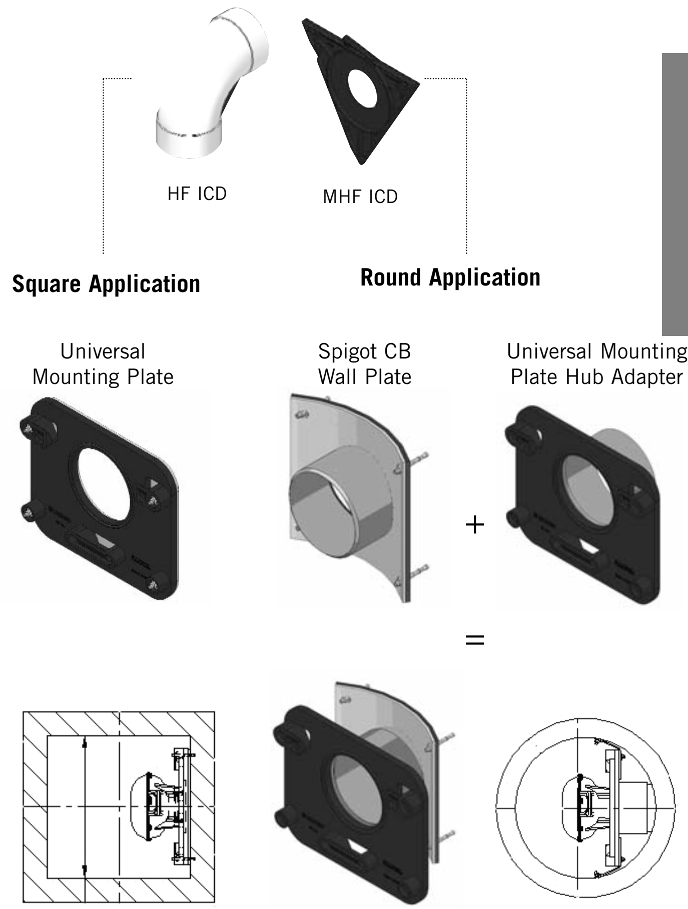
TEMPEST MHF (Medium to High Flow): The MHF plate or plug is designed to control flow rates 9 L/s (143 gpm) or greater. It is not designed to prevent the propagation of odour and floatables.

Product Construction

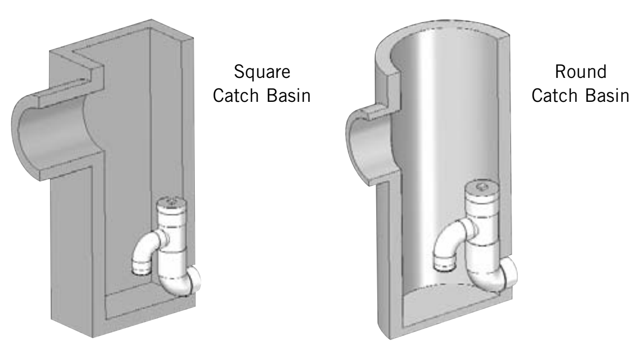
The HF, HF Sump and MHF ICDs are built to be light weight at a maximum weight of 6.82 Kg (14.6 lbs).

Product Applications

The HF and MHF ICD are available to accommodate both square and round applications:



The HF Sump is available to accommodate low to no sump applications in both square and round catch basins:



TEMPEST
HF & MHF ICD

NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

PRODUCT INSTALLATION

Instructions to assemble a TEMPEST HF or MHF ICD into a Square Catch Basin:

1. Materials and tooling verification:
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level, and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers, (4) nuts, universal mounting plate, ICD device
2. Use the mounting wall plate to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a minimum of 1-1/2" depth up to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you will hit the anchors with the hammer. Remove the nuts the ends of the anchors
5. Install the universal from wall mounting plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the wall mounting plate and the catch basin wall.
6. From the ground above using a reach bar, lower the device by hooking the end of the reach bar to the handle of the LMF device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the universal wall mounting plate and has created a seal.

WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- Call your IPEX representative for more information or if you have any questions about our products.

Instructions to assemble a TEMPEST HF or MHF ICD into a Round Catch Basin:

STEPS:

1. Materials and tooling verification.
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers and (4) nuts, spigot CB wall plate, universal mounting plate hub adapter, ICD device.
2. Use the round catch basin spigot adaptor to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to sure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a depth between 1-1/2" to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you will hit the anchors with the hammer. Remove the nuts from the ends of the anchors
5. Install the spigot CB wall plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the spigot CB wall plate and the catch basin wall.
6. Put solvent cement on the hub of the universal mounting plate, hub adapter and the spigot of spigot CB wall plate and slide the hub over the spigot. Make sure the universal mounting plate is at the horizontal and its hub is completely inserted onto the spigot. Normally, the corners of the hub adapter should touch the catch basin wall.
7. From ground above using a reach bar, lower the ICD device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the wall mounting plate and has created a seal.

WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- The solvent cement which is used in this installation is to be approved for PVC.
- The solvent cement should not be used below 0°C (32°F) or in a high humidity environment. Refer to the IPEX solvent cement guide to confirm the required curing time or visit the IPEX Online Solvent Cement Training Course available at www.ipexinc.com.
- Call your IPEX representative for more information or if you have any questions about our products.

PRODUCT TECHNICAL SPECIFICATION

Instructions to assemble a TEMPEST HF Sump into a Square or Round Catch Basin:

STEPS:

1. Materials and tooling verification:
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level, mastic tape and metal strapping
   - Material: (2) concrete anchor 3/8 x 3-1/2, (2) washers, (2) nuts, HF Sump pieces (2).
2. Apply solvent cement to the spigot end of the top half of the sump. Apply solvent cement to the hub of the bottom half of the sump. Insert the spigot of the top half of the sump into the hub of the bottom half of the sump.
3. Install the 8" spigot of the device into the outlet pipe. Use the mastic tape to seal the device spigot into the outlet pipe. You should use a level to be sure that the fitting is standing at the vertical.
4. Use an impact drill with a 3/8" concrete bit to make a series of 2 holes along each side of the body throat. The depth of the hole should be between 1-1/2" to 2-1/2". Clean the concrete dust from the 2 holes.
5. Install the anchors (2) in the holes by using a hammer. Put the nuts on the top of the anchors to protect the threads when you will hit the anchors. Remove the nuts on the anchors at the end.
6. Cut the metal strapping to length and connect each end of the strapping to the anchors. Screw the nuts in place with a maximum torque of 40 N.m (30 lbf-ft). The device should be completely flush with the catch basin wall.

⚠ WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- The solvent cement which is used in this installation is to be approved for PVC.
- The solvent cement should not be used below 0°C (32°F) or in a high humidity environment. Refer to the IPEX solvent cement guide to confirm the required curing time or visit the IPEX Online Solvent Cement Training Course available at www.ipexinc.com.
- Call your IPEX representative for more information or if you have any questions about our products.

General

Inlet control devices (ICD's) are designed to provide flow control at a specified rate for a given water head level and also provide odour and floatable control where specified. All ICD's will be IPEX Tempest or approved equal.

All devices shall be removable from a universal mounting plate. An operator from street level using only a T-bar with a hook will be able to retrieve the device while leaving the universal mounting plate secured to the catch basin wall face. The removal of the TEMPEST devices listed above must not require any unbolting or special manipulation or any special tools.

High Flow (HF) Sump devices will consist of a removable threaded cap which can be accessible from street level with out entry into the catchbasin (CB). The removal of the threaded cap shall not require any special tools other than the operator's hand.

ICD's must have no moving parts.

Materials

ICD's are to be manufactured from Polyvinyl Chloride (PVC) or Polyurethane material, designed to be durable enough to withstand multiple freeze-thaw cycles and exposure to harsh elements.

The inner ring seal will be manufactured using a Buna or Nitrile material with hardness between Duro 50 and Duro 70.

The wall seal is to be comprised of a 3/8" thick Neoprene Closed Cell Sponge gasket which is attached to the back of the wall plate.

All hardware will be made from 304 stainless steel.

Dimensioning

The Low Medium Flow (LMF), High Flow (HF) and the High Flow (HF) Sump shall allow for a minimum outlet pipe diameter of 200mm with a 600mm deep Catch Basin sump.

Installation

Contractor shall be responsible for securing, supporting and connecting the ICD's to the existing influent pipe and catchbasin/manhole structure as specified and designed by the Engineer.

SALES AND CUSTOMER SERVICE

Canadian Customers call IPEX Inc.

Toll free: (866) 473-9462

www.ipexinc.com

U.S. Customers call IPEX USA LLC

Toll free: (800) 463-9572

www.ipexamerica.com

About the IPEX Group of Companies

As leading suppliers of thermoplastic piping systems, the IPEX Group of Companies provides our customers with some of the largest and most comprehensive product lines. All IPEX products are backed by more than 50 years of experience. With state-of-the-art manufacturing facilities and distribution centers across North America, we have established a reputation for product innovation, quality, end-user focus and performance.

Markets served by IPEX group products are:

- Electrical systems
- Telecommunications and utility piping systems
- PVC, CPVC, PP, ABS, PEX, FR-PVDF and PE pipe and fittings (1/4" to 48")
- Industrial process piping systems
- Municipal pressure and gravity piping systems
- Plumbing and mechanical piping systems
- PE Electrofusion systems for gas and water
- Industrial, plumbing and electrical cements
- Irrigation systems

Products manufactured by IPEX Inc. and distributed in the United States by IPEX USA LLC.

Tempest™ is a trademark of IPEX Branding Inc.

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IPEX

ZURN CANADA

SPECIFICATION DRAINAGE

Control-Flo

Roof Drainage System

www.zurn.com

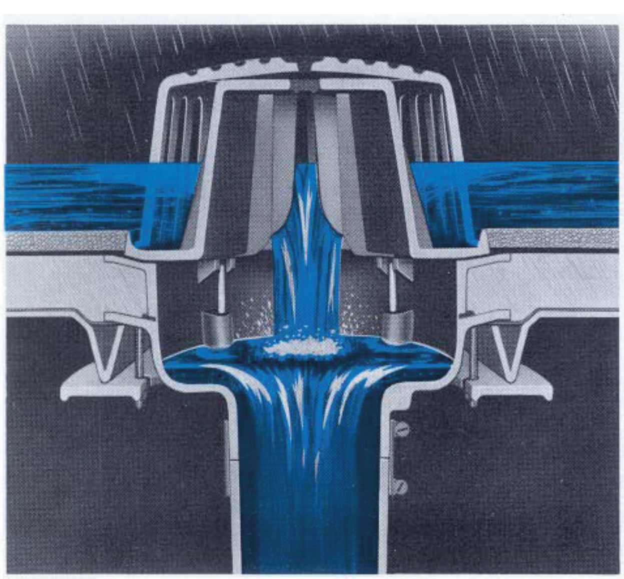
THE ZURN "CONTROL-FLO CONCEPT"
Originally, Zurn introduced the scientifically-advanced "Control-Flo" drainage principle for dead-level roofs. Today, after thousands of successful applications in modern, large dead-level roof areas, Zurn engineers have adapted the comprehensive "Control-Flo" data to **sloped roof** areas.

WHAT IS "CONTROL-FLO"?
It is an advanced method of removing rain water off dead-level or sloped roofs. As contrasted with conventional drainage practices, which attempt to drain off storm water as quickly as it falls on the roof's surface, "Control-Flo" drains the roof at a controlled rate. Excess water accumulates on the roof under controlled conditions...then drains off at a lower rate after a storm abates.

CUTS DRAINAGE COSTS
Fewer roof drains, smaller diameter piping, smaller sewer sizes, and lower installation costs are possible with a "Control-Flo" drainage system because roof areas are utilized as temporary storage reservoirs.

REDUCES PROBABILITY OF STORM DAMAGE
Lightens load on combination sewers by reducing rate of water drained from roof tops during severe storms thereby reducing probability of flooded sewers, and consequent backflow into basements and other low areas.

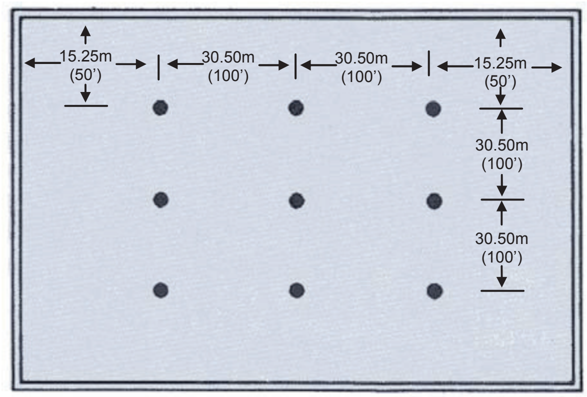
THANKS TO EXCLUSIVE ZURN "AQUA-WEIR" ACTION
Key to successful "Control-Flo" drainage is a unique scientifically-designed weir containing accurately calibrated notches with sides formed by parabolic curves which provide flow rates directly proportional to the head. Shape and size of notches are based on predetermined flow rates, and all factors involved in roof drainage to assure permanent regulation of drainage flow rates for specific geographic locations and rainfall intensities.



DEFINITION

DEAD LEVEL ROOFS
DIAGRAM "A"

A dead-level roof for purposes of applying the Zurn "Control-Flo" drainage principle is one which has been designed for zero slope across its entire surface. Measurements shown are for maximum distances.

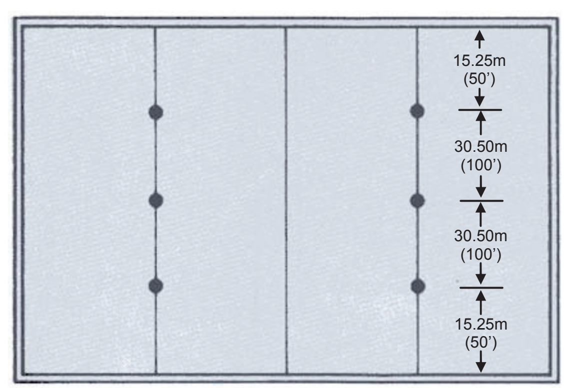


(Plan View)

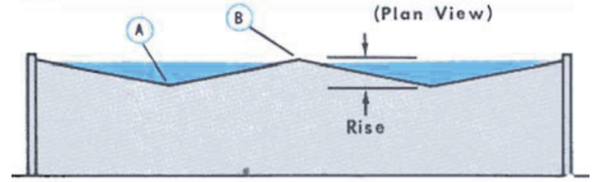
(Section View)

SLOPED ROOFS
DIAGRAM "B"

A sloped roof is one designed commonly with a shallow slope. The Zurn "Control-Flo" drainage system can be applied to any slope which results in a total rise up to 152mm (6").
The total rise of a roof as calculated for "Control-Flo" application is defined as the vertical increase in height in inches, from the low point or valley of a sloping roof (A) to the top of the sloping section (B). (Example: a roof that slopes 3mm (1/8") per foot having a 7.25m (24') span would have a rise of 7.25m x 3mm or 76mm (24' x 1/8" or 3")).
Measurements shown are for maximum distances.



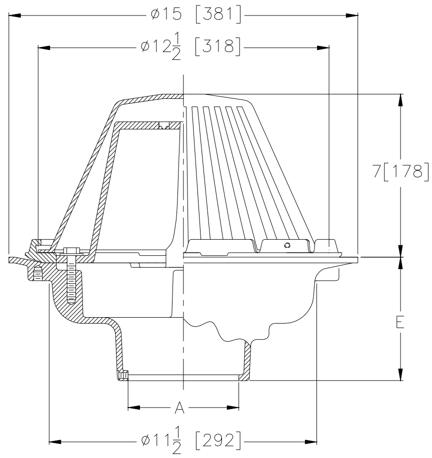
(Plan View)



(Section View)

Dimensions and other measurements given in metric and imperial forms.

SPECIFICATION DATA



ENGINEERING SPECIFICATION: ZURN Z-105 "Control-Flo" roof drain for dead -level or sloped roof construction, Dura-Coated cast iron body. "Control-Flo" weir shall be linear functioning with integral membrane flashing clamp/ gravel guard and Poly-Dome. All data shall be verified proportional to flow rates.

