

136 Bayfield Street and 14 Sophia Street West
Barrie, ON

Water Balance Study

PREPARED FOR:
Rockap Holdings Inc.
701 St. Nicolas Court
Mississauga, ON L5H 4M5

PREPARED BY:
PGL Environmental Consultants
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Whitby, ON L1N 0G5

PGL File: 5689-02.02

October 2022 v4



solve and simplify

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List of Acronyms

bgs	-	below ground surface
IF	-	infiltration factor
LID	-	low-impact development
LSRCA	-	Lake Simcoe Region Conservation Authority
MECP	-	Ministry of the Environment, Conservation and Parks
PGL	-	PGL Environmental Consultants

1.0 INTRODUCTION

Rockap Holdings Inc. retained PGL Environmental Consultants Limited (PGL) to conduct a Water Balance Study for the proposed development at 136 Bayfield Street and 14 Sophia Street West, Barrie, Ontario (the Site; Figure 1). This Water Balance Study was conducted to assess the hydrologic conditions at the Site both prior to and following the proposed development to evaluate the changes to infiltration and runoff.

The proposed development consists of a 12-storey condominium tower, with two 9-storey and one 3-storey podium, and two 3-storey townhouse blocks. There are no underground levels. Current commercial buildings exist at the Site and will be removed as part of Site redevelopment. Development will also include landscaping and paved features at the Site.

Several previous investigations have been completed at the Site, including a geotechnical investigation by V.A. Wood Associates Ltd., which included advancing five boreholes across the Site and completing them as monitoring wells. PGL has also completed separate hydrogeological and environmental investigations at the Site.

2.0 SCOPE OF WORK

PGL reviewed the following documents for this Water Balance Study:

- *Preliminary Geotechnical Investigation, by V.A. Wood Associates Limited*, dated October 2022. Particle Size analysis results are included as Appendix 1;
- *Proposed Drainage Area Plan, by The Municipal Infrastructure Group Ltd (TMIG Ltd)*, version date September 21, 2022 (Appendix 2); and
- *Pervious and impervious land cover areas provided by TMIG Ltd*, June 7, 2021 (Appendix 3).

We also reviewed available Ministry of the Environment, Conservation and Parks (MECP) well records and Ministry of Natural Resources and Forestry Heritage maps.

3.0 SITE BACKGROUND

3.1 Site Location

The Site is a rectangular property on the northwest corner of Bayfield Street and Sophia Street West. It is bounded to the west by Maple View Drive, to the north by a commercial property, to the east by Bayfield Street, and to the south by Sophia Street West.

The Site is improved with a five-storey commercial building on the northeast side, and a two-storey commercial building on the southwest side. Most of the remaining Site area is asphalt-covered for parking. The surrounding area is a mix of commercial and residential uses.

3.2 Physical Setting

The 8,853m² Site is improved with two commercial buildings and surface parking. The Site and area slope south to southeast towards Lake Simcoe, which is about 665m southeast of the Site. Sophia Creek flows westwards in a concrete culvert within the road allowance of Sophia Street West. The creek is daylighted in sections about 300m east of the Site, about 40m west of the Site, and about 250m southwest of the Site.

The Town of Barrie Official Plan Schedule H shows a Natural Heritage Area at the southern part of the Site. The southern part of the Site is classified as 'Level 1 with Existing Development'.

Based on a review of the Lake Simcoe and Couchiching/Black River Source Protection Plan the Site is within a Significant Groundwater Recharge Area (SGRA) and Highly Vulnerable Aquifer Area (HVAA). As such, it is subject to Designated Policy 6.40 of the Lower Simcoe Protection Plan (LSPP) and may be subject to compensation fees if development activities reduce recharge at the Site relative to pre-development conditions.

The southern part of the Site is regulated by the Lake Simcoe Region Conservation Authority (LSRCA), as shown in Appendix 4; therefore, a development permit application will be required.

No further Natural Resources Heritage Sites, Area of Natural and Scientific Research sites, Oak Ridges Moraine, Niagara Escarpment or Environmentally Sensitive areas were identified within 250m of the Site.

Geological maps show the surficial soils near the Site are expected to comprise glaciofluvial ice deposits consisting of gravel and sand, minor till including esker, kame, end moraine and ice-marginal delta, and subaqueous fan deposits (OGS, 2000). Overburden at the Site is underlain by Shadow Lake Formation bedrock consisting of limestone, dolostone, shale, arkose, and sandstone (OGS, 2010). Bedrock is expected to be at a depth of greater than 88.4m based on review of the MECP well records.