ROOF DESIGN RECOMMENDATIONS

Basic roofing design should incorporate protection that will prevent roof overloading by installing adequate over-flow scuppers in parapet walls.

GENERAL INFORMATION

The “Control-Flo” roof drainage data is tabulated for four areas (232.25m^2 (2500 sq. ft.), 464.502m^2 (5000 sq. ft.), 696.75m^2 (7500 sq. ft.), 929m^2 (10,000 sq. ft.) notch areas ratings) for each locality. For each notch area rating the maximum discharge in L.P.M. (G.P.M.) - draindown in hours, and maximum water depth at the drain in inches for a dead level roof — 51mm (2 inch) rise — 102mm (4 inch) rise and 152mm (6 inch) rise—are tabulated. The rise is the total change in elevation from the valley to the peak. Values for areas, rise or combination thereof other than those listed, can be arrived at by extrapolation. All data listed is based on the fifty-year return frequency storm. In other words the maximum conditions as listed will occur on the average of once every fifty years.

NOTE: The tabulated “Control-Flo” data enables the individual engineer to select his own design limiting condition. The limiting condition can be draindown time, roof load factor, or maximum water depth at the drain. If draindown time is the limiting factor because of possible freezing conditions, it must be recognized that the maximum time listed will occur on the average of once every 50 years and would most likely be during a heavy summer thunder storm. Average winter draindown times would be much shorter in duration than those listed.

GENERAL RECOMMENDATIONS

On sloping roofs, we recommend a design depth referred to as an equivalent depth. An equivalent depth is the depth of water attained at the drains that results in the same roof stresses as those realized on a dead-level roof. In all cases this equivalent depth is almost equal to that attained by using the same notch area rating for the different rises to 152mm (6”). With the same depth of water at the drain the roof stresses will decrease with increasing total rise. Therefore, it would be possible to have a depth in excess of 152mm (6”) at the drain on a sloping roof without exceeding stresses normally encountered in a 152mm (6”) depth on a dead-level roof. However, it is recommended that scuppers be placed to limit the maximum water depth on any roof to 152mm (6”) to prevent the overflow of the weirs on the drains and consequent overloading of drain piping. In the few cases where the data shows a flow rate in excess of 136 L.P.M. (30 G.P.M.) if all drains and drain lines are sized according to recommendations, and the one storm in fifty years occurs, the only consequence will be a brief flow through the scuppers or over-flow drains.

NOTE: An equivalent depth is that depth of water attained at the drains at the lowest line or valley of the roof with all other conditions such as notch area and rainfall intensity being equal. For Toronto, Ontario a notch area rating of 464.50m^2 (5,000 sq. ft.) results in a 74mm (2.9 inch) depth on a dead level roof for a 50-year storm. For the same notch area and conditions, equivalent depths for a 51mm (2”), 102mm (4”) and 152mm (6”) rise respectively on a sloped roof would be 86mm (3.4”), 104mm (4.1”) and 124mm (4.9”). Roof stresses will be approximately equal in all cases.

The exclusive Zurn "Selecta-Drain" Chart (pages 8—11) tabulates selection data for 34 localities in Canada. Proper use of this chart constitutes your best assurance of sure, safe, economical application of Zurn "Control-Flo" systems for your specific geographical area. If the "Selecta-Drain Chart does not cover your specific design criteria, contact Zurn Industries Limited, Mississauga, Ontario, for additional data for your locality. Listed below is additional information pertinent to proper engineering of the "Control-Flo" system.

ROOF USED AS TEMPORARY RETENTION

The key to economical "Control-Flo" is the utilization of large roof areas to temporarily store the maximum amount of water without overloading average roofs or creating excessive draindown time during periods of heavy rainfall. The data shown in the "Selecta-Drain" Chart enables the engineer to select notch area ratings from 232.25 m^2 (2,500 $ft.^2$) to 929m^2 (10,000 $ft.^2$) and to accurately predict all other design factors such as maximum roof load, L.P.M. (G.P.M.) discharge, draindown time and water depth at the drain. Obviously, as design factors permit the notch area rating to increase the resulting money saved in being able to use small leaders and drain lines will also increase.

ROOF LOADING AND RUN-OFF RATES

The four values listed in the "Selecta-Drain" Chart for notch area ratings for different localities will normally span the range of good design. If areas per notch below 232.25m^2 (2,500 $ft.^2$) are used considerable economy of the "Control-Flo" concept is being lost. The area per notch is limited to 929m^2 (10,000 $ft.^2$) to keep the draindown time within reasonable limits. Extensive studies show that stresses due to water load on a sloping roof for any fixed set of conditions are very nearly the same as those on a dead-level roof. A sloping roof tends to concentrate more water in the valleys and increase the water depth at this point. The greater depth around the drain leads to a faster run-off rate, particularly a faster early run -off rate. As a result, the total volume of water stored on the roof is less, and the total load on the sloping roof is less. By using the same area on the sloping roof as on the dead-level roof the increase in roof stresses due to increased water depth in the valleys is offset by the decrease in the total load due to less water stored. The net result of the maximum roof stress is approximately the same for any single span rise and fixed set of conditions. A fixed set of conditions, would be the same notch area, the same frequency store, and the same locality.

SPECIAL CONSIDERATIONS FOR STRUCTURAL SAFETY: Normal practice of roof design is based on 18kg (40 lbs.) per 929 cm^2 (sq ft.). (Subject to local codes and by-laws.) Thus it is extremely important that design is in accordance with normal load factors so deflection will be slight enough in any bay to prevent progressive deflection which could cause water depths to load the roof beyond its design limits.

ADDITIONAL NOTCH RATINGS

The 'Selecta-Drain" Chart along with Tables I and II enables the engineer to select "Control-Flo" Drains and drain pipe sizes for most Canadian applications. These calculations are computed for a proportional flow weir that is sized to give a flow of 23 L.P.M. (5 G.P.M.) per inch of head. The 23 L.P.M. (5 G.P.M.) per inch of head notch opening is selected as the bases of design as it offers the most economical installation as applied to actual rainfall experienced in Canada.
Should you require design criteria for locations outside of Canada or for special project applications please contact Zurn Industries Limited, Mississauga, Ontario.

LEADER AND DRAIN PIPE SIZING

Since all data in the "Selecta-Drain" Chart is based on the 50-year-storm it is possible to exceed the water depth listed in these charts if a 100-year or 1000-year storm would occur. Therefore, for good design it is recommended that scuppers or other methods be used to limit water depth to the design depth and tables I and II be used to size the leaders and drain pipes. If the roof is capable of supporting more water than the design depth it is permissible to locate the scuppers or other overflow means at a height that will allow a greater water depth on the roof. However, in this case the leader and drain pipes should be sized to handle the higher flow rates possible based on a flow rate of 23 L.P.M. (5 G.P.M.) per inch of depth at the drain.

PROPER DRAIN LOCATION

The following good design practice is recommended for selecting the proper number of "Control-Flo" drains for a given area. **On dead-level roofs**, drains should be located no further than 15.25m (50 feet) from edge of roof and no further than 30.50m (100 feet) between drains. See diagram "A" page 2. **On sloping roofs**, drains should be located in the valleys at a distance no greater than 15.25m (50 feet) from each end of the valleys and no further than 30.50m (100 feet) between drains. See diagram "B" page 2. Compliance with these recommendations will assure good run off regardless of wind direction.

Saves Specification Time, Assures Proper Application

QUICK, EASY SELECTION

Using the “Selecta-Drain” Chart (pages 9—13) in combination with the steps and examples appearing below, should save you countless hours in engineering specification time. This vast compilation of data is related to the proper selection of drains for 34 cities. All cities in alphabetical order by province. If a specific city does not appear in the tabulation, chooses the city nearest your area and select the proper drain using these factors.

3 EASY STEPS…

AND 3 TYPICAL EXAMPLES FOR APPLICATION OF SURE, SCIENTIFIC CONTROL OF DRAINAGE FROM DEAD-LEVEL AND SLOPING ROOFS WITH THE ZURN CONCEPT.

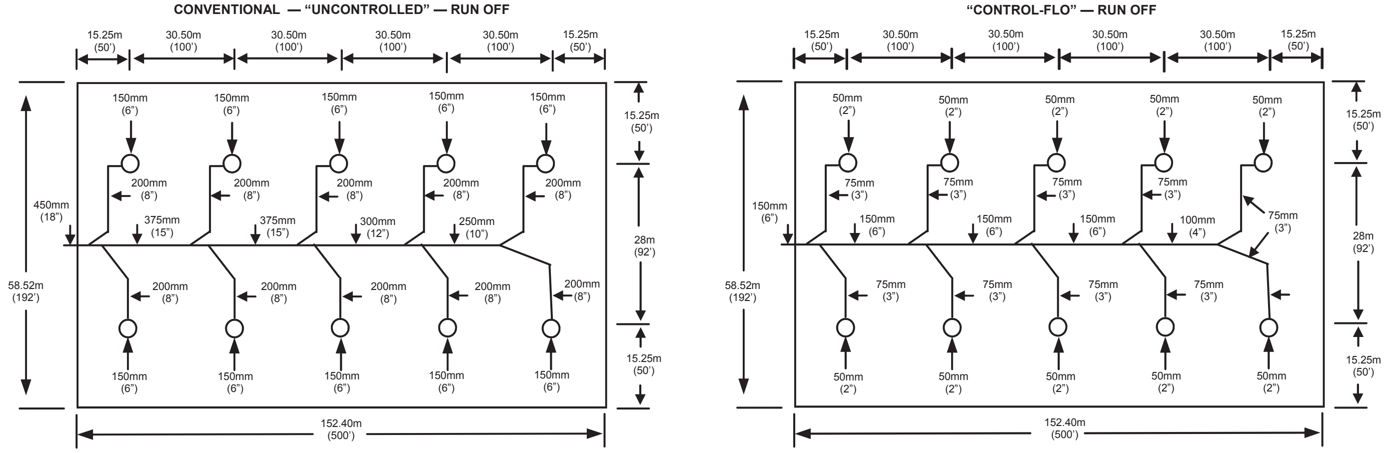
NOTE: Where roof area to be drained is adjacent to one or more vertical walls projecting above the roof, then a percentage of the of the wall(s) must be added to the roof area in determining total roof area to be drained.

	TORONTO, ONTARIO	DEAD-LEVEL ROOF	102mm (4 INCH) SLOPE	152mm (6 INCH) SLOPE
1	Determine total roof area or individual areas when roof is divided by expansion joints or peaks in the case of sloping roof.	Roof Area: 56.52m x 152.40m = 8918.40m^2 (192ft x 500ft = 96,000 sq. ft.) (See Z105 layout bottom of this page.)	3 Individual Roof Areas: 19.50m x 152.40m = 2972.80m^2 (64ft x 500ft = 32,000 sq. ft.) Valleys 152.40m (500ft) long 3 x 2972.80 = 8918.40m^2 (3 x 32,000 = 96,000 sq. ft.)	2 Individual Roof Areas: 29.87m x 152.40m = 4552m^2 (98ft x 500ft = 49,000 sq. ft.) Valleys 152.40m (500ft) long 2 x 4552 = 9104m^2 (2 x 49,000 = 98,000 sq. ft.)
2	Divide roof area or individual areas by Zurn Notch Area Rating selected to obtain the total number of notches required.	Zurn Notch Area Rating selected for Toronto = 464.50m^2 (5,000 sq. ft.) from “Selecta-Drain Chart, page 11. Total Roof Area = 8918.40m^2 (96,000 sq. ft.) Entire roof. 464.50m^2 (5,000 sq. ft.) notch area = 19.2 notches—USE 20.	Zurn Notch Area Rating selected for Toronto = 464.50m^2 (5,000 sq. ft.) from “Selecta-Drain Chart, page 11. Total Roof Area = 2972.80m^2 (32,000 sq. ft.) Each area. 464.50m^2 (5,000 sq. ft.) notch area = 6.4 notches—USE 7 PER AREA.	Zurn Notch Area Rating selected for Toronto = 464.50m^2 (5,000 sq. ft.) from “Selecta-Drain Chart, page 11. Total Roof Area = 4552m^2 (49,000 sq. ft.) Each area. 464.50m^2 (5,000 sq. ft.) notch area = 9.8 notches—USE 10 PER AREA.
3	Determine total number of drains required by not exceeding maximum spacing dimensions in the preceding instructions. See Diagrams “A” or “B”, page 2. Divide total number of notches required to determine the number of notches per drain. Note maximum water depth at drain and use this dimension to determine scupper height. Maximum scupper height to be used is 152mm (6”). *Use this flow rate to size leaders and drain lines.*	*10 drains required. All drains must have two notches each for a total of 20 notches. Flow rate is 66 L.P.M. (14.5 G.P.M.) per notch. Size leaders for 2 notch weirs for a flow rate of 66 L.P.M. (14.5 G.P.M.) 50 mm (two inch) pipe size leaders required. Maximum water depth and scupper height is 74mm (2.9“). Requires 19 hours draindown time maximum. For drain, vertical and horizontal pipe sizing data see Tables I and II on page 6 and 7.	**5 drains per area required located in the valleys 15.25m (50ft.) from each end with 3 in the middle at 30.50m (100ft.) spacings. Two drains on ends with two notches—3 drains in middle on notch each for a total of 7 notches. Maximum flow rate 93 L.P.M. (20.5 G.P.M.) per notch. Leader size 50mm (2”) for single notch weirs—75mm (3”) notch weirs. Maximum water depth and scupper height is 104mm (4.1”). Requires 11 hours draindown time maximum. For drain, vertical and horizontal pipe sizing data see Tables I and II on page 6 and 7.	**5 drains per area required located in the valleys 15.25m (50ft.) from each end with 3 in the middle at 30.50m (100ft.) spacing in the middle. 10 notches are required therefore all drains must have two notches. Flow rate is 111 L.P.M. (24.5 G.P.M.) per notch. Size all leaders for 2 notch weirs. 75mm (3”) pipe size required. Maximum water depth and scupper height is 124mm (4.9”). Requires 9 hours draindown time maximum. For drain, vertical and horizontal pipe sizing data see Tables I and II on page 6 and 7.

*See Diagram “A” page 2 for recommended drain placement.
**See Diagram “B” page 2 for recommended drain placement.

DEAD LEVEL ROOF

6mm (1/4”) PER FT. SLOPE STORM DRAIN



Select The Proper Vertical Drain Leaders

ROOF DRAINAGE DATA

The flow rate for any design condition can be easily read from the data contained on the following pages; the tabulations shown below (and on the opposite page) can be used to simplify selection of drain line sizes.

TABLE 1 - SUGGESTED RELATION OF DRAIN OUTLET AND VERTICAL LEADER SIZE TO ZURN CONTROL-FLO ROOF DRAINS (BASED ON NATIONAL PLUMBING CODE ASA -A40.8 DATA ON VERTICAL LEADERS).

No. of Notches in Drain	**Max. Flow per Notch in L.P.M. (G.P.M.)**		
	Pipe Size		
	50mm (2”)	75mm (3”)	100mm (4”)
1	136* (30*)	—	—
2	68 (15)	136* (30*)	—
3	45 (10)	136* (30*)	—
4	—	105 (23)	136* (30*)
5	—	82 (18)	136* (30*)
6	—	68 (15)	136* (30*)

*Maximum flow obtainable from 1 notch with 152mm (6”) water depth at drain.

Table 1 should be used to select **vertical drain** leaders which at the same time establishes the drain outlet size. This table illustrates the minimum flow per notch in L.P.M. (G.P.M.) Since the Z-105 drain is available with a minimum of one and a maximum of six notches, calculations have already been a made and are listed in this table for any quantity of weir notch openings established in your design. It was determined ten drains with two notches each weir would be required in the Dead-Level Roof example on page 5. A 66 L.P.M. (14.5 G.P.M.) discharge per notch flow rate was also established.