Per the geotechnical report provided by V.A. Wood, boreholes were extended to a maximum depth of 15.6m below ground surface (bgs). Soil stratigraphy was observed to include asphalt, gravelly sand, sand till, silt till followed by silt. Particle size analysis results are included as Appendix 1.

A hydrogeological report by PGL (submitted under separate cover) found that springtime water levels at the Site were generally between 0.88m and 2.11m bgs. Groundwater elevation data suggests that local groundwater flow is to the southeast towards Lake Simcoe.

4.0 WATER BALANCE ASSESSMENT

PGL completed water balance calculations for the pre-development conditions compared with a post-development scenario. TGMI confirmed on June 7, 2021, that low-impact development (LID) measures, such as permeable pavements, infiltration trenches, etc., are not being included in the development. This is largely due to the presence of a high water table at the Site (i.e., groundwater within 1m of the surface), which limits the effectiveness of many LID measures.

A stormwater management vault (tank dimensions 15.2m x 5.3m x 3.65m) is proposed to be installed at the southwest corner of the Site on the first level of the building. The design identifies an active storage volume of 231m³ and dead storage volume of 25m³ with a controlled outlet rate of 49.38L/s from the tank to the storm service¹. The tank is to receive roof (rain) water only. It is not an LID.

¹ Functional Servicing and Stormwater Management Report (version 4), October 2022, TGMI

The water balance calculations are included as Appendix 5.

4.1 Pre-Development Conditions

The Site is currently developed. PGL measured a total of 755m² of pervious cover at the Site, and 8,098m² of impervious cover. PGL is not aware of any LID measures at the existing Site.

4.2 Proposed Development

The proposed development includes a 12-storey condominium tower, with two 9-storey and one 3-storey podium, and two 3-storey townhouse blocks. There are no underground levels. Development will also include landscaping and paved features at the Site.

Information received from TMIG Ltd. (Appendix 3) indicates that the developed Site will consist of a total of 8,028m² of impervious cover (parking lots, buildings, sidewalks) and 825m² pervious cover (gardens, landscaping).

4.3 Water Balance Methodology

The annual water budget represents the hydrologic cycle, and can be stated as:

$$\text{Flow in} - \text{flow out} = \text{Change in groundwater storage } (\Delta S)$$

Using long-term estimates or averages for precipitation, evapotranspiration, runoff, and infiltration, there is little to no annual groundwater storage net change on the Site in steady-state conditions. As such, we have assumed ΔS is zero. The flow-in accounts for precipitation (e.g., rain, snow). The flow out considers water runoff to lakes and streams, infiltration to the groundwater table, and evaporation from surface water or vegetation. Groundwater flow into and out of the Site is assumed to balance and is not included in the calculation.

$$P - ET - R - I = \Delta S$$

Where:

- P = Precipitation (mm/year)
- ET = Evapotranspiration (mm/year)
- R = Runoff (mm/year)
- I = Infiltration (mm/year)
- ΔS = Change in groundwater storage annually (mm/year)

The Site water balance was calculated for pre- and post-development to determine the change in runoff and infiltration after development. The Site-level water balance calculations are provided in Appendix 5.

4.4 Climate, Precipitation and Evapotranspiration

Climate data was obtained from the MECP historical climate records and available LSRCA information.

Precipitation data was gathered from the Government of Canada historical climate data. Barrie WPCC, about 1.8km from the Site, was the nearest station with available climate data over a significant period. The provided value for 1981 to 2010 Climate normals was used for pre- and post-development infiltration, which was equal to **933mm/year**.

Evapotranspiration was calculated using the Thornthwaite-Mather method based on available climate data from Barrie WPCC from 1981 to 2010. The calculated evapotranspiration rate was 556mm/year. A previous report prepared for the LSRCA (AquaResource Inc., 2012) shows simulated evapotranspiration rates in the area of 400–500mm/year. This simulated value is likely lower due to the presence of impervious surfaces in the area, and therefore 565mm/year is considered a reasonable approximation of evapotranspiration on pervious surfaces. Pre- and post-development evapotranspiration rates on pervious areas was therefore equal to **556mm/year**.

Evapotranspiration on impervious areas was assumed to be equal to 10% of precipitation (i.e., 93mm/year). As there is no infiltration on impervious areas, the surplus and runoff in these areas are both equal to 840mm/year.

Based on the above data, there is a water surplus at the Site, as annual precipitation exceeds annual evapotranspiration. The surplus for the Site is calculated as precipitation minus evapotranspiration, which is equal to **377mm/year for pervious areas**. This value applied to pre- and post-development conditions at the Site.

4.5 Infiltration and Runoff

4.5.1 Infiltration Factors

Based on the above water budget equation, the surplus water equals the combined infiltration and runoff components. The infiltration factor (IF) was calculated for pervious areas pre- and post-development based on the topography, soil type, and land cover, as per the MECP's Stormwater Management Planning and Design Manual (2003). The calculations are presented in Appendix 5.

The pre-development IF was calculated based on the following factors:

- Topography at the Site is steep, hilly land;
- Borehole logs and grain-size distribution curves for the Site show mostly sand and sandy silt; and
- Land cover is cultivated land.

The pre-development IF is therefore equal to 0.5.

The post-development IF was calculated based on the following factors:

- Topography at the Site will remain steep;
- Borehole logs and grain-size distribution curves for the Site show mostly sand and sandy silt; and
- Land cover will be cultivated land.

The post-development IF is therefore equal to 0.5.

4.5.2 Pre-Development Infiltration and Runoff

Runoff was calculated as follows:

$$R \text{ (pervious)} = S * (1 - IF) * \text{area} = 377\text{mm/year} * (1 - 0.5) * 755\text{m}^2 * (1\text{m}/1,000\text{mm}) = 142\text{m}^3/\text{year}$$

$$R \text{ (impervious)} = S * \text{area} = 840\text{mm/year} * 8,098\text{m}^2 * (1\text{m}/1,000\text{mm}) = 6,799\text{m}^3/\text{year}$$

$$R \text{ (total)} = 142\text{m}^3/\text{year} + 6,802\text{m}^3/\text{year} = 6,941\text{m}^3/\text{year}$$

Infiltration was calculated as follows:

$$I = S * IF * \text{area} = 377\text{mm/year} * 0.5 * 755\text{m}^2 * (1\text{m}/1,000\text{mm}) = 142\text{m}^3/\text{year}$$

Therefore, total pre-development runoff and infiltration volumes are 6,941m³/year and 142m³/year, respectively.

4.5.3 Post-Development

The post-development drainage conditions were broken down by TMIG Ltd. into the following four areas (Appendix 3):

Runoff Location	Area (m ²)		
	Total	Impervious	Pervious
Bayfield (Unrestricted)	507	336	171
Sophia (Unrestricted)	640	512	128
Maple (Unrestricted)	784	258	526
Maple (Restricted to tank)	6,922	6,922	0

PGL calculated the runoff and infiltration volumes from each of these areas using the same methods as the pre-development conditions.

Based on the above calculations, the post-development runoff and infiltration volumes at the Site were calculated as 6,524m³/year and 263m³/year, respectively.

4.5.4 Net Changes in Infiltration and Runoff

The following tables summarize the change in runoff and infiltration volumes from the pre-development and post-development scenario.

Table A: Annual Pre-Development Water Balance

Drainage Area	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Runoff (m ³)	Infiltration (m ³)
Entire Site	8,853	8,259	1,175	6,941	142
TOTAL	8,853	8,259	1,175	6,941	142

Table B: Annual Post-Development Water Balance

Drainage Area	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Runoff (m ³)	Infiltration (m ³)
Bayfield (Unrestricted)	507	473	126	314	32
Sophia (Unrestricted)	640	597	119	454	24
Maple (Unrestricted)	784	731	317	316	99
Maple (Restricted to tank)	6,922	6,458	646	5,812	0
TOTAL	8,853	8,259	1,208	6,896	155

Table C: Comparison of Pre-Development and Post-Development Water Balance

Development Stage	Precipitation (m ³)	Evapotranspiration (m ³)	Runoff Volume (m ³)	Infiltration Volume (m ³)
Pre-development	8,259	1,175	6,941	142
Post-development	8,259	1,472	6,896	156
Change from pre- to post-development			- 46	+ 13
%			- 0.7%	+9.3 %

5.0 CONCLUSIONS

PGL completed a water balance assessment for the proposed development at 136 Bayfield Street and 14 Sophia Street West, Barrie, Ontario. The assessment was completed according to LSRCA and Toronto and Region Conservation Authority guidelines. The assessment compared pre-development and post-development conditions to estimate changes in infiltration and runoff due to the proposed development with no inclusion of LID measures.