Once this design criteria has been determined it will be the key to the proper selection of all drain outlet sizes, vertical and horizontal storm drain sizes in Table I and II. Enter the column “Number of Notches in Drain”, Table I, read down the column to the figure 2 which indicates two notches in weir, then read across until you reach a figure equal to or closest figure in excess of 66 L.P.M. (14.5 G.P.M.) You will find fifteen in the column under 50mm (2”) which represents the pipe size. Therefore all drain outlets and vertical leaders are 50mm (2”) size.

Let us digress for a moment assuming a specific structure requires a total of six drains each containing a weir with a different number of notches. One with 1, one with 2, etc. Table 1 discloses the pipe size for one notch is 50mm (2”), two notch is 50mm (2”), three notch is 75mm (3”), four notch is 75mm (3”), five notch is 75mm (3”) and six notch is 75mm (3”) as they all equal or closely exceed the 66 L.P.M. (14.5 G.P.M.) design.

NOTE: Although pipe size calculations should be based on accumulated flow rate, local by-laws should be referred to for minimum pipe size requirements and roof drain spacing.

TABLE II should be used to select **horizontal** storm drain piping. Use the same flow rate 66 L.P.M. (14.5 G.P.M.) used to establish the vertical leaders to size the storm drainage system and main storm drain. Let us assume the ten drains each with two notch weirs were actually on the roof in two separate lines of five drains each and joined at a common point before leaving the building. Since Table II includes 3mm (1/8”), 6mm (1/4”) and 13mm (1/2”) per foot slope, let **us use 6mm (1/4”) as our basis for selection** which will take us to the centre section. Starting with the first of five drains we enter the extreme left column in Table II and read down to the figure 2 since this drain has two notches in weir, read across horizontally and the size of first section of horizontal storm drain is 75mm (3”) between 1st and 2nd drain, return to left hand column proceed reading down until you reach figure 4 then read across horizontally and the pipe size will be 100mm (4”) between 2nd and 3rd drain, 100mm (4”) between 3rd and 4th and 125mm (5”) (if available) between 4th and 5th. If not available use 150mm (6”). (You may be tempted to use 100mm (4”) since the capacity is close. We recommend you go to the larger size.) Pipe size leaving 5th drain would be 150mm (6”). The same sizing would hold true for the second line of five drains. Since both columns of five drains each are being joined together before leaving the building there will be total of twenty notches discharging into the main building storm sewer. Enter left hand column Table II, read down until you reach the figure twenty, then read across horizontally to the 6mm (1/4”) per 305mm (1’) slope column and you will see a 150mm (6”) storm drain will handle the job adequately. The same procedure should be followed for sloped roof installations. The above method of sizing was done to better acquaint you with Table II and its use. The more economical and practical way of laying out and installing this same job is illustrated in the control-flo layout shown on bottom of page 5.

NOTE: Although pipe size calculations should be based on accumulated flow rates, local by-laws should be referred to for minimum pipe size requirements and roof drain spacing.

Select Proper Horizontal Storm Drain Piping

ZURN

Table II — SUGGESTED RELATION OF HORIZONTAL STORM DRAIN SIZE TO ZURN CONTROL-FLO ROOF DRAINAGE

Total No. of Notches Discharging to Storm Drain	MAX. FLOW PER NOTCH IN L.P.M. (G.P.M.)								MAX. FLOW PER NOTCH IN L.P.M. (G.P.M.)							MAX. FLOW PER NOTCH IN L.P.M. (G.P.M.)						
	Storm Drain Size 3mm (1/8") per 305mm (1') Slope								Storm Drain Size 6mm (1/4") per 305mm (1') Slope							Storm Drain Size 13mm (1/2") per 305mm (1') Slope						
	75 (3")	100 (4")	125 (5")	150 (6")	200 (8")	250 (10")	300 (12")	375 (15")	75 (3")	100 (4")	125 (5")	150 (6")	200 (8")	250 (10")	300 (12")	75 (3")	100 (4")	125 (5")	150 (6")	200 (8")	250 (10")	300 (12")
1	136* (30*)	—	—	—	—	—	—	—	136* (30*)	—	—	—	—	—	—	136* (30*)	—	—	—	—	—	—
2	77 (17)	136* (30*)	—	—	—	—	—	—	109 (24)	136* (30*)	—	—	—	—	—	136* (30*)	—	—	—	—	—	—
3	50 (11)	118 (26)	136* (30*)	—	—	—	—	—	73 (16)	136* (30*)	—	—	—	—	—	100 (22)	136* (30*)	—	—	—	—	—
4	36 (8)	86 (19)	136* (30*)	—	—	—	—	—	55 (12)	127 (28)	136* (30*)	—	—	—	—	77 (17)	136* (30*)	—	—	—	—	—
5	—	65 (15)	127* (28*)	136* (30*)	—	—	—	—	—	100 (22)	136* (30*)	—	—	—	—	59 (13)	136* (30*)	—	—	—	—	—
6	—	59 (13)	105 (23)	136* (30*)	—	—	—	—	—	82 (18)	136* (30*)	—	—	—	—	50 (11)	118 (26)	136* (30*)	—	—	—	—
7	—	50 (11)	91 (20)	136* (30*)	—	—	—	—	—	73 (16)	127 (28)	136* (30*)	—	—	—	—	100 (22)	136* (30*)	—	—	—	—
8	—	—	77 (17)	127 (28)	136* (30*)	—	—	—	—	64 (14)	114 (25)	136* (30*)	—	—	—	—	86 (19)	136* (30*)	—	—	—	—
9	—	—	68 (15)	114 (25)	136* (30*)	—	—	—	—	55 (12)	100 (22)	136* (30*)	—	—	—	—	77 (17)	136* (30*)	—	—	—	—
10	—	—	64 (14)	100 (22)	136* (30*)	—	—	—	—	—	91 (20)	136* (30*)	—	—	—	—	68 (15)	123 (27)	136* (30*)	—	—	—
11	—	—	55 (12)	91 (20)	136* (30*)	—	—	—	—	—	82 (18)	132 (29)	136* (30*)	—	—	—	64 (14)	114 (25)	136* (30*)	—	—	—
12	—	—	—	82 (18)	136* (30*)	—	—	—	—	—	73 (16)	118 (26)	136* (30*)	—	—	—	59 (13)	105 (23)	136* (30*)	—	—	—
13	—	—	—	77 (17)	136* (30*)	—	—	—	—	—	68 (15)	109 (24)	136* (30*)	—	—	—	55 (12)	95 (21)	136* (30*)	—	—	—
14	—	—	—	73 (16)	136* (30*)	—	—	—	—	—	64 (14)	100 (22)	136* (30*)	—	—	—	—	86 (19)	136* (30*)	—	—	—
15	—	—	—	68 (15)	136* (30*)	—	—	—	—	—	59 (13)	95 (21)	136* (30*)	—	—	—	—	82 (18)	132 (29)	136* (30*)	—	—
16	—	—	—	64 (14)	136* (30*)	—	—	—	—	—	—	91 (20)	136* (30*)	—	—	—	—	77 (17)	123 (27)	136* (30*)	—	—
17	—	—	—	59 (13)	127 (28)	136* (30*)	—	—	—	—	—	82 (18)	136* (30*)	—	—	—	—	73 (16)	118 (26)	136* (30*)	—	—
18	—	—	—	55 (12)	118 (26)	136* (30*)	—	—	—	—	—	77 (17)	136* (30*)	—	—	—	—	68 (15)	109 (24)	136* (30*)	—	—
19	—	—	—	—	114 (25)	136* (30*)	—	—	—	—	—	73 (16)	136* (30*)	—	—	—	—	64 (14)	105 (23)	136* (30*)	—	—
20	—	—	—	—	109 (24)	136* (30*)	—	—	—	—	—	68 (15)	136* (30*)	—	—	—	—	59 (13)	100 (22)	136* (30*)	—	—
23	—	—	—	—	91 (20)	136* (30*)	—	—	—	—	—	64 (14)	132 (29)	136* (30*)	—	—	—	55 (12)	86 (19)	136* (30*)	—	—
25	—	—	—	—	86 (19)	136* (30*)	—	—	—	—	—	59 (13)	123 (27)	136* (30*)	—	—	—	—	77 (17)	136* (30*)	—	—
30	—	—	—	—	73 (16)	127 (28)	136* (30*)	—	—	—	—	—	100 (22)	136* (30*)	—	—	—	—	64 (14)	136* (30*)	—	—
35	—	—	—	—	59 (13)	109 (24)	136* (30*)	—	—	—	—	—	86 (19)	136* (30*)	—	—	—	—	55 (12)	123 (27)	136* (30*)	—
40	—	—	—	—	55 (12)	95 (21)	136* (30*)	—	—	—	—	—	77 (17)	136* (30*)	—	—	—	—	—	105 (23)	136* (30*)	—
45	—	—	—	—	—	86 (19)	136* (30*)	—	—	—	—	—	68 (15)	123 (27)	136* (30*)	—	—	—	—	95 (21)	136* (30*)	—
50	—	—	—	—	—	77 (17)	123 (27)	136* (30*)	—	—	—	—	59 (13)	109 (24)	136* (30*)	—	—	—	—	86 (19)	136* (30*)	—
55	—	—	—	—	—	68 (15)	114 (25)	136* (30*)	—	—	—	—	—	100 (22)	136* (30*)	—	—	—	—	77 (17)	136* (30*)	—
60	—	—	—	—	—	64 (14)	105 (23)	136* (30*)	—	—	—	—	—	91 (20)	136* (30*)	—	—	—	—	68 (15)	127 (28)	136* (30*)
65	—	—	—	—	—	59 (13)	95 (21)	136* (30*)	—	—	—	—	—	82 (18)	136* (30*)	—	—	—	—	64 (14)	118 (26)	136* (30*)
70	—	—	—	—	—	55 (12)	91 (20)	136* (30*)	—	—	—	—	—	77 (17)	127 (28)	—	—	—	—	59 (13)	109 (24)	136* (30*)

*Maximum flow obtainable from 1 notch with 152mm (6") water depth at drain.

TABLE III - TO BE USED WHEN ROOF STORM WATER RUN OFF AND OTHER SURFACE WATER RUN OFF IS BEING CONSOLIDATED INTO ONE COMMON MAIN HORIZONTAL STORM SEWER.

Flow capacity of vertical leaders litres per minute (gallons per minute)

Pipe Size	Maximum Capacity L.P.M. (G.P.M.)
50mm (2”)	136 (30)
75mm (3”)	409 (90)
100mm (4”)	864 (190)
†125mm (5”)	1582 (348)
150mm (6”)	2550 (561)

†In some areas 125mm (5”) drainage pipe may not be available.

Flow capacity of horizontal storm sewers litres per minute (gallons per minute).

Pipe Size	Slope per 305mm (1’0”)		
	3mm (1/8”)	6mm (1/4”)	13mm (1/2”)
75mm (3”)	163 (36)	232 (51)	327 (72)
100mm (4”)	355 (78)	505 (111)	714 (157)
†125mm (5”)	646 (142)	914 (201)	1291 (284)
150mm (6”)	1050 (231)	1487 (327)	2100 (462)
200mm (8”)	2264 (498)	3205 (705)	4528 (996)
250mm (10”)	4100 (902)	5796 (1275)	8201 (1804)
300mm (12”)	6669 (1467)	9437 (2076)	13338 (2934)
375mm (15”)	12120 (2666)	17157 (3774)	24239 (5332)

Note: Although pipe size calculations should be based on accumulated flow rate, local by-laws should be referred to for minimum pipe size requirements and roof drain spacing.

SCUPPER AND OVERFLOW DRAINS

Roofing members and understructures, weakened by seepage and rot resulting from improper drainage and roof construction can give away under the weight of rapidly accumulated water during flash storms. Thus, it is recommended, and often required by building codes, to install scuppers and overflow drains in parapet-type roofs. Properly selected and sized scuppers and overflow drains are vital to a well-engineered drainage system to prevent excessive loading, erosion, seepage and rotting.

Selecta-Drain Chart

LOCATION	SQUARE METRE (SQUARE FOOT) NOTCH AREA RATING	ROOF LOAD FACTOR KGS. (LBS.)	TOTAL ROOF SLOPE: DEAD LEVEL L.P.M. (G.P.M.) Discharge	DEAD LEVEL Draindown Time Hrs.	DEAD LEVEL mm (in.) Water Depth	51mm (2") RISE L.P.M. (G.P.M.) Discharge	51mm (2") RISE Draindown Time Hrs.	51mm (2") RISE mm (in.) Water Depth	102mm (4") RISE L.P.M. (G.P.M.) Discharge	102mm (4") RISE Draindown Time Hrs.	102mm (4") RISE mm (in.) Water Depth	152mm (6") RISE L.P.M. (G.P.M.) Discharge	152mm (6") RISE Draindown Time Hrs.	152mm (6") RISE mm (in.) Water Depth
Calgary, Alberta	232 (2,500)	4.7 (10.4)	45.5 (10)	7	51 (2)	57 (12.5)	6	63.5 (2.5)	72.5 (16)	4	81.5 (3.2)	86.5 (19)	3.2	96.5 (3.8)
	465 (5,000)	5.9 (13)	57 (12.5)	17	63.5 (2.5)	66 (14.5)	14	73.5 (2.9)	82 (18)	9	91.5 (3.6)	97.5 (21.5)	7.5	109 (4.3)
	697 (7,500)	6.4 (14)	61.5 (13.5)	28	68.5 (2.7)	72.5 (16)	22	81.5 (3.2)	88.5 (19.5)	15	99 (3.9)	104.5 (23)	12	117 (4.6)
	929 (10,000)	6.8 (15.1)	66 (14.5)	38	73.5 (2.9)	77.5 (17)	31	86.5 (3.4)	93 (20.5)	22	104 (4.1)	109 (24)	17	122 (4.8)
Edmonton, Alberta	232 (2,500)	4.5 (9.9)	43 (9.5)	7	48.5 (1.9)	57 (12.5)	6	63.5 (2.5)	72.5 (16)	4	81.5 (3.2)	82 (18)	3	91.5 (3.6)
	465 (5,000)	5.9 (13)	57 (12.5)	17	63.5 (2.5)	68 (15)	14.5	76 (3)	84 (18.5)	9.5	94 (3.7)	97.5 (21.5)	7.5	109 (4.3)
	697 (7,500)	6.6 (14.5)	63.5 (14)	28	71 (2.8)	75 (16.5)	24	84 (3.3)	97.5 (21.5)	16	104 (4.1)	107 (23.5)	12	119.5 (4.7)
	929 (10,000)	7.1 (15.6)	68 (15)	38	76 (3.0)	79.5 (17.5)	32	89 (3.5)	100 (22)	22	112 (4.4)	113.5 (25)	18	127 (5.0)
Penticton, British Columbia	232 (2,500)	3.8 (8.3)	36.5 (8)	6	40.5 (1.6)	38.5 (8.5)	4	43 (1.7)	52.5 (11.5)	3	58.5 (2.3)	61.5 (13.5)	2.3	68.5 (2.7)
	465 (5,000)	4.0 (8.8)	38.5 (8.5)	13	43 (1.7)	41 (9)	9	45.5 (1.8)	57 (12.5)	6	63.5 (2.5)	68 (15)	5	76 (3)
	697 (7,500)	4.2 (9.3)	41 (9)	21	45.5 (1.8)	43 (9.5)	14.5	48.5 (1.9)	61.5 (13.5)	10.5	68.5 (2.7)	72.5 (16)	8	81.5 (3.2)
	929 (10,000)	4.2 (9.3)	41 (9)	27	45.5 (1.8)	45.5 (10)	20	51 (2)	63.5 (14)	14	71 (2.8)	75 (16.5)	11	84 (3.3)
Vancouver, British Columbia	232 (2,500)	3.3 (7.3)	32 (7)	5.5	35.5 (1.4)	38.5 (8.5)	4	43 (1.7)	47.5 (10.5)	2.8	53.5 (2.1)	57 (12.5)	2	63.5 (2.5)
	465 (5,000)	4.0 (8.8)	38.5 (8.5)	13	43 (1.7)	45.5 (10)	10	51 (2)	57 (12.5)	6	63.5 (2.5)	68 (15)	5	76 (3)
	697 (7,500)	4.5 (9.9)	43 (9.5)	22	48.5 (1.9)	50 (11)	17	56 (2.2)	63.5 (14)	11	71 (2.8)	75 (16.5)	8.5	84 (3.3)
	929 (10,000)	4.9 (10.9)	47.5 (10.5)	30	53.5 (2.1)	54.5 (12)	24	61 (2.4)	68 (15)	15	76 (3)	79.5 (17.5)	12	89 (3.5)
Victoria, British Columbia	232 (2,500)	3.3 (7.3)	32 (7)	5.5	35.5 (1.4)	38.5 (8.5)	4	43 (1.7)	43 (9.5)	2.5	48.5 (1.9)	54.5 (12)	2	61 (2.4)
	465 (5,000)	4.0 (8.8)	38.5 (8.5)	13	43 (1.7)	45.5 (10)	10	51 (2)	54.5 (12)	6	61 (2.4)	68 (15)	5	76 (3)
	697 (7,500)	4.5 (9.9)	43 (9.5)	22	48.5 (1.9)	50 (11)	16	56 (2.2)	59 (13)	10	66 (2.6)	75 (16.5)	8	84 (3.3)
	929 (10,000)	4.7 (10.4)	45.5 (10)	30	51 (2)	54.5 (12)	23	61 (2.4)	63.5 (14)	14	71 (2.8)	79.5 (17.5)	12	89 (3.5)
Brandon, Manitoba	232 (2,500)	5.9 (13)	57 (12.5)	8	63.5 (2.5)	68 (15)	7	76 (3)	82 (18)	4.5	91.5 (3.6)	92.5 (21)	3.5	106.5 (4.2)
	465 (5,000)	7.3 (16.1)	73 (16)	20	81.5 (3.2)	84 (18.5)	17	94 (3.7)	97.5 (21.5)	11	109 (4.3)	113.5 (25)	8.5	127 (5)
	697 (7,500)	8.3 (18.2)	79.5 (17.5)	32	89 (3.5)	93 (20.5)	27	104 (4.1)	107 (23.5)	19	119.5 (4.7)	125 (27.5)	15	139.5 (5.5)
	929 (10,000)	9.0 (19.8)	86.5 (19)	43	96.5 (3.8)	100 (22)	38	112 (4.4)	113.5 (25)	26	127 (5.0)	132 (29)	21	147.5 (5.8)
Winnipeg, Manitoba	232 (2,500)	4.7 (10.4)	45.5 (10)	7	51 (2)	57 (12.5)	6	63.5 (2.5)	75 (16.5)	4	84 (3.3)	86.5 (19)	3.2	96.5 (3.8)
	465 (5,000)	5.9 (13)	57 (12.5)	17	63.5 (2.5)	68 (15)	15	76 (3)	84 (18.5)	10	94 (3.7)	100 (22)	7.5	112 (4.4)
	697 (7,500)	6.6 (14.5)	63.5 (14)	28	71 (2.8)	75 (16.5)	24	84 (3.3)	93 (20.5)	16	104 (4.1)	107 (23.5)	12	119.5 (4.7)
	929 (10,000)	7.1 (15.6)	68 (15)	39	76 (3)	82 (18)	32	91.5 (3.6)	97.5 (21.5)	22	109 (4.3)	113.5 (25)	17	127 (5.0)
Campbellton, New Brunswick	232 (2,500)	6.4 (14)	62 (13.5)	9	68.5 (2.7)	70.5 (15.5)	7	78.5 (3.1)	79.5 (17.5)	4.5	89 (3.5)	91 (20)	3.5	101.5 (4.0)
	465 (5,000)	9.0 (19.8)	86.5 (19)	22	96.5 (3.8)	91 (20)	18	101.5 (4)	102.5 (22.5)	12	115 (4.5)	113.5 (25)	9	127 (5.0)
	697 (7,500)	10.4 (22.9)	100 (22)	35	112 (4.4)	102.5 (22.5)	28	114.5 (4.5)	118 (26)	20	132 (5.2)	132 (29)	15	147.5 (5.8)
	929 (10,000)	11.3 (25)	109 (24)	47	122 (4.8)	111.5 (24.5)	40	124.5 (4.9)	127.5 (28)	29	142 (5.6)	141 (31)	22	157.5 (6.2)