After development, we anticipate that there will be a 0.7% decrease in average annual runoff from the Site (-46m³/year) and an 9.3% increase in infiltration (+13m³/year). The decrease in runoff and increase in infiltration were due to the addition of more pervious surfaces at the Site.

Based on the calculated infiltration volumes, PGL does not anticipate any net loss of infiltration at the Site due to the proposed development.

If the development plan changes or any of the assumptions stated in this report are otherwise violated, re-evaluation of the water balance calculations will be required.

6.0 STATEMENT OF LIMITATIONS AND CONDITIONS FOR REPORT

6.1 Complete Report

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to PGL by the Client, communications between PGL and the Client, and any other reports, proposals or documents prepared by PGL for the Client relative to the specific site described herein, all of which together constitute the Report.

In order to properly understand the suggestions, recommendations and opinions expressed herein, reference must be made to the whole of the Report. **PGL is not responsible for use by any part of portions of the Report without reference to the whole report.**

6.2 Basis of Report

The Report has been prepared for the specific site and purposes that are set out in the contract between PGL and the Client. The findings, recommendations, suggestions, or opinions expressed in the Report are only applicable to the site and purposes in relation to which the Report is expressly provided, and then only to the extent that there has been no material alteration to or variation from the information provided or available to PGL.

6.3 Use of the Report

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. No other party may use or rely upon the Report or any portion thereof without PGL's written consent, and such use shall be on terms and conditions as PGL may expressly approve. Ownership in and copyright for the contents of the Report belong to PGL. Any use which a third party makes of the Report, is the sole responsibility of such third party. **PGL accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report.**

We trust this meets your needs. If you have any questions or require clarification, please contact Salima Jaffer at 905-430-5502.

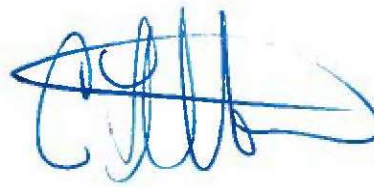
Respectfully submitted,

PGL ENVIRONMENTAL CONSULTANTS

Per:



Salima Jaffer, B.Sc.
Environmental Consultant



Christina Trotter, M.Sc., P.Geo.
Senior Hydrogeologist

SAJ/CET/slr/mtl/ncb
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7.0 REFERENCES

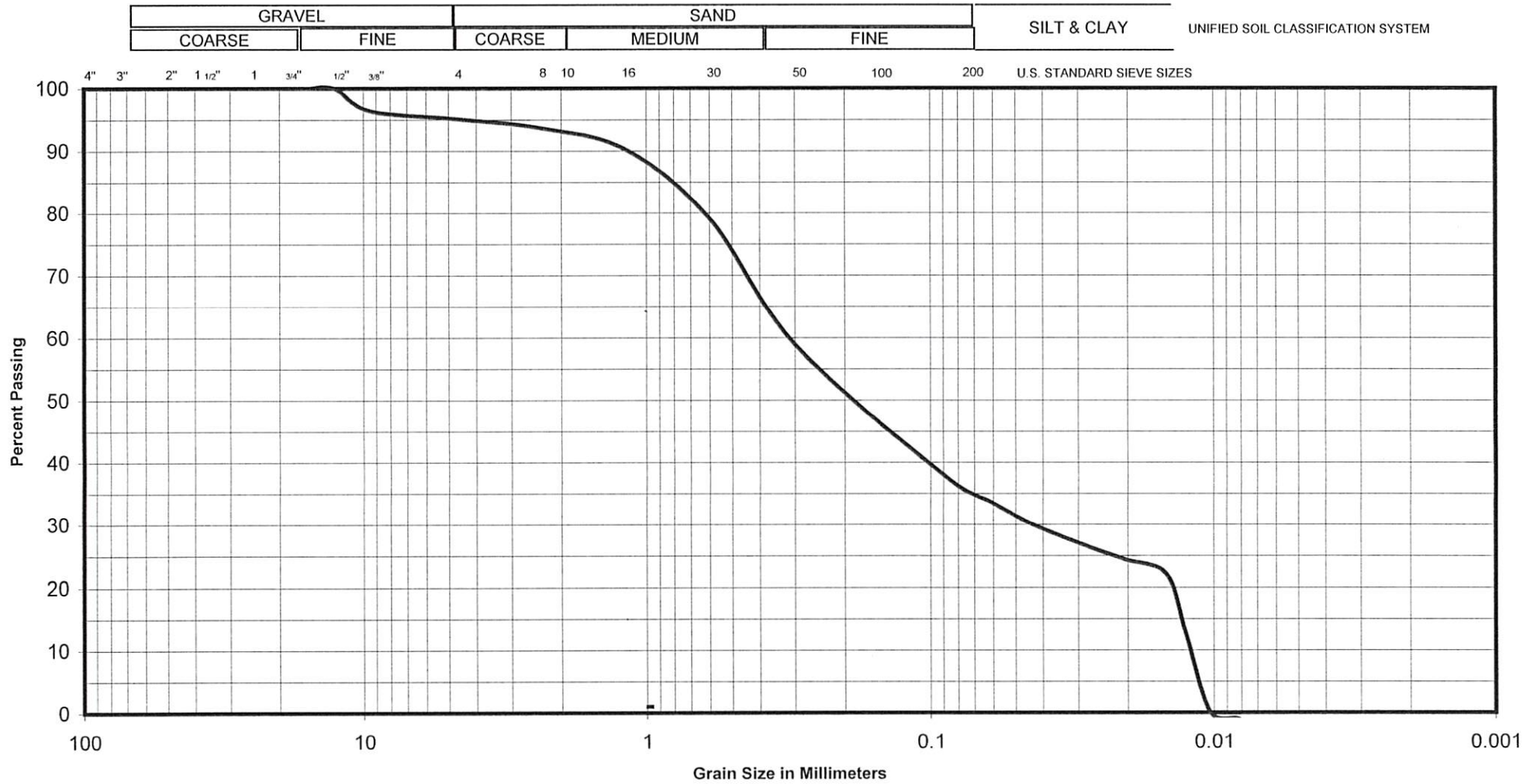
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Appendix 1