Selecta-Drain Chart

LOCATION	SQUARE METRE (SQUARE FOOT) / NOTCH AREA RATING	ROOF LOAD FACTOR KGS. (LBS.)	TOTAL ROOF SLOPE											
			DEAD LEVEL			51mm (2") RISE			102mm (4") RISE			152mm (6") RISE		
			L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth
Chatham, New Brunswick	232 (2,500)	4.5 (9.9)	43 (9.5)	**7**	48.5 (1.9)	52.5 (11.5)	**5.5**	58.5 (2.3)	63.5 (14)	**3.5**	71 (2.8)	77.5 (17)	**2.9**	86.5 (3.4)
	465 (5,000)	5.7 (12.5)	54.5 (12)	**16**	61 (2.4)	63.5 (14)	**13**	71 (2.8)	77.5 (17)	**9**	86.5 (3.4)	91 (20)	**7**	101.5 (4.0)
	697 (7,500)	6.4 (14)	61.5 (13.5)	**27**	68.5 (2.7)	68 (15)	**22**	76 (3)	84 (18.5)	**14**	94 (3.7)	102.5 (22.5)	**12**	114.5 (4.5)
	929 (10,000)	6.6 (14.6)	63.5 (14)	**37**	71 (2.8)	75 (16.5)	**30**	84 (3.3)	91 (20)	**20**	101.5 (4.0)	107 (23.5)	**16**	119.5 (4.7)
Moncton, New Brunswick	232 (2,500)	4.3 (9.4)	41 (9)	**7**	45.5 (1.8)	54.5 (12)	**6**	61 (2.4)	63.5 (14)	**3.5**	71 (2.8)	72.5 (16)	**2.7**	81.5 (3.2)
	465 (5,000)	5.9 (13)	57 (12.5)	**17**	63.5 (2.5)	68 (15)	**14**	76 (3)	82 (18)	**9**	91.5 (3.6)	93 (20.5)	**7**	104 (4.1)
	697 (7,500)	6.6 (14.6)	63.5 (14)	**28**	71 (2.8)	79.5 (17.5)	**24**	89 (3.5)	93 (20.5)	**16**	104 (4.1)	104.5 (23)	**12**	117 (4.6)
	929 (10,000)	7.5 (16.6)	73.5 (16)	**39**	81.5 (3.2)	84 (18.5)	**34**	94 (3.7)	100 (22)	**23**	112 (4.4)	113.5 (25)	**17**	127 (5.0)
Saint John, New Brunswick	232 (2,500)	5.7 (12.5)	54.5 (12)	**8**	61 (2.4)	57 (12.5)	**6**	63.5 (2.5)	75 (16.5)	**4**	84 (3.3)	86.5 (19)	**3**	96.5 (3.8)
	465 (5,000)	7.5 (16.6)	72.5 (16)	**20**	81.5 (3.2)	79.5 (17.5)	**16**	89 (3.5)	95.5 (21)	**11**	106.5 (4.2)	104.5 (23)	**8**	117 (4.6)
	697 (7,500)	8.7 (19.2)	84 (18.5)	**32**	94 (3.7)	93 (20.5)	**27**	104 (4.1)	107 (23.5)	**19**	119.5 (4.7)	118 (26)	**13.5**	132 (5.2)
	929 (10,000)	9.7 (21.3)	93 (20.5)	**44**	104 (4.1)	104.5 (23)	**38**	117 (4.6)	113.5 (25)	**27**	127 (5.0)	127.5 (28)	**20**	142 (5.6)
Gander, Newfound-land	232 (2,500)	3.5 (7.8)	34 (7.5)	**5.5**	38 (1.5)	45.5 (10)	**5**	51 (2.0)	57 (12.5)	**3.5**	63.5 (2.5)	68 (15)	**2.5**	76 (3.0)
	465 (5,000)	4.7 (10.4)	45.5 (10)	**15**	51 (2.0)	57 (12.5)	**12**	63.5 (2.5)	72.5 (16)	**8**	81.5 (3.2)	82 (18)	**6.5**	91.5 (3.6)
	697 (7,500)	5.7 (12.5)	54.5 (12)	**25**	61 (2.4)	63.5 (14)	**21**	71 (2.8)	79.5 (17.5)	**13.5**	89 (3.5)	93 (20.5)	**11**	104 (4.1)
	929 (10,000)	6.1 (13.5)	59 (13)	**35**	66 (2.6)	70.5 (15.5)	**29**	78.5 (3.1)	84 (18.5)	**19**	94 (3.7)	100 (22)	**15**	112 (4.4)
St. Andrews, Newfound-land	232 (2,500)	3.5 (7.8)	34 (7.5)	**5.5**	38 (1.5)	45.5 (10)	**5**	51 (2.0)	59 (13)	**3.5**	66 (2.6)	63.5 (14)	**2.5**	71 (2.8)
	465 (5,000)	5.2 (11.4)	47.5 (10.5)	**15**	53.5 (2.1)	59 (13)	**13**	66 (2.6)	72.5 (16)	**8**	81.5 (3.2)	79.5 (17.5)	**6**	89 (3.5)
	697 (7,500)	5.9 (13)	57 (12.5)	**26**	63.5 (2.5)	66 (14.5)	**21**	73.5 (2.9)	82 (18)	**14**	91.5 (3.6)	88.5 (19.5)	**10**	99 (3.9)
	929 (10,000)	6.6 (14.6)	63.5 (14)	**36**	71 (2.8)	72.5 (16)	**30**	81.5 (3.2)	86.5 (19)	**20**	96.5 (3.8)	95.5 (21)	**14.5**	106.5 (4.2)
St. John's, Newfound-land	232 (2,500)	5.9 (13)	57 (12.5)	**8**	63.5 (2.6)	68 (15)	**7**	76 (3.0)	77.5 (17)	**4.5**	86.5 (3.4)	86.5 (19)	**3.2**	96.5 (3.8)
	465 (5,000)	8.5 (18.7)	82 (18)	**21**	91.5 (3.6)	91 (20)	**18**	101 (4.0)	100 (22)	**11**	112 (4.4)	113.5 (25)	**9**	127 (5.0)
	697 (7,500)	10.6 (23.4)	102.5 (22.5)	**34**	114.5 (4.5)	109 (24)	**29**	122 (4.8)	122.5 (27)	**21**	137 (5.4)	132 (29)	**15**	147.5 (5.8)
	929 (10,000)	11.8 (26)	113.5 (25)	**48**	127 (5.0)	129.5 (28.5)	**43**	145 (5.7)	143 (31.5)	**33**	160 (6.3)	150 (33)	**24**	167.5 (6.6)
Torbay, Newfound-land	232 (2,500)	4.9 (10.9)	47.5 (10.5)	**7.5**	53.5 (2.1)	61.5 (13.5)	**6.5**	68.5 (2.7)	75 (16.5)	**4**	84 (3.3)	84 (18.5)	**3**	94 (3.7)
	465 (5,000)	6.4 (14)	61.5 (13.5)	**18**	68.5 (2.7)	75 (16.5)	**15.5**	84 (3.3)	88.5 (19.5)	**10**	99 (3.9)	102.5 (22.5)	**8**	114.5 (4.5)
	697 (7,500)	7.3 (16.1)	70.5 (15.5)	**29**	78.5 (3.1)	84 (18.5)	**25**	94 (3.7)	100 (22)	**17.5**	112 (4.4)	113.5 (25)	**13**	127 (5)
	929 (10,000)	8.0 (17.7)	77.5 (17)	**40**	86.5 (3.4)	88.5 (19.5)	**34**	99 (3.9)	107 (23.5)	**24**	119.5 (4.7)	122.5 (27)	**19**	137 (5.4)
Halifax, Nova Scotia	232 (2,500)	5.9 (13)	57 (12.5)	**8**	63.5 (2.5)	68 (15)	**7**	76 (3.0)	77.5 (17)	**4.5**	86.5 (3.4)	86.5 (19)	**3.2**	96.5 (3.8)
	465 (5,000)	8.5 (18.7)	82 (18)	**21**	91.5 (3.6)	91 (20)	**18**	101.5 (4.0)	100 (22)	**11**	112 (4.4)	113.5 (25)	**9**	127 (5.0)
	697 (7,500)	10.6 (23.4)	102.5 (22.5)	**34**	114.5 (4.5)	109 (24)	**29**	122 (4.8)	122.5 (27)	**21**	137 (5.4)	132 (29)	**15**	147.5 (5.8)
	929 (10,000)	11.8 (26)	113.5 (25)	**48**	127 (5.0)	129.5 (28.5)	**43**	145 (5.7)	143 (31.5)	**33**	160 (6.3)	150 (33)	**24**	167.5 (6.6)

Selecta-Drain Chart

LOCATION	SQUARE METRE (SQUARE FOOT) / NOTCH AREA RATING	ROOF LOAD FACTOR KGS. (LBS.)	TOTAL ROOF SLOPE											
			DEAD LEVEL			51mm (2") RISE			102mm (4") RISE			152mm (6") RISE		
			L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth
Sydney, Nova Scotia	232 (2,500)	4.3 (9.4)	41 (9)	**6.5**	45.5 (1.8)	45.5 (10)	**5**	51 (2.0)	57 (12.5)	**3.5**	6.5 (2.5)	68 (15)	**2.5**	76 (3)
	465 (5,000)	5.7 (12.5)	54.5 (12)	**16**	61 (2.4)	59 (13)	**13**	66 (2.6)	75 (16.5)	**8**	84 (3.3)	84 (18.5)	**6.5**	94 (3.7)
	697 (7,500)	6.4 (14)	61.5 (13.5)	**28**	68.5 (2.7)	68 (15)	**22**	76 (3)	84 (18.5)	**14**	94 (3.7)	97.5 (21.5)	**11**	109 (4.3)
	929 (10,000)	7.1 (15.6)	68 (15)	**38**	76 (3)	75 (16.5)	**30**	84 (3.3)	91 (20)	**20**	101.5 (4)	104.5 (23)	**16**	117 (4.6)
Yarmouth, Nova Scotia	232 (2,500)	6.4 (14)	61.5 (13.5)	**9**	68.5 (2.7)	70.5 (15.5)	**7.5**	78.5 (3.1)	82 (18)	**4.5**	91.5 (3.6)	91 (20)	**3.5**	101.5 (4)
	465 (5,000)	8.3 (18.2)	79.5 (17.5)	**21**	89 (3.5)	88.5 (19.5)	**18**	99 (3.9)	104.5 (23)	**12**	117 (4.6)	116 (25.5)	**9**	129.5 (5.1)
	697 (7,500)	9.4 (20.8)	91 (20)	**34**	101.5 (4)	102.5 (22.5)	**29**	114.5 (4.5)	118 (26)	**21**	132 (5.2)	132 (29)	**15**	147.5 (5.8)
	929 (10,000)	10.4 (22.9)	100 (22)	**45**	112 (4.4)	109 (24)	**41**	122 (4.8)	129.5 (28.5)	**29**	145 (5.7)	141 (31)	**22**	157.5 (6.2)
Thunder Bay, Ontario	232 (2,500)	4.9 (10.9)	47.5 (10.5)	**7.5**	53.5 (2.1)	61.5 (13.5)	**6.5**	68.5 (2.7)	75 (16.5)	**4**	84 (3.3)	88.5 (19.5)	**3.5**	91.5 (3.6)
	465 (5,000)	6.1 (13.5)	59 (13)	**18**	66 (2.6)	72.5 (16)	**15**	81.5 (3.2)	86.5 (19)	**9.5**	96.5 (3.8)	102.5 (22.5)	**7.5**	114.5 (4.5)
	697 (7,500)	6.6 (14.6)	63.5 (14)	**28**	71 (2.8)	77.5 (17)	**24**	86.5 (3.4)	93 (20.5)	**16**	104 (4.1)	109 (24)	**13**	122 (4.8)
	929 (10,000)	7.1 (15.6)	68 (15)	**38**	76 (3)	84 (18.5)	**33**	94 (3.7)	97.5 (21.5)	**22**	109 (4.3)	116 (25.5)	**18**	129.5 (5.1)
Guelph, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	**8**	61 (2.4)	63.5 (14)	**7**	71 (2.8)	86.5 (19)	**5**	96.5 (3.8)	100 (22)	**3.7**	112 (4.4)
	465 (5,000)	6.6 (14.6)	63.5 (14)	**19**	71 (2.8)	75 (16.5)	**15.5**	84 (3.3)	97.5 (21.5)	**11**	109 (4.3)	116 (25.5)	**9**	129.5 (5.1)
	697 (7,500)	7.3 (16.1)	70.5 (15.5)	**29**	78.5 (3.1)	82 (18)	**25**	91.5 (3.6)	104.5 (23)	**18**	117 (4.6)	125 (27.5)	**14**	139.5 (5.5)
	929 (10,000)	8.0 (17.7)	77.5 (17)	**40**	86.5 (3.4)	84 (18.5)	**34**	94 (3.7)	109 (24)	**26**	122 (4.8)	132 (29)	**20**	147.5 (5.8)
Hamilton, Ontario	232 (2,500)	5.9 (13)	57 (12.5)	**8.5**	63.5 (2.5)	72.5 (16)	**7.5**	81.5 (3.2)	93 (20.5)	**5**	104 (4.1)	109 (24)	**4**	122 (4.8)
	465 (5,000)	6.6 (14.6)	63.5 (14)	**19**	71 (2.8)	79.5 (17.5)	**16**	89 (3.5)	104.5 (23)	**12**	117 (4.6)	122.5 (27)	**9**	137 (5.4)
	697 (7,500)	6.8 (15.1)	66 (14.5)	**28**	73.5 (2.9)	84 (18.5)	**26**	94 (3.7)	111.5 (24.5)	**20**	124.5 (4.9)	127.5 (28)	**15**	142 (5.6)
	929 (10,000)	7.1 (15.6)	68 (15)	**39**	76 (3)	86.5 (19)	**34**	96.5 (3.8)	116 (25.5)	**27**	129.5 (5.1)	134 (29.5)	**21**	150 (5.9)
Kingston, Ontario	232 (2,500)	6.4 (14)	61.5 (13.5)	**9**	68.5 (2.7)	77.5 (17)	**8**	86.5 (3.4)	91 (20)	**5**	101.5 (4)	109 (24)	**4**	122 (4.8)
	465 (5,000)	7.5 (16.6)	72.5 (16)	**20**	81.5 (3.2)	86.5 (19)	**18**	96.5 (3.8)	104.5 (23)	**12**	117 (4.6)	122.5 (27)	**9.5**	137 (5.4)
	697 (7,500)	8.5 (18.7)	82 (18)	**31**	91.5 (3.6)	93 (20.5)	**28**	104 (4.1)	111.5 (24.5)	**20**	124.5 (4.9)	132 (29)	**15**	147.5 (5.8)
	929 (10,000)	8.7 (19.2)	86.5 (19)	**42**	96.5 (3.8)	97.5 (21.5)	**38**	109 (4.3)	116 (25.5)	**27**	129.5 (5.1)	68 (15)	**21**	152.5 (6)
London, Ontario	232 (2,500)	6.1 (13.5)	59 (13)	**8.5**	66 (2.6)	72.5 (16)	**7.5**	81.5 (3.2)	88.5 (19.5)	**5**	99 (3.9)	107 (23.5)	**4**	119.5 (4.7)
	465 (5,000)	7.1 (15.6)	68 (15)	**20**	76 (3)	84 (18.5)	**17**	94 (3.7)	102.5 (22.5)	**12**	114.5 (4.5)	122.5 (27)	**9.5**	137 (5.4)
	697 (7,500)	8.0 (17.7)	77.5 (17)	**30**	86.5 (3.4)	88.5 (19.5)	**27**	99 (3.9)	109 (24)	**19**	122 (4.8)	129.5 (28.5)	**15**	145 (5.7)
	929 (10,000)	8.5 (18.7)	82 (18)	**41**	91.5 (3.6)	91 (20)	**36**	101.5 (4)	113.5 (25)	**27**	127 (5)	134 (29.5)	**21**	150 (5.9)
North Bay, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	**8**	61 (2.4)	68 (15)	**7**	76 (3)	86.5 (19)	**5**	96.5 (3.8)	100 (22)	**3.8**	112 (4.4)
	465 (5,000)	6.6 (14.6)	63.5 (14)	**19**	71 (2.8)	79.5 (17.5)	**16**	89 (3.5)	97.5 (21.5)	**11**	109 (4.3)	113.5 (25)	**9**	127 (5)
	697 (7,500)	7.5 (16.6)	72.5 (16)	**30**	81.5 (3.2)	86.5 (19)	**26**	96.5 (3.8)	107 (23.5)	**19**	119.5 (4.7)	122.5 (27)	**14**	137 (5.4)
	929 (10,000)	8.3 (18.2)	77.5 (17)	**40**	86.5 (3.4)	93 (20.5)	**36**	104 (4.1)	111.5 (24.5)	**26**	124.5 (4.9)	127.5 (28)	**20**	142 (5.6)

Selecta-Drain Chart

ZURN®

LOCATION	SQUARE METRE (SQUARE FOOT) NOTCH AREA RATING	ROOF LOAD FACTOR KGS. (LBS.)	TOTAL ROOF SLOPE											
			DEAD LEVEL			51mm (2") RISE			102mm (4") RISE			152mm (6") RISE		
			L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth
Ottawa, Ontario	232 (2,500)	4.7 (10.4)	45.5 (10)	**7**	51 (2)	59 (13)	**6.5**	66 (2.6)	77.5 (17)	**4.5**	86.5 (3.4)	86.5 (19)	**3.2**	96.5 (3.8)
	465 (5,000)	5.9 (13)	57 (12.5)	**17**	63.5 (2.5)	68 (15)	**14**	76 (3)	86.5 (19)	**10**	96.5 (3.8)	100 (22)	**7.5**	112 (4.4)
	697 (7,500)	6.4 (14)	61.5 (13.5)	**27**	68.5 (2.7)	75 (16.5)	**23**	84 (3.3)	93 (20.5)	**16**	104 (4.1)	107 (23.5)	**12**	119.5 (4.7)
	929 (10,000)	6.6 (14.6)	63.5 (14)	**36**	71 (2.8)	79.5 (17.5)	**32**	89 (3.5)	97.5 (21.5)	**22**	109 (4.3)	113.5 (25)	**18**	127 (5)
St. Thomas, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	**8**	61 (2.4)	68 (15)	**7**	76 (3.0)	86.5 (19)	**5**	96.5 (3.8)	104.5 (23)	**4**	117 (4.6)
	465 (5,000)	6.6 (14.6)	63.5 (14)	**19**	71 (2.8)	77.5 (17)	**16**	86.5 (3.4)	97.5 (21.5)	**11**	109 (4.3)	118 (26)	**9**	132 (5.2)
	697 (7,500)	7.1 (16.6)	68 (15)	**29**	76 (3.0)	82 (18)	**26**	91.5 (3.6)	102.5 (22.5)	**18**	114.5 (4.5)	125 (27.5)	**15**	139.5 (5.5)
	929 (10,000)	7.5 (16.6)	72.5 (16)	**40**	81.5 (3.2)	86.5 (19)	**34**	96.5 (3.8)	107 (23.5)	**24**	119.5 (4.7)	132 (29)	**20**	147.5 (5.8)
Timmins, Ontario	232 (2,500)	4.3 (9.4)	41 (9)	**7**	45.5 (1.8)	57 (12.5)	**6**	63.5 (2.5)	72.5 (16)	**4**	81.5 (3.2)	86.5 (19)	**3.3**	96.5 (3.8)
	465 (5,000)	5.7 (12.5)	54.5 (12)	**16**	61 (2.4)	63.5 (14)	**14**	71 (2.8)	82 (18)	**9**	91.5 (3.6)	97.5 (21.5)	**7.5**	109 (4.3)
	697 (7,500)	6.4 (14)	61.5 (13.5)	**27**	68.5 (2.7)	70.5 (15.5)	**22**	78.5 (3.1)	86.5 (19)	**15**	96.5 (3.8)	104.5 (23)	**12**	117 (4.6)
	929 (10,000)	6.6 (14.6)	63.5 (14)	**36**	71 (2.8)	72.5 (16)	**30**	81.5 (3.2)	91 (20)	**21**	101.5 (4.0)	109 (24)	**17**	122 (4.8)
Toronto, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	**8**	61 (2.4)	66 (14.5)	**7**	73.5 (2.9)	82 (18)	**4.5**	91.5 (3.6)	97.5 (21.5)	**3.5**	109 (4.3)
	465 (5,000)	6.8 (15.1)	66 (14.5)	**19**	73.5 (2.9)	77.5 (17)	**16**	86.5 (3.4)	93 (20.5)	**11**	104 (4.1)	111.5 (24.5)	**9**	124.5 (4.9)
	697 (7,500)	8.0 (17.7)	77.5 (17)	**30**	86.5 (3.4)	84 (18.5)	**26**	94 (3.7)	100 (22)	**18**	112 (4.4)	120.5 (26.5)	**14**	134.5 (5.3)
	929 (10,000)	8.7 (19.2)	82 (18)	**42**	91.5 (3.6)	86.5 (19)	**34**	96.5 (3.8)	104.5 (23)	**24**	117 (4.6)	127.5 (28)	**20**	142 (5.6)
Windsor, Ontario	232 (2,500)	6.1 (13.5)	59 (13)	**8.5**	66 (2.6)	70.5 (15.5)	**7.5**	78.5 (3.1)	84 (18.5)	**4.5**	94 (3.7)	107 (23.5)	**4**	119.5 (4.7)
	465 (5,000)	7.1 (15.6)	68 (15)	**20**	76 (3.0)	79.5 (17.5)	**16**	89 (3.5)	97.5 (21.5)	**11**	109 (4.3)	118 (26)	**9**	132 (5.2)
	697 (7,500)	8.0 (17.7)	77.5 (17)	**30**	86.5 (3.4)	86.5 (19)	**26**	96.5 (3.8)	107 (23.5)	**18**	119.5 (4.7)	125 (27.5)	**15**	139.5 (5.5)
	929 (10,000)	8.7 (19.2)	82 (18)	**42**	91.5 (3.6)	91 (20)	**36**	101.5 (4.0)	113.5 (25)	**26**	127 (5.0)	129.5 (28.5)	**20**	145 (5.7)
Charlottetown, Prince Edward Island	232 (2,500)	4.9 (10.9)	47.5 (10.5)	**7.5**	53.5 (2.1)	57 (12.5)	**6**	63.5 (2.5)	68 (15)	**3.8**	76 (3.0)	79.5 (17.5)	**3**	89 (3.5)
	465 (5,000)	6.6 (14.6)	63.5 (14)	**19**	71 (2.8)	75 (16.5)	**15.5**	84 (3.3)	88.5 (19.5)	**10**	99 (3.9)	100 (22)	**7.5**	112 (4.4)
	697 (7,500)	7.8 (17.2)	75 (16.5)	**31**	84 (3.3)	86.5 (19)	**26**	96.5 (3.8)	102.5 (22.5)	**18**	114.5 (4.5)	113.5 (25)	**13**	127 (5.0)
	929 (10,000)	8.7 (19.2)	84 (18.5)	**42**	94 (3.7)	97.5 (21.5)	**37**	106.5 (4.2)	111.5 (24.5)	**26**	124.5 (4.9)	125 (27.5)	**20**	139.5 (5.5)
Montreal, Quebec	232 (2,500)	5.2 (11.4)	50 (11)	**7.5**	56 (2.2)	61.5 (13.5)	**7**	68.5 (2.7)	79.5 (17.5)	**4.5**	89 (3.5)	97.5 (21.5)	**3.5**	109 (4.36)
	465 (5,000)	5.9 (13)	57 (12.5)	**17**	63.5 (2.5)	70.5 (15.5)	**15**	78.5 (3.1)	88.5 (19.5)	**10**	99 (3.9)	109 (24)	**8**	122 (4.8)
	697 (7,500)	6.1 (13.5)	59 (13)	**27**	66 (2.6)	72.5 (16)	**23**	81.5 (3.2)	93 (20.5)	**16**	104 (4.1)	113.5 (25)	**13**	127 (5.0)
	929 (10,000)	6.4 (14)	61.5 (13.5)	**36**	68.5 (2.7)	77.5 (17)	**31**	86.5 (3.4)	95.5 (21)	**22**	106.5 (4.2)	120.5 (26.5)	**19**	134.5 (5.3)
Quebec City, Quebec	232 (2,500)	5.4 (12)	52.5 (11.5)	**8**	58.5 (2.3)	63.5 (14)	**7**	71 (2.8)	79.5 (17.5)	**4.5**	89 (3.5)	97.5 (21.5)	**3.5**	109 (4.3)
	465 (5,000)	6.4 (14)	61.5 (13.5)	**18**	68.5 (2.7)	70.5 (15.5)	**15**	78.5 (3.1)	84 (18.5)	**10**	94 (3.7)	104.5 (23)	**8**	117 (4.6)
	697 (7,500)	6.6 (14.6)	63.5 (14)	**28**	71 (2.8)	72.5 (16)	**23**	81.5 (3.2)	86.5 (19)	**15**	96.5 (3.8)	107 (23.5)	**12**	119.5 (4.7)
	929 (10,000)	7.1 (15.6)	68 (15)	**37**	76 (3.0)	77.5 (17)	**31**	86.5 (3.4)	88.5 (19.5)	**20**	99 (3.9)	109 (24)	**17**	122 (4.8)

Selecta-Drain Chart

LOCATION	SQUARE METRE (SQUARE FOOT) / NOTCH AREA RATING	ROOF LOAD FACTOR KGS. (LBS.)	TOTAL ROOF SLOPE											
			DEAD LEVEL			51mm (2") RISE			102mm (4") RISE			152mm (6") RISE		
			L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth
Regina, Saskatchewan	232 (2,500)	4.5 (9.9)	43 (9.5)	**7**	48.5 (1.9)	54.5 (12)	**6**	61 (2.4)	72.5 (16)	**4**	81.5 (3.2)	79.5 (17.5)	**3**	89 (3.5)
	465 (5,000)	6.4 (14)	61.5 (13.5)	**18**	68.5 (2.7)	68 (15)	**14**	76 (3.0)	86.5 (19)	**10**	96.5 (3.8)	97.5 (21.5)	**7.5**	109 (4.3)
	697 (7,500)	7.3 (16.1)	70.5 (15.5)	**29**	78.5 (3.1)	77.5 (17)	**24**	86.5 (3.4)	100 (22)	**17**	112 (4.4)	109 (24)	**12**	122 (4.8)
	929 (10,000)	8.3 (18.2)	79.5 (17.5)	**40**	89 (3.5)	82 (18)	**32**	91.5 (3.6)	104.5 (23)	**24**	117 (4.6)	118 (26)	**18**	132 (5.2)
Saskatoon, Saskatchewan	232 (2,500)	4.0 (8.8)	38.5 (8.5)	**6**	43 (1.7)	57 (12.5)	**6**	63.5 (2.5)	66 (14.5)	**3.8**	73.5 (2.9)	77.5 (17)	**2.8**	86.5 (3.4)
	465 (5,000)	5.7 (12.5)	54.5 (12)	**16**	61 (2.4)	68 (15)	**14.5**	76 (3.0)	82 (18)	**9**	91.5 (3.6)	95.5 (21)	**7**	106.5 (4.2)
	697 (7,500)	6.6 (14.6)	63.5 (14)	**28**	71 (2.8)	75 (16.5)	**24**	84 (3.3)	91 (20)	**16**	101.5 (4.0)	104.5 (23)	**12**	117 (4.6)
	929 (10,000)	7.1 (15.6)	68 (15)	**38**	76 (3.0)	82 (18)	**32**	91.5 (3.6)	97.5 (21.5)	**22**	109 (4.3)	113.5 (25)	**18**	127 (5.0)

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Form 81-31, Rev. 9/10

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Appendix H CORRESPONDENCE

246082

THIS INDENTURE made in duplicate this 11th day of May, 1984.