Soil Particle Size Analysis Results by V.A. Wood Associates Limited

GRAIN SIZE DISTRIBUTION

OUR REFERENCE No.: 7601-19-4



PROJECT: Proposed Condominium
LOCATION: 136 Bayfield Street, Barrie, ON
BOREHOLE NO.: 2
SAMPLE NO.: 5
DEPTH: 3.4 m
DATE: May 2019

Silty Fine to medium SAND (SM)
TILL

ENCLOSURE No. 7

GRAIN SIZE DISTRIBUTION

OUR REFERENCE No.: 7601-19-4



PROJECT: Proposed Condominium
LOCATION: 136 Bayfield Street, Barrie, ON
BOREHOLE NO.: 3
SAMPLE NO.: 6
DEPTH: 4.9 m
DATE: May 2019

Silty Fine to medium SAND (SM)
TILL

ENCLOSURE No. 8

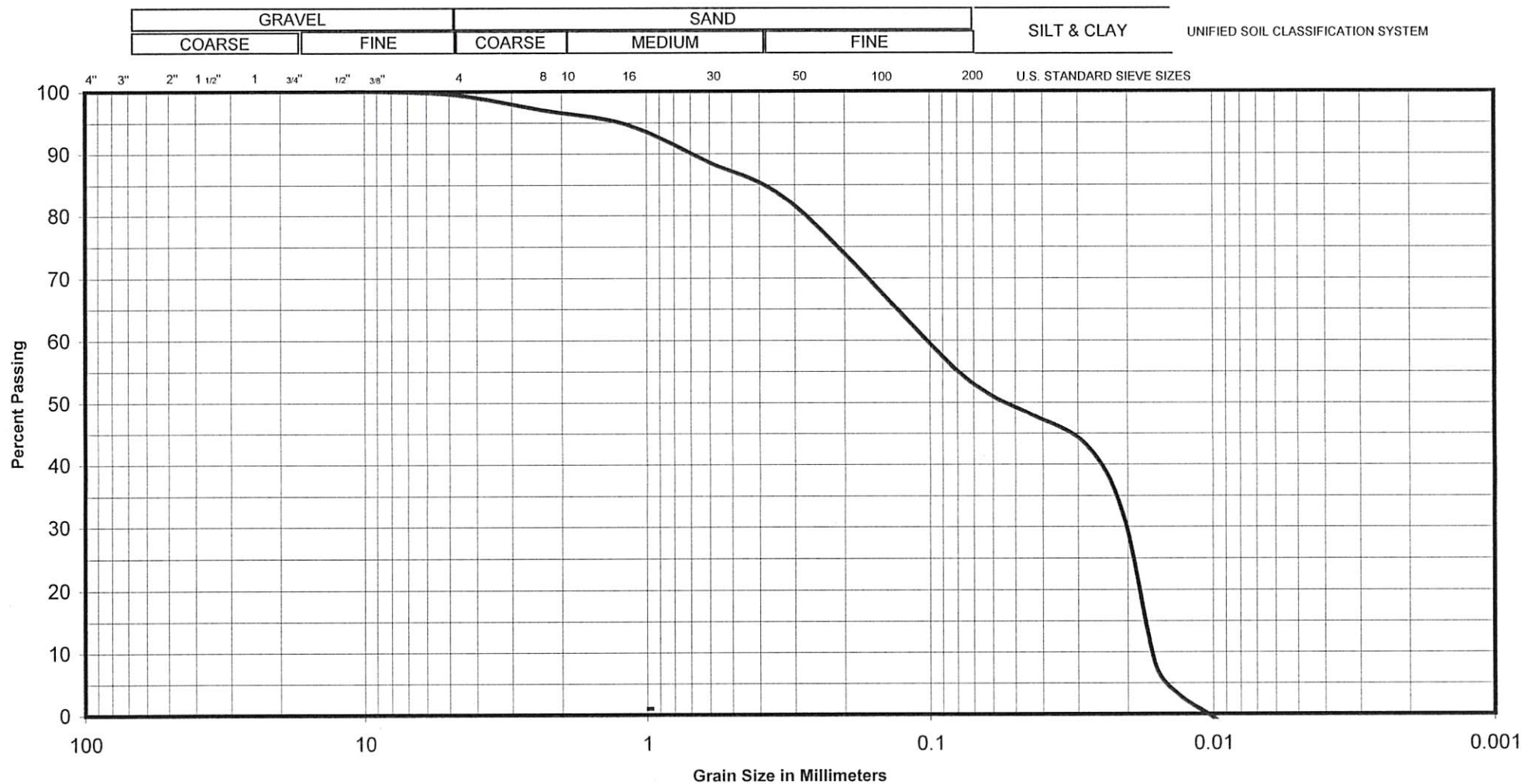
GRAIN SIZE DISTRIBUTION

OUR REFERENCE No.: 7601-19-4



GRAIN SIZE DISTRIBUTION

OUR REFERENCE No.: 7601-19-4



PROJECT: Proposed Condominium

LOCATION: 136 Bayfield Street, Barrie, ON