BETWEEN:

Z. MICHAEL TERKUC and ANGELA TERKUC, of the Village of Stittsville, in the Township of Goulbourn, in the Regional Munipality of Ottawa-Carleton,

Hereinafter called the "GRANTORS"

OF THE FIRST PART

AND:

THE CORPORATION OF THE TOWNSHIP OF GOULBOURN,

Hereinafter called the "TOWNSHIP"

OF THE SECOND PART

WHEREAS:

1. The Grantors are the registered owners of an easement for storm sewer and drainage works transferred to them by Grant of Easement dated July 28, 1983 and registered April 6 1984 as Instrument No. NS 234946 over the lands described in Schedule "A";

2. The Township is now the registered owner of Joseph Circle in the Township of Goulbourn and of certain easements for storm sewers and drainage works transferred to the Township by the Grantors herein by Transfer of Easement dated January 9, 1984 and registered June 28, 1984 as Instrument No. 371917, which lands and easements are now more particularly described in Schedule "B" hereto annexed and which lands and easements form part of the benefiting lands described in Schedule "B" of the said Grant of Easement;

3. The Grantors have agreed to grant unto the Township in common with all others entitled thereto the rights and easements for storm sewer and drainage works granted unto the Grantors by the said Instrument No. NS 234946 for the benefit of the lands described in Schedule "B" for the purpose of enabling the Township to construct, operate, repair and maintain storm sewer and drainage works and equipment appurtenant thereto on the lands described in Schedule "A" hereto annexed.

NOW THIS AGREEMENT WITNESSETH that in consideration of the sum of ONE DOLLAR ($1.00) of lawful money of Canada now paid by the Township to the Grantors the receipt whereof is hereby acknowledged the Grantors hereby grant to the Township, its successors and assigns, in common with all others entitled thereto to be used and enjoyed as appurtenant to the said lands of the Township described in Schedule "B" hereto for the following purposes:

1. To enter on and construct, repair and replace storm sewers and drainage works and equipment appurtenant thereto from time to time including all fixtures and equipment as the Township may from time to time or at any time hereafter deem requisite over, under and along and across the lands described in Schedule "A" hereof for the purpose of providing part of the drainage system of the Township of Goulbourn.

2. Together with the right of free unimpeded access to the Township its workmen, vehicles, supplies and equipment at all times and for all purposes necessary for or incidental to the exercise and enjoyment of the rights hereby granted, over the lands described in Schedule "A" hereof and the lands of the Grantor in Instrument No.NS234946, adjacent thereto which may from time to time be unencumbered by other buildings or other structures from the highways or lands abbuting thereon to and from the said storm sewer and drainage works and fixtures or any part or parts thereof which are to be constructed, repaired and replaced and maintained.

3. To trim, fell, and remove any trees and brush necessary and incidental to permit access to construct, maintain and repair any part of the said storm sewer and drainage system.

4. The easements hereinbefore set forth are granted to the Township on the conditions that the Township , its successors and assigns shall be responsible for any damage caused by it or its workment, servants, agents or employees to the lands described in Schedule "A" hereto and the adjoining lands and further covenant and agree to replace as far as

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possible at its own expense any soil or turf removed in connection with any of its work herein referred to.

This Grant and everything herein contained shall enure to the benefit of and be binding upon the parties hereto and their respective heirs, executors, administrators, successors and assigns.

IN WITNESS WHEREOF the Grantors herein have hereunto set their hands and seals this day of , 1984.

SIGNED, SEALED AND DELIVERED in the presence of	as attorney for Z. Michael Terkuc
	as attorney for Angela Terkuc

COMBINED { AFFIDAVIT OF SUBSCR[illegible]NG WITNESS
AFFIDAVIT AS TO AGE AND SPOUSAL STATUS

UN[illegible] STATIONERY CO. LTD., LEGAL FORM DEPT
30 PRODUCTION DRIVE, SCARBOROUGH

246082

AFFIDAVIT OF SUBSCRIBING WITNESS

I, KENNETH V. YOUNG

of the City of Ottawa

in the Regional Municipality of Ottawa-Carleton

make oath and say:

I am a subscribing witness to the attached instrument and I was present and saw it executed

*See footnote at Ottawa by Ray Terkuc as attorney for Z. Michael Terkuc and ~~Angela Terkuc~~ as attorney for ANGELA TERKUC.

*See footnote I verily believe that each person whose signature I witnessed ~~is the party of the same name referred to in the~~ was authorized to execute the instrument as attorney for Z. Michael Terkuc and Angela Terkuc.

SWORN before me at the ~~in the~~ Regional Municipality of Ottawa-Carleton

this 24th day of February 1984

A COMMISSIONER FOR TAKING AFFIDAVITS, ETC.

* *Where a party is unable to read the instrument or where a party signs by making his mark or in foreign characters add "after the instrument had been read to him and he appeared fully to understand it". Where executed under a power of attorney insert "(name of attorney) as attorney for (name of party)"; and for next clause substitute "I verily believe that the person whose signature I witnessed was authorized to execute the instrument as attorney for (name)".*

AFFIDAVIT AS TO AGE AND SPOUSAL STATUS

I, RAY TERKUC ~~I/WE Z. MICHAEL TERKUC and ANGELA TERKUC~~

of the Village of Stittsville, in the Township of Goulbourn

in the Regional Municipality of Ottawa-Carleton

*If attorney see footnote make oath and say: When ~~WE~~ I executed the attached instrument as attorney for Z. MICHAEL TERKUC and as attorney for ANGELA TERKUC, they were spouses of one another within the meaning of Section 1(f) of The Family Law Reform Act and when they executed the Power of attorneys they had attained the age of majority. The Power of Attorneys are in full force and effect and have not been revoked.

~~I/WE were~~ I was at least eighteen years old.

Within the meaning of section 1(f) of the Family Law Reform Act:—

Strike out inapplicable clauses I was a spouse. The property described in the attached instrument has ~~XXXXXXXXXXXXXXXXXXXX~~ never been occupied by myself and my spouse as a matrimonial home. I am not a non resident in Canada within the provisions of The ~~b) We were spouses of one another.~~ Canada Income Tax Act.

~~XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX was my spouse.~~

**Not a Matrimonial Home, etc. see footnote. That Z. Micheal Terkuc and Zvone (Mike) Terkuc are one and the same person and that the said Z. Michael Terkuc also known as Zvone (Mike) Terkuc and Angela Terkuc are not non residents in Canada within the provisions of The Canada Income Tax Act.

(SEVERALLY) SWORN before me at the City of Ottawa, in the Regional Municipality of Ottawa-Carleton

this 24th day of February 1984

~~Z. Michael Terkuc~~

~~Angela Terkuc~~

A COMMISSIONER FOR TAKING AFFIDAVITS, ETC.

**Where affidavit made by attorney substitute: "When I executed the attached instrument as attorney for (name), he/she was (spousal status and, if applicable, name of spouse) within the meaning of Section 1(f) of the Family Law Reform Act and when he/she executed the power of attorney, he/she had attained the age of majority".*

**[illegible]

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WHEREAS Power of attorney was granted to Ray Terkuc by Power of Attorney dated December 13, 1983, and registered in the Land Registry Office of Ottawa-Carleton No. 4 on the 6th day of March, 1984, as Instrument Number 358313, AND IN the Land Registry Office of Ottawa-Carleton No. 5 on March 5, 1984, as Number NS231281.

AND WHEREAS Power of Attorney was granted to Ray Terkuc by Power of Attorney dated December 13, 1983, and registered in the Land Registry Office of Ottawa-Carleton No. 4 on the 6th day of March, 1984, as Instrument Number 358314, AND in the Land Registry Office of Ottawa-Carleton No. 5 on March 5, 1984, as Number NS 231280.

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Schedule "A"

ALL AND SINGULAR THAT certain parcel or tract of land and premises situate, lying and being in the Township of Goulbourn, formerly in the Old Township of Goulbourn, in the Regional Municipality of Ottawa-Carleton AND BEING COMPOSED OF Part of the East half of Lot 26 and part of the West half of Lot 27 in Concession 12 of the said Township and which said parcel or tract of land may be more particularly described as follows:

PREMISING that all bearings mentioned herein are astronomic and referred to the northwesterly limit of Highway #15 as widened across the said East half of Lot 26 and the West half of Lot 27, and shown to be North 48 degrees 15 minutes 10 seconds East on a plan registered in the Registry Office for the Registry Division of Ottawa-Carleton (No. 5) as Instrument No. 10069.

COMMENCING at an iron bar marking the intersection of the established division line between the East and West halves of Lot 26 and the northwesterly limit of Highway #15 as widened by said Plan No. 10069, the said point of commencement being distant 16.49 feet measured on a bearing North 40 degrees 36 minutes 50 seconds West from the most southerly corner of the East half of Lot 26;

THENCE on a bearing of North 48 degrees 15 minutes 10 seconds East along the said northwesterly limit of Highway #15 as widened, a distance of 20 feet to the most southerly corner of the lands described in Instrument No. 35674 registered in the said Registry Office.

THENCE on a bearing of North 42 degrees 02 minutes 50 seconds West parallel to the said established division line between the East and West halves of Lot 26, a distance of 252.10 feet to an iron bar distant 20 feet southeasterly from an old log fence, the said iron bar defining the most westerly corner of the said lands described in Instrument No. 35674;

THENCE on a bearing of North 45 degrees, 37 minutes 40 seconds East and parallel to the said old log fence, a distance of 389.5 feet to an iron bar marking the most northerly corner of the said lands described in Instrument No. 35674;

THENCE on a bearing of South 52 degrees 16 minutes 50 seconds East a distance of 274.5 feet to an iron bar marking the most easterly limit of the said lands described in Instrument No. 35674, the said iron bar being on the northwesterly

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limit of Highway #15 as widened by the said Plan No. 10069 and distant 457.8 feet measured along the said northwesterly limit on a bearing of North 48 degrees 15 minutes 10 seconds East from the point of commencement;

THENCE on a bearing of North 48 degrees 15 minutes 10 seconds East and along the said northwesterly limit of Highway #15 as widened a distance of 1533.73 feet to a point distant 20 feet measured on a bearing of South 48 degrees 15 minutes 10 seconds west from the established division line between the East and West halves of Lot 27, the said point being the most southerly corner of the lands described as "Secondly" in Instrument No. 11372 registered in the aforesaid Registry Office;

THENCE Northwesterly and parallel to the southwesterly limit of the said Lot 27 and along the southwesterly limit of the said lands described in Instrument No. 11372, a distance of 979.6 feet, more or less, to an old fence defining the southeasterly limit of the lands described as "firstly" in said Instrument No. 11372:

THENCE Southwesterly and parallel to the Southerly limit of said Lot 27 and along the said old fence defining the southeasterly limit of the lands described in Instrument Nos. 11372 and 14393, a distance of 970 feet more or less, to the established division line between Lots 26 and 27;

THENCE northwesterly along the said established division line between Lots 26 and 27, a distance of 1993.2 feet more or less, as per Instrument No. 14393, to the northwesterly limit of the said lots;

THENCE Southwesterly along the northwesterly limit of said Lot 26, a distance of 996 feet more or less, to the aforesaid established division line between the East and West halves of Lot 26;

THENCE southeasterly and along the said established division line between the East and West halves of Lot 26 a distance of 2942.8 feet more or less to the point of commencement.

The above described lands are intended to be the same lands described in Instrument Nos. 11906 and 12569, registered in the said Registry Office.

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SCHEDULE "B"

LANDS OWNED BY THE TOWNSHIP

The street, namely: Joseph Circle on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa being the whole of Parcel Street-1 in the Register for Section 4M-433.

LANDS OVER WHICH THE TOWNSHIP HAS AN EASEMENT FOR STORM SEWERS AND DRAINAGE WORKS

(1) Part of Lot 4 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 1 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 4-1 in the Register for Section 4M-433.

(2) Part of Lot 5 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 22 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 5-1 in the Register for Section 4M-433.

(3) Part of Lot 6 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 23 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 6-1 in the Register for Section 4M-433.

(4) Part of Lot 9 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 2 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 9-1 in the Register for Section 4M- 433 .

(5) Part of Lot 10 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 3on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 10-1 in the Register for Section 4M- 433 .

(6) Part of Lot 11 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 4 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 11-1 in the Register for Section 4M- 433 .

(7) Part of Lot 12 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 5 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 12-1 in the Register for Section 4M- 433 .

(8) Part of Lot 13 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 6 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 13-1 in the Register for Section 4M- 433 .

(9) Part of Lot 14 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 7 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 14-1 in the Register for Section 4M- 433 .

(10) Part of Lot 15 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 8 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 15-1 in the Register for Section 4M- 433 .

(11) Part of Lot 16 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 9 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 16-1 in the Register for Section 4M- 433 .

(12) Part of Lot 17 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 10 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 17-1 in the Register for Section 4M- 433 .

(13) Part of Lot 18 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 11 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 18-1 in the Register for Section 4M- 433 .

(14) Part of Lot 19 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 12 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 19-1 in the Register for Section 4M- 433 .

(15) Part of Lot 20 on Plan 4M- 433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 13 on a plan of survey of record deposited in the said office as Plan 4R- 4527 being part of Parcel 20-1 in the Register for Section 4M- 433 .

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SCHEDULE "B" cont'd B-4

(16) Part of Lot 21 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 14 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 21-1 in the Register for Section 4M-433.

(17) Part of Lot 22 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 15 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 22-1 in the Register for Section 4M-433.

(18) Part of Lot 23 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 16 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 23-1 in the Register for Section 4M-433.

(19) Part of Lot 24 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 17 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 24-1 in the Register for Section 4M-433.

(20) Part of Lot 25 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 18 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 25-1 in the Register for Section 4M-433.

(21) Part of Lot 26 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 19 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 26-1 in the Register for Section 4M-433.

SCHEDULE "B" cont'd

(22) Part of Lot 27 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 20 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 27-1 in the Register for Section 4M-433.

(23) Part of Lot 28 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 21 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 28-1 in the Register for Section 4M-433.

(24) Part of Lot 29 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 24 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 29-1 in the Register for Section 4M-433.

(25) Part of Block 36 on Plan 4M-433 registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa designated as Part 25 on a plan of survey of record deposited in the said office as Plan 4R-4527 being part of Parcel 36-1 in the Register for Section 4M-433.

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Rev Oct /81

Form 1
Land Transfer Tax Act

246082 REFER to all instructions on reverse side

AFFIDAVIT OF RESIDENCE AND OF VALUE OF THE CONSIDERATION

IN THE MATTER OF THE CONVEYANCE OF *(insert brief description of land)* Part of Lots 26 and 27, Concession 12, Township of Goulbourn

BY *(print names of all transferors in full)* Z. MICHAEL TERKUC and ANGELA TERKUC

TO *(see instruction 1 and print names of all transferees in full)* THE CORPORATION OF THE TOWNSHIP OF GOULBOURN

I, *(see instruction 2 and print name(s) in full)* JUDITH M. OYEN

MAKE OATH AND SAY THAT:

1. I am (place a clear mark within the square opposite that one of the following paragraphs that describes the capacity of the deponent(s)): *(see instruction 2)*
   - ☐ (a) A person in trust for whom the land conveyed in the above - described conveyance is being conveyed;
   - ☐ (b) A trustee named in the above - described conveyance to whom the land is being conveyed;
   - ☐ (c) A transferee named in the above - described conveyance;
   - ☒ (d) The authorized agent or solicitor acting in this transaction for THE CORPORATION OF THE TOWNSHIP OF GOULBOURN *(insert name(s) of principal(s))* described in paragraph(s) (a), (b), (c) above; *(strike out references to inapplicable paragraphs)*
   - ☐ (e) The President, Vice-President, Manager, Secretary, Director, or Treasurer authorized to act for *(insert name(s) of corporation(s))* described in paragraph(s) (a), (b), (c) above. *(strike out references to inapplicable paragraphs)*
   - ☐ (f) A transferee described in paragraph ( ) *(insert only one of paragraph (a), (b) or (c) above, as applicable)* and am making this affidavit on my own behalf and on behalf of *(insert name of spouse)* who is my spouse described in paragraph ( ). *(insert only one of paragraph (a), (b) or (c) above, as applicable)*

   and as such, I have personal knowledge of the facts herein deposed to.