BOREHOLE NO.: 1

SAMPLE NO.: 9

DEPTH: 9.3 m

DATE: May 2019

SILT and Fine to medium SAND (SM)
TILL

ENCLOSURE No. 10

GRAIN SIZE DISTRIBUTION

OUR REFERENCE No.: 7601-19-4

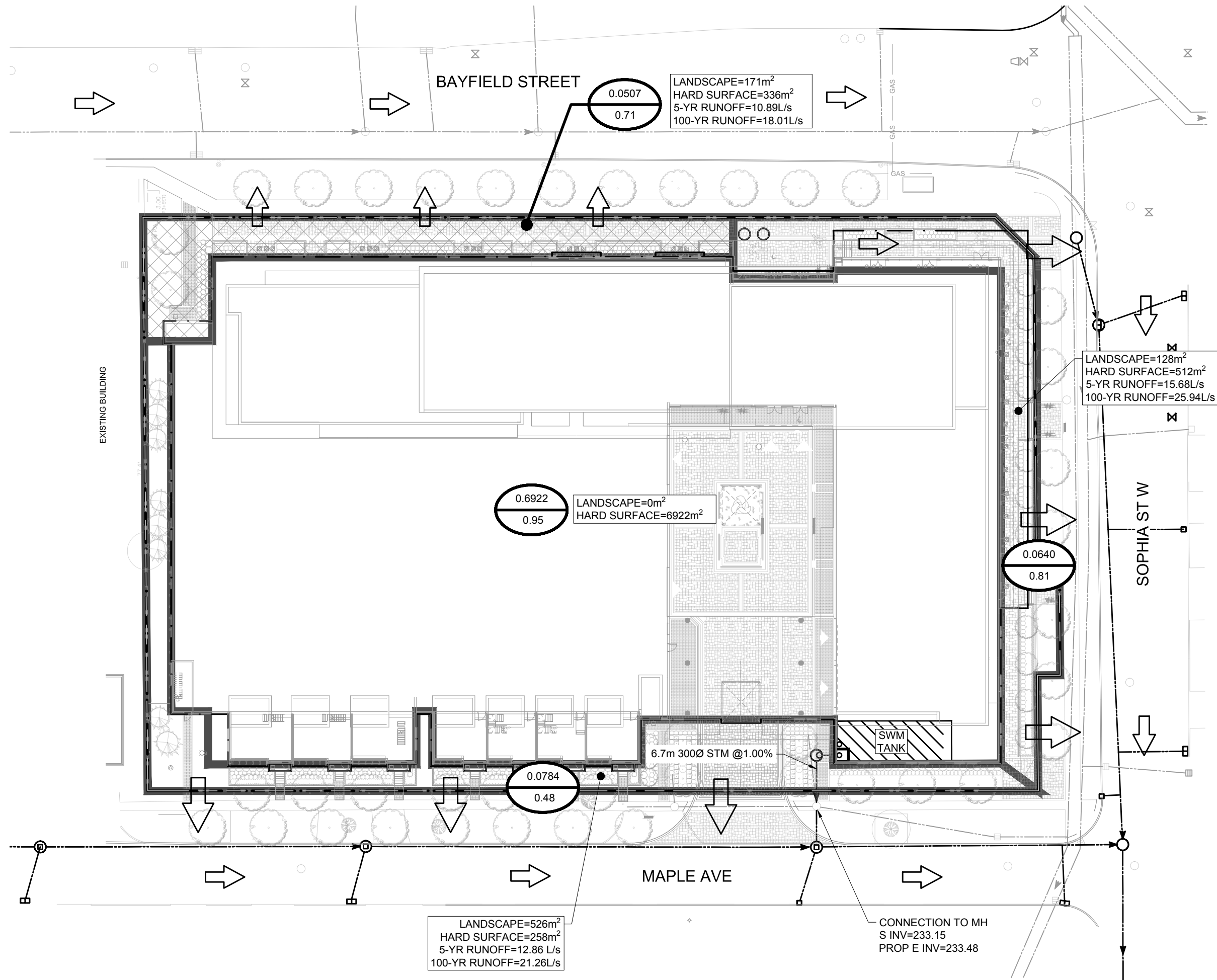
GRAVEL					SAND					SILT & CLAY	
COARSE		FINE			COARSE	MEDIUM	FINE				

UNIFIED SOIL CLASSIFICATION SYSTEM



Appendix 2
Site Plan by TMIG Ltd.

File: G:\Projects\19501 - One Space - Bayfield Branch\Drawings\3. Design\Drawings\19501_01501.dwg Layout: F2-2 Date: Sep 21, 2022 - 10:11 am Edited by: karpman



Appendix 3

Pervious and Impervious Land Cover Areas provided by TMIG Ltd.

Salima Jaffer

From: Caitlin Beaudoin <CBeaudoin@tmig.ca>
Sent: June 7, 2021 9:38 AM
To: Salima Jaffer; Rachel Lahn
Cc: Paula Schuster
Subject: RE: revised dwgs for water balance - RE: 20001 - Bayfield Development - (5689-02.02)
Attachments: 210607-19501-F2-2.pdf

WARNING: Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good Morning,

Hope you had a great weekend.

Sorry this is a bit late, but we didn't get the landscape until Fri afternoon.

I've attached our revised post-development drainage area figure. Additionally, here is the breakdown for the pervious/impervious:

UNRESTRICTED TO MAPLE AVE

- TOTAL=784m²
- LAND=526 m²
- HARD SURFACE=258 m²
- C=0.48

UNRESTRICTED TO SOPHIA

- TOTAL=640 m²
- LANDSCAPE=128 m²
- HARD SURFACE=512 m²
- C=0.81

UNRESTRICTED TO BAYFIELD

- TOTAL=507 m²
- LANDSCAPE=171 m²
- HARDSCAPE=336 m²
- C=0.71

TO SWM TANK

- TOTAL=6922 m²
- ALL HARDSCAPE
- C=0.90

Thanks,

Caitlin Beaudoin, P.Eng.