2. I have read and considered the definitions of "non-resident corporation" and "non-resident person" set out respectively in clauses 1 (1)(f) and (g) of the Act. *(see instruction 3)*

3. The following persons to whom or in trust for whom the land conveyed in the above-described conveyance is being conveyed are non-resident persons within the meaning of the Act. *(see instruction 4)* nil

4. THE TOTAL CONSIDERATION FOR THIS TRANSACTION IS ALLOCATED AS FOLLOWS:

(a) Monies paid or to be paid in cash	$ 1.00		ALL BLANKS MUST BE FILLED IN.
(b) Mortgages (i) Assumed *(show principal and interest to be credited against purchase price)*	$ nil		
(ii) Given back to vendor	$ nil		
(c) Property transferred in exchange *(detail below)*	$ nil		
(d) Securities transferred to the value of *(detail below)*	$ nil		
(e) Liens, legacies, annuities and maintenance charges to which transfer is subject	$ nil		
(f) Other valuable consideration subject to land transfer tax *(detail below)*	$ nil		
(g) VALUE OF LAND, BUILDING, FIXTURES AND GOODWILL SUBJECT TO LAND TRANSFER TAX *(total of (a) to (f))*	$ 1.00	$ 1.00	INSERT "NIL" WHERE APPLICABLE
(h) VALUE OF ALL CHATTELS – items of tangible personal property *(Retail Sales Tax is payable on the value of all chattels unless exempt under the provisions of the Retail Sales Tax Act, R.S.O. 1980, c.454, as amended)*		$ nil	
(i) Other consideration for transaction not included in (g) or (h) above		$ nil	
(j) TOTAL CONSIDERATION		$ 1.00	

5. If consideration is nominal, describe relationship between transferor and transferee and state purpose of conveyance. *(see instruction 5)* Transfer to a municipality for storm sewers and drainage works.

6. If the consideration is nominal, is the land subject to any encumbrance? nil

7. Other remarks and explanations, if necessary nil

SWORN before me at the City of Ottawa in the Regional Municipality of Ottawa-Carleton this 28 day of June 1984

L. Uitch
A Commissioner for taking Affidavits

LYNNE S. UITCH, a Commissioner for taking Affidavits, Judicial District of Ottawa - Carleton, for Bell, Baker, Barristers and Solicitors. Expires October 18, 1986

Judith M. Oyen
Judith M. Oyen

PROPERTY INFORMATION RECORD

A. Describe nature of instrument Grant of Easement

B. (i) Address of property being conveyed *(if available)* not available

(ii) Assessment Roll # *(if available)* not available

C. Mailing address(es) for future Notices of Assessment under *the Assessment Act* for property being conveyed *(see instruction 6)*. Box 189, Stittsville, Ontario.

D. (i) Registration number for last conveyance of property being conveyed *(if available)*. not available

(ii) Legal description of property conveyed: Same as in D. (i) above. ☐ Yes ☐ No ☒ Not Known

E. Name(s) and address(es) of each transferee's solicitor
Bell, Baker
116 Lisgar Street
Suite 500
Ottawa, Ontario
K2P 0C2

For Land Registry Office use only

REGISTRATION NO.
Land Registry Office No.
Registration Date

©UNIFAX 1983
30 Production Drive
Scarborough, Ont. M1H 2X9

Form 1130 Affidavit, Planning Act
For use under
Land Titles Act
and Registry Act
Revised Nov., 1982

246082

Affidavit - Planning Act

IN THE MATTER OF THE PLANNING ACT (as amended)

AND IN THE MATTER OF THE TITLE TO Part of Lots 26 and 27, Concession 12, Township of Goulbourn

Deed, Mortgage, Partial Discharge of Mortgage, Lease, Transfer, Charge, etc.

AND IN THE MATTER OF A Grant of Easement

THEREOF, FROM Z. MICHAEL TERKUC and ANGELA TERKUC

TO THE CORPORATION OF THE TOWNSHIP OF GOULBOURN

DATED 1984.

I, JUDITH M. OYEN

of the City of Ottawa in the Regional Municipality of Ottawa-Carleton

MAKE OATH AND SAY AS FOLLOWS:

1. I am the Solicitor for the Grantee named in the above mentioned Instrument, and have knowledge of the matters hereinafter sworn.

2. A consent under section 49 of the Planning Act, as amended, in respect of the said Instrument is not required because

Delete (a) if not applicable

~~(a) [illegible]~~ with.

State other reason if any

(b) The Grantor is a municipality exempt pursuant to Section 49(3)(c) of the Planning Act, 1983.

SWORN before me

at the City of Ottawa

in the Regional Municipality of Ottawa-Carleton

this 28

day of June 1984

LYNN D. VEITCH, a Commissioner for taking Affidavits, Judicial District of Ottawa - Carleton, for Bell, Baker, Barristers and Solicitors
Expires October 19, 19[illegible]

L. Veitch

246082

PROPERTY OF THE
LAND REGISTRY OFFICE

NS246082

REGISTRY DIVISION
OF OTTAWA-CARLETON (NO 5)
I CERTIFY THAT THIS INSTRUMENT
IS REGISTERED AS OF

'84 JUN 28 P3:53

IN THE LAND REGISTRY AT
OTTAWA, ONTARIO
LAND REGISTRAR

15

LAND REGISTRY # 5

CK	Bk 8
2	
ABS	

28JUN84 AA 5761 15:53
#5761 RFEE 19.00

19.

NS246082

DATED: May 11 1984.

BETWEEN:

Z. MICHAEL TERKUC and
ANGELA TERKUC

AND:

THE CORPORATION OF THE
TOWNSHIP OF GOULBOURN

GRANT OF EASEMENT

Box 22

Bell, Baker
Barristers & Solicitors
116 Lisgar Street
Suite 500
Ottawa, Ontario
K2P 0C2

Lynch, Amanda

From: Diamond, Emily (MOECC) <Emily.Diamond@ontario.ca>
Sent: Friday, February 05, 2016 9:41 AM
To: Lynch, Amanda
Cc: Moroz, Peter
Subject: RE: 5731 Hazeldean Road proposed development

Hi Amanda,

The option of going through with the Kanata Master Servicing Study would not require an Environmental Compliance Approval through the MOECC as the storm water would be discharging directly to the storm sewer.

As discussed, the MOECC has no objections to the option of treating storm water on-site and discharging to Poole Creek. An ECA would be required for this option as this would be direct discharge to a watercourse.

Please let me know if you have any further questions.

Thank you,

Emily Diamond
Environmental Officer
Ministry of the Environment and Climate Change

Ottawa District Office
2430 Don Reid Drive
Ottawa, Ontario, K1H 1E1
Tel: 613-521-3450 ext 238
Fax: 613-521-5437
e-mail: emily.diamond@ontario.ca

From: Lynch, Amanda [mailto:Amanda.Lynch@stantec.com]
Sent: February-02-16 3:13 PM
To: Diamond, Emily (MOECC)
Cc: Moroz, Peter
Subject: 5731 Hazeldean Road proposed development

Hi Emily,

Thank you again for meeting with us today. I am sending this email for record of confirmation of our pre-consultation meeting with you regarding the proposed development at 5731 Hazeldean Road.

We discussed that the Kanata Master Servicing Study includes the subject site as connected to the storm sewer in Huntmar Road and discharging to the future Pond 5. Due to timing of development and construction of Pond 5 the site would likely need to connect to the Fairwinds interim pond in the interim condition. You confirmed that in this case an ECA would not be required since the subject site would discharge to a storm sewer. We also discussed the option to provide on-site quality and quantity control and discharge directly to Poole Creek in order to reduce infrastructure and cost sharing costs and invest in low-impact development measures on-site instead. You confirmed for us that this option would require a direct sumbmission to the MOECC for a stormwater management ECA as it would we discharging to a watercourse. Additionally, we asked if the MOECC had any other concerns with regards to the option to discharge to Poole Creek and we were told only that it is noted that Poole Creek supports cool water fish and measures to mitigate temperature impacts should be implemented. We noted that the MVCA had previously indicated this to us and mitigating measures would be incorporated into the design.

In summary, the MOECC had no objections to the option to provide on-site quality and quantity control and discharge to Poole Creek, and confirmed that an ECA would be required for this servicing option.

Could you please reply to this email with your confirmation of this pre-consultation meeting and the ECA requirements for the 5731 Hazeldean Road site.

Thank you,

Amanda Lynch, P.Eng., ENV SP
Water Resources Engineer

Stantec

Phone: (613) 784-2202
Fax: (613) 722-2799

Amanda.Lynch@stantec.com

To:	Nadege Balima, P.Eng. Project Manager Infrastructure Approvals City of Ottawa	From:	Amanda Lynch, P.Eng. Water Resources Engineer Stantec Consulting
File:	160401195	Date:	January 30, 2017

Reference: 5731 Hazeldean Road – LID Monitoring Plan - DRAFT

The following is submitted as a draft monitoring plan for the SWM measures proposed at 5731 Hazeldean Road. This memorandum is to be read in conjunction with the site design report *Servicing and Stormwater Management Brief- 5731 Hazeldean Road,* Stantec, September 9, 2016 and its supporting documents including the site LID design report.

The proposed development site is located in the Kanata West area and at a minimum should follow the monitoring requirements outlined in the *Kanata West Overall Monitoring Plan* (City of Ottawa 2012 see attached excerpt). Due to the unique nature of the proposed site SWM these monitoring requirements have been expanded for this site to include pre-construction and construction monitoring in addition to the post-construction criteria. In order to ensure the stormwater infrastructure is functioning as designed, the following maintenance and monitoring is recommended for the site;

- Annual inspection and maintenance of the catchbasins, catchbasin manholes, and area drains.
- Annual inspection of any sediment accumulation within the infiltration gallery and bioswale which may require removal to promote the overall function of the bioswale/infiltration gallery over time.

The proponent will be responsible for the monitoring and inspection for the duration of the monitoring program as well as the long-term operation and maintenance of the LID measures, catchbasins, catchbasin manhole, and area drains.

The recommended monitoring plan includes:

- Pre-Construction Monitoring;
- During Construction Monitoring; and
- Post-Construction Monitoring.

MONITORING OBJECTIVES AND TARGETS

The primary objective of the monitoring program is to confirm that the constructed SWM and LID measures are meeting the design performance levels which include both water quantity and quality objectives. The secondary objective of the program is to provide routine inspections to assess maintenance requirements. The following section outlines the proposed monitoring targets for the site.

Poole Creek is designated as cool water fish habitat therefore creek temperatures must remain around 19-25°C (per Fisheries and Oceans Canada, *Fish Habitat Primer*, 2008). Continuous temperature monitoring at the site discharge and instream must demonstrate that the site construction activities and post-construction development are not impacting the temperatures in the creek.

Turbidity testing will need to be completed downstream of the site outlet during construction and should show no more than 5NTU increase in turbidity above background levels (upstream levels in the creek).

TSS sampling will be completed before and after construction. Post-construction monitoring should confirm the 80% TSS removal criterion is met by the site controls.

Water level monitoring is to be used to assess actual storage requirements and discharge rates. Facilities constructed and operated as designed should have results confirming that design discharges are generally not exceeded.

MONITORING PLANS

MONITORING LOCATIONS

Adequate monitoring of the overall system will require data collection from various locations. A plan identifying each of the locations is attached as Figure 1.0. The **Table 1** below provides a description of each of these locations and at which monitoring stages they will need to be included.

Table 1: Summary of Monitoring Locations

Location ID	Description	Pre-construction		Construction		Post-Construction	
		Quality	**Quantity/Flow**	**Quality**	**Quantity/Flow**	**Quality**	**Quantity/Flow**
1	Upstream of outlet in Poole Creek	Y	Y	Y	Y	Y	Y
2	Downstream of outlet in Poole Creek	Y	Y	Y	Y	Y	Y
3	Upstream of OGS (at STM104)	N/A	N/A	N/A	N/A	Y	Y

Location ID	Description	Pre-construction		Construction		Post-Construction	
4	Downstream of OGS (at STM101)	N/A	N/A	N/A	N/A	Y	Y
5	Infiltration Gallery	N/A	N/A	N/A	N/A	N	Y
6a & 6b	Rainwater Harvesting Tank	N/A	N/A	N/A	N/A	N	Y
7	Bioswale (at monitoring port)	N/A	N/A	N/A	N/A	N	Y

PRE-CONSTRUCTION MONITORING

On-site inspections by an inspector, Certified Arborist, or qualified biologist are recommended to ensure the proper installation of:

- Sediment and erosion control measures.
- Tree protection measures.

To confirm seasonal groundwater levels for infiltration measures and provide a basis of comparison for post-construction conditions, the pre-construction monitoring for this site should also consist of seasonal water level monitoring of the on-site monitoring wells and piezometers from winter 2017 to Fall 2017.

Table 2 shows the recommended pre-construction monitoring activities and how they will apply to this site.

Table 2: Recommended Pre-Construction Monitoring

Parameter	Location	Method	Frequency
Water Quality (TSS, TP, temperature)	Upstream and downstream of proposed discharge location	Grab samples – quality Continuous logger - temperature	Quality – monthly following minimum 10mm rainfall event Temperature - Continuous
Groundwater	Level- across site Quality- at upstream and downstream limits	Levels – manual measurement Quality – grab sample	Levels- Monthly Quality- annual
Vegetative units and buffers	Across site and adjacent natural features and/or perimeter lands	Visual observation	Seasonally

DURING CONSTRUCTION MONITORING

In addition to an environmental inspector, the following is recommended during construction:

- Pruning of any limbs or roots disrobed during construction by a Certified Arborist;
- Maintenance of vegetated setbacks from creek;
- Fueling of machinery to be done at designated locations away from the Core Environmental Features and their associated buffer;
- Storage of machinery and material, fill, etc. to be done in designated areas away form the Core Environmental Features and their associated buffer;
- Equipment movement through natural areas and associated buffers to be controlled;
- Nest searches, if construction during the breeding bird season (May 1 to July 31); and
- Regular inspection and maintenance of the catchbasins, catchbasin manholes, area drains, and culvert.

Table 3 shows the recommended during-construction monitoring activities and how they will apply to this site.

Table 3: Recommended During-Construction Monitoring

Parameter	Location	Method	Frequency
Water Quality (Turbidity temperature)	Upstream and downstream of proposed discharge location	Grab samples/in-situ testing – quality Continuous logger - temperature	Quality – following all events >10mm or during all construction dewatering activities Temperature - Continuous
Groundwater	Level- across site Quality- at upstream and downstream limits	Levels – manual measurement Quality – grab sample	Levels- monthly Quality- annual
Vegetative units and buffers	Across site and adjacent natural features and/or perimeter lands	Visual observation	Seasonal
E&SC measures	At outlets from sedimentation facilities	Turbidity testing – quality Continuous logger - temperature	Minimum monthly or following all runoff events, continuously for Temperature
Detailed buffer observations	Any vegetated area identified for protection	Visual observation	Seasonal

POST-CONSTUCTION MONITORING

The post-construction monitoring program is recommended to be phased into two periods as follows:

- Stage 1 – years 1 to 3: frequent monitoring and inspection following significant rainfall events >10mm or at least 4 times per year from May to October (inclusive)

- Stage 2 – after year 3: annual monitoring and inspection in the spring to identify any maintenance needed as a result of winter weather/operations.

Monitoring during stage 1 will be required to provide sufficient evidence of compliant performance of the LID features as required by the City of Ottawa for LID Pilot Project sites. Monitoring during stage 2 will be required to ensure the system continues to operate properly and is in compliance with criteria outlined in the MOECC ECA.

Table 4 and **Table 5** shows the recommended post-construction monitoring activities and how they will apply to this site. It is noted that all water quality sampling and temperature monitoring will be completed upstream of the outfall to Poole Creek in order to collect samples and data that is not influenced by discharge from the CMHC site discharging at the same outlet to Poole Creek.

Table 4: Recommended Post-Construction Monitoring Years 1-3

Parameter	Location	Method	Frequency
Water Quality in Poole Creek (TSS, TP, temperature)	Upstream and downstream of proposed discharge location	Grab samples – quality Continuous logger - temperature	Quality – Monthly following rainfall event >10mm Temperature - Continuous
Groundwater	Level- across site Quality- at upstream and downstream limits	Levels – manual measurement Quality – grab sample	Levels- seasonal Quality- annual
Vegetative units and buffers	Across site and adjacent natural features and/or perimeter lands	Visual observation	Seasonal
Quality Control Performance of SWM systems (at-source, conveyance, and end-of-pipe facilities	Water quality (TSS and TP) upstream and downstream of water quality unit. Water temperature before property line.	Grab samples – quality Continuous logger - temperature	Once per year following significant rainfall event (25 mm) Once per month following rainfall event >10mm from May 1st to Oct 31st Continuous for temperature
Quantity Control Performance of SWM systems (at-source, conveyance, and end-of-pipe facilities	On-site SWM systems	Continuous water level monitoring	Continuous water level monitoring of RWH Tank, infiltration gallery and bioswale
Detailed buffer observations	Any vegetated area identified for protection	Visual inspection	Seasonal

Table 5: Recommended Post-Construction Monitoring after Year 3

Parameter	Location	Method	Frequency
Water Quality in Poole Creek (TSS, TP)	Upstream and downstream of proposed discharge location	Grab samples – quality	Quality – twice per year following rainfall event >10mm
Groundwater	Level- across site Quality- at upstream and downstream limits	Levels – manual measurement Quality – grab sample	Levels- seasonal Quality- annual
Vegetative units and buffers	Across site and adjacent natural features and/or perimeter lands	Visual observation	Seasonal
Quality Control Performance of SWM systems (at-source, conveyance, and end-of-pipe facilities	Water quality (TSS and TP) upstream and downstream of water quality unit.	Grab samples – quality	Twice per year following rainfall event >10mm from May 1st to Oct 31st
Quantity Control Performance of SWM systems (at-source, conveyance, and end-of-pipe facilities	On-site SWM systems	Inspection and manual measurement	Twice per year following rainfall event >10mm
Detailed buffer observations	Any vegetated area identified for protection	Visual inspection	Seasonal

POST-CONSTRUCTION MAINTENANCE

In addition to monitoring of the LID features, regular or routine maintenance will be required. It is anticipated that inspection of each of the facilities would be completed in conjunction with appropriate monitoring events however, separate visits may be needed to complete the necessary maintenance. The following section outlines routine maintenance that should be completed for each of the LID features.

RAINWATER HARVESTING TANK

The rainwater Harvesting system consists of two 167m^3 storage tanks which collect runoff from the tributary roof tops. The tanks provide storage of runoff to be used for irrigation of the site landscaped areas. An overflow pipe is provided from each of the tanks that connects to the site storm sewers and allow runoff volume greater than the available tank storage to drain to the storm sewer. During months when irrigation is not required, the proposed system will be switched to allow the irrigation pump to discharge to the storm sewer to ensure the tank does not sit full.

Routine inspection and maintenance activities for the proposed rainwater harvesting tank should include the activities listed in **Table 6** below.

Table 6: Rainwater Harvesting Post-construction Maintenance and Operation Activities

Activity	Frequency Years 1-3	Frequency After Year 3
Manual measurement of water level in tank	Seasonal inspection at start and end of irrigation season Two visits during irrigation season	Seasonal inspection at start and end of irrigation season
Manual measurement of any sediment accumulation in the tank	Seasonal inspection at start and end of irrigation season Two visits during irrigation season	One inspection mid-irrigation season One inspection at end of irrigation season
cleanout if sediment depth exceeds 100mm. Sediment should be removed via a vacuum truck following drawdown of the tank	As needed	As needed
Review of water level data to ensure that high/low floats triggering the pumps are operating properly	Twice during irrigation season	Not applicable no water level monitoring

Routine operational requirements:

- At the end of the irrigation season: The valves controlling the feed to the irrigation system should be closed and the valve for the storm sewer should be opened

- At the start of the irrigation season: The valves controlling the feed to the irrigation system should be opened and the valve for the storm sewer should be closed

BIOSWALE

The proposed bioswale is located along the northeastern property line and has an area of approximately 190m^2. The swale consists of a 300mm amended soil layer above a 700mm thick clear stone trench. A 250mm perforated subdrain is located at the top of the trench layer to provide drainage of the system in larger rainfall events.

Routine inspection and maintenance activities for the proposed bioswale should include the activities listed in **Table 7** below.

Table 7: Bioswale Post-construction Maintenance Activities

Activity	Frequency Years 1-3	Frequency After Year 3
Frequent watering of planted vegetation following initial planting to ensure vegetation is well established.	As needed in year 1 depending on precipitation	As needed in drought years
Removal of any trash build up in bioswale.	Once in spring, summer and fall	Once in spring, summer and fall
Inspection of bioswale for sediment build-up and excess water ponding	Once per month following rainfall event >10mm	Once in spring, summer, and fall following a rainfall event >10mm
Removal, disposal and replacement of mulch layer	Recommended every two years or as inspection requires if sediment accumulation is observed.	Recommended every two years or as inspection requires if sediment accumulation is observed.

INFILTRATION GALLERY

The proposed infiltration gallery consists of Stormtech MC-4500 prefabricated storage cells that increase the storage volume available in the system foot print. The units are backfilled with clearstone to provide additional storage volume. The total system storage is 592m^3 with footprint area of 474m^2. The proposed system is located below the parking lot near the northern corner of the site.

Routine inspection and maintenance activities for the proposed infiltration gallery should include the activities listed in **Table 8** below.

Table 8: Infiltration Gallery Post-construction Maintenance Activities

Activity	Frequency Years 1-3	Frequency After Year 3
Manual measurement of water level in tank	Seasonal inspection at start and end of irrigation season Two visits during irrigation season	Seasonal inspection at start and end of irrigation season
Manual measurement of any sediment accumulation in the tank	Seasonal inspection at start and end of irrigation season Two visits during irrigation season	One inspection mid- irrigation season One inspection at end of irrigation season
cleanout if sediment depth exceeds 100mm. Sediment should be removed via a vacuum truck following drawdown of the tank	As needed	As needed

OIL GRIT SEPARATOR

The proposed oil/grit separator is a StormCeptor STC3000 and is sized to provide 80% TSS removal for the site. The unit is located below the drive isle immediately upstream of the infiltration gallery.

Routine inspection and maintenance activities for the proposed oil/grit separator should include the activities listed in **Table 9** below.

Reference: 5731 Hazeldean Road – LID Monitoring Plan - DRAFT

Table 9: Infiltration Gallery Post-construction Maintenance Activities

Activity	Frequency Years 1-3	Frequency After Year 3
Manual measurement of water level in tank	Seasonal inspection at start and end of irrigation season Two visits during irrigation season	Seasonal inspection at start and end of irrigation season
Manual measurement of any sediment accumulation in the unit	Seasonal inspection at start and end of irrigation season Two visits during irrigation season	One inspection mid- irrigation season One inspection at end of irrigation season
cleanout if sediment depth exceeds 250mm. Sediment should be removed via a vacuum truck following drawdown of the tank	As needed	As needed

ANNUAL REPORTING

Annual reports will be prepared in accordance with the *Implementation Plan Kanata West Development Area*; and submitted to the City of Ottawa and the MOECC. Reports will summarize monitoring activities, maintenance requirements or recommendations as necessary, and overall system performance.

STANTEC CONSULTING LTD.

Amanda Lynch, P.Eng.
Water Resources Engineer
Phone: (613) 784-2202
Fax: (613) 722-2799
Amanda.Lynch@stantec.com

Attachments: Kanata West Overall Monitoring Plan, Monitoring Location Plan

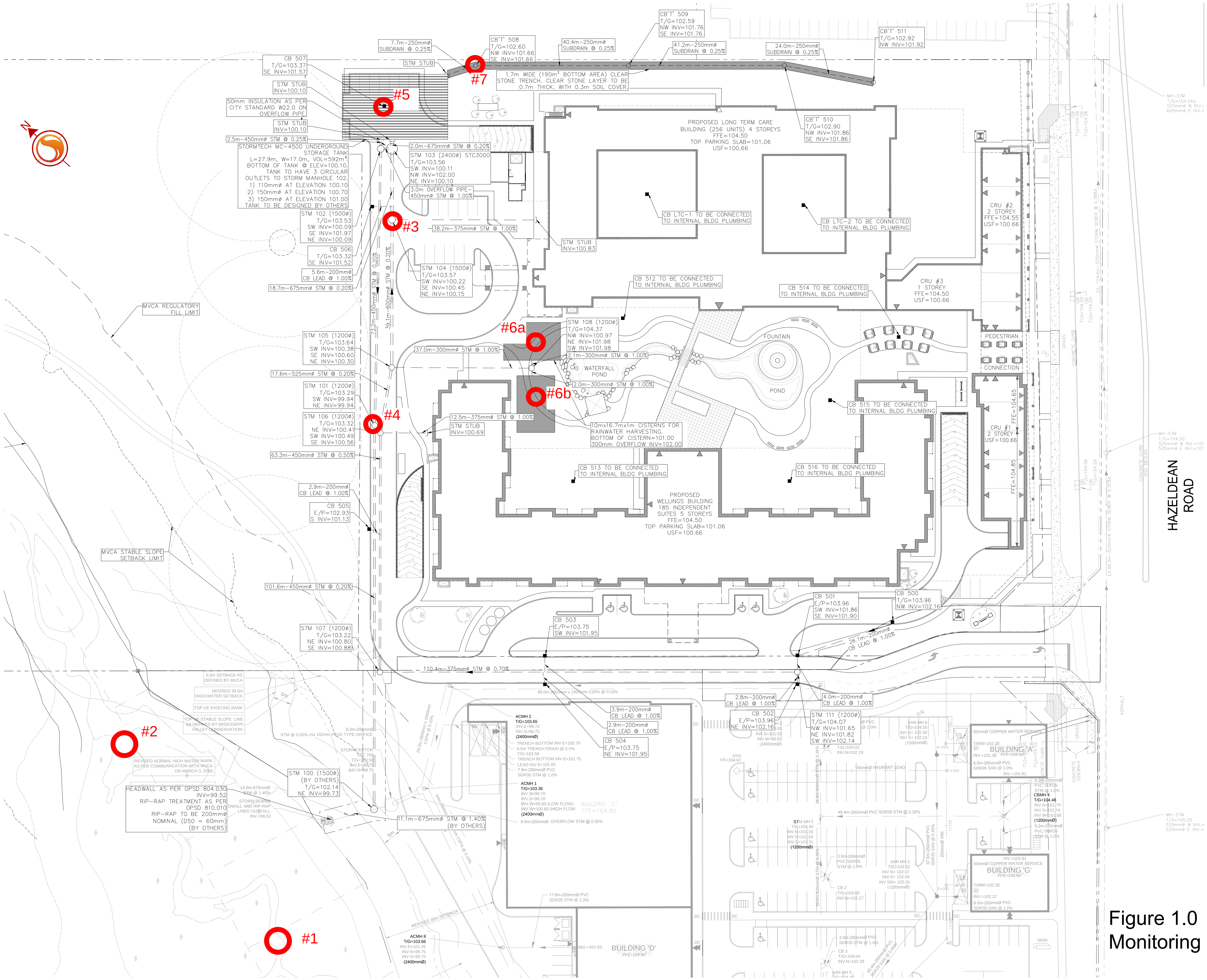

Figure 1.0
Monitoring Locations Plan

Excerpt from Kanata West Overall Monitoring Plan, City of Ottawa, 2012

Stormwater Management Monitoring

The City provides on-going monitoring of stormwater management facilities for suspended solids, phosphorous, and temperature (if required by the classification of the receiver). Visual inspections of SWM facilities occur after each large event (15 mm or greater) and debris is removed as necessary to ensure proper functioning of the facility. Routine inspections of inlets/outlets and the depth of sediment are carried out at the same time.

Construction inspection staff regularly checks these facilities prior to the City assuming the facilities after 80% build-out and identify any remedial measures required to be implemented by the developer to ensure the protection of the receiving stream. An operation and maintenance manual must be prepared and provided to the City prior to assumption of the facility.

The following represents a standardized SWM monitoring program for the Kanata West Area:

Monitoring Program:

1. The stormwater monitoring program shall be implemented for a minimum of two years and shall continue to be implemented until such time that the MOE's Ottawa District Office provides written notice that the program may be discontinued;

2. Monitoring will be provided during the period between May 1st and October 31st for water quality and water level as well as general performance. Water quality would be established for both baseflow and rainfall event conditions;

3. Routine operational inspections would be conducted over the life of the facility, to confirm: general site conditions (erosion/landscaping); ensure monitoring equipment is functioning appropriately; and that orifices and weirs are not clogged with debris. Routine cleaning of any blockages would be done during the inspections, if required;

4. Pond water levels would be monitored to determine drawdown characteristics of the facility (typically 24 - 48 hours). No flow monitoring is proposed in this program;

5. Water quality samples would consist of composite samples (collected utilizing automated equipment or by grab sampling) taken at the facility inlet and outlet during/after specified rainfall events. The routine inspection would typically be conducted coincident with sample collection activities;

6. Water quality parameters would include the Total Suspended Solids (TSS) and Total Phosphorous (TP) and Water Temperature (spot measurement);

7. The sample collection, preservation, handling and analytical methods including detection limits, would be documented. Sample analysis to be conducted per Standard Methods or approved equivalent at a CALA certified laboratory. Field and lab QA/QC procedures would reflect standard sampling protocols (i.e. samples delivered within 12 hours to lab following collection);

8. Provide monitoring (sampling, water levels) during the following events over a two year period to ensure that the facility is performing as designed:

- Two small rainfall events (less than 7mm)
- Two medium rainfall events (7-15mm)
- Three large rainfall events (greater than 15mm)

9. The requirement is for a minimum of the 7 noted events of the size specified. Monitoring activities would typically capture a number of other events during the process, as the amount of rainfall from an event is not predictable in advance. All events that are monitored/sampled, are to be reported in the annual reports. The sampling of all the events within a one year period, although possible, is not acceptable as the intent is a two year program;

10. Rainfall measurements should be obtained from the nearest available City of Ottawa raingauge(s) to the facility;

11. A topographic/bathymetric survey should be undertaken after 3-5 years of operation to determine sediment deposition and sediment deposition rates. This would allow for more concise forecast of forebay cleanout frequency; either confirming or revising the frequency in final SWM report.

Annual Stormwater Monitoring Report

The Annual Stormwater monitoring report shall be prepared and submitted to the District Manager, Ottawa District Office of MOE within six months following the end of the monitoring period. The Annual Stormwater Monitoring Report shall also be provided to the City of Ottawa's Planning and Growth Management Department so that the City can review and include results in its annual Overall Monitoring Report in accordance with the *Implementation Plan Kanata West Development Area*; the Report is to contain the following:

1. A description of the physical works, its location, and how it is designed to function;

2. A tabulation, interpretation and summary of all monitoring data with an assessment of the performance of the facility based on TSS removal including comparison of the water quality data with applicable criteria such as the Provincial Water Quality Objectives (PWQO's);

3. An evaluation of the pond's performance and its ability to meet the design performance criteria of 70% TSS removal (during the monitoring period) and ability to achieve an appropriate draw down time (24 – 48 hours);

4. A description of any operating problems encountered and corrective actions taken during the reporting period and the need for further investigation in the following reporting period for pond refinements or ways of improving the performance of the facility to meet the performance target;

5. Any need for modifications of the monitoring program and/or the work plan;

6. A summary of any complaints received during the reporting period and any steps taken to address the complaints;

7. Appendices of inspection logs and facility photos;

8. Any other information that is deemed to have been obtained by the Owner pursuant to the requirements of the Certificate of Approval that the MOE District Manager requires for inclusion in the reports.