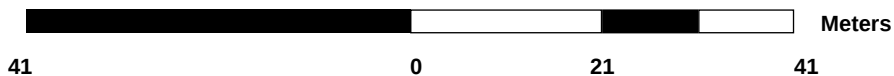
TMIG | TYLI
+1.647.914.3008

From: Salima Jaffer <SJaffer@pggroup.com>
Sent: May 31, 2021 4:01 PM
To: Caitlin Beaudoin <CBeaudoin@tmig.ca>; Rachel Lahn <rlahn@onespaceunlimited.com>

Appendix 4
LSRCA Regulated Area



Scale 1: 811



Features

- LSRCA Watershed Boundary
- LSPP Watershed Boundary
- Regulation Boundary
- Regulated Wetland
 - PSW
 - Non PSW
- Wetland With Adjacent Lands
- Regulation Area
- MNRF Evaluated Wetland
 - PSW
 - Other Evaluated
- MNRF Unevaluated Wetland
- Assessment Parcel
- Lot and Concession
- Assessment Parcel Labels
- Watercourse
- Roads
 - Hwy 400 Series
 - Highway, Arterials
 - Local Road
- Railway
- Lower Tier Municipality

Printed On:
2/5/2020



WGS_1984_Web_Mercator_
Auxiliary_Sphere

Mapped By:

This product was produced by the Lake Simcoe Region Conservation Authority and some information depicted on this map may have been compiled from various sources. While every effort has been made to accurately depict the information, data/mapping errors may exist. This map has been produced for illustrative purposes from an interactive web mapping site. LSRCA GIS Services DRAFT printed 2020. © LAKE SIMCOE REGION CONSERVATION AUTHORITY, 2020. All Rights Reserved. The following data sets of Assessment Parcel, Roads, Upper & Lower Tier Municipalities, Wetlands are © Queens Printer for Ontario. Reproduced with Permission, 2020. The Current Regulation Limit and Boundary data sets are derived products from several datasets. Orthophotography 2002, 2005, 2007-2009, 2011-2018, © First Base Solutions, Inc.

Appendix 5
Water Balance Calculations

P	Precipitation (mm/year)
ET	Evapotranspiration (mm/year)
R	Runoff (mm/yr)
I	Infiltration (Recharge) (mm/year)
IF	Cumulative Infiltration Factor (-)
S	Surplus water (mm/year)

Surplus water $S = P - ET$
Infiltration (Recharge) $I = IF \times S$
Thornwaite and Mather, 1957 $P = ET + R + I$

Precipitation (mm/yr)	933	Data from Environment Canada - Barrie WPCC Climate Normals 1981-2010
Evapotranspiration	556	Calculated using Thornthwaite-Mather model for Barrie WPCC Climate Normals 1981-2010. Consistent with previously reported values in the area (AquaResource Inc., 2012)

IF factors: The infiltration factor (IF) is determined by summing a factor for topography, soils and cover (Ontario Ministry of Environment (2003)).			Pre-Development	Post Development			
				Bayfield (Unrestricted)	Sophia (Unrestricted)	Maple (Unrestricted)	Maple (Restricted) STM Tank
Topography	Flat land, average slope < 0.6 m/km	0.3	0.1	0.1	0.1	0.1	0.1
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2					
	Hilly Land, average slope 28 m to 47 m/km	0.1					
Soils	Tight impervious clay	0.1	0.3	0.3	0.3	0.3	0.3
	Medium combinations of clay and loam	0.2					
	Open sandy loam	0.4					
Cover	Cultivated Land	0.1	0.1	0.1	0.1	0.1	0.1
	Woodland	0.2					
			0.5	0.5	0.5	0.5	0.5

Total Area (m ²)	8853	8853			
Pervious Area (m ²)	755	171	128	526	0
Impervious Area (m ²)	8098	336	512	258	6922
LID Area (m ²)	0	0	0	0	0

Parameter		Units	Pre-Development	Post Development				Post- Development Total
				Bayfield (Unrestricted)	Sophia (Unrestricted)	Maple (Unrestricted)	Maple (Restricted) STM Tank	
Pervious areas	Precipitation (P)	mm/yr	933	933	933	933	933	
	Evapotranspiration (ET)	mm/yr	556	556	556	556	556	
	Surplus (S)	mm/yr	377	377	377	377	377	
	Infiltration (I)	mm/yr	188	188	188	188	188	
	Runoff (R)	mm/yr	188	188	188	188	188	
Impervious areas	Evapotranspiration (ET)	mm/yr	93	93	93	93	93	
	Surplus (S)	mm/yr	840	840	840	840	840	
	Infiltration (I)	mm/yr	0	0	0	0	0	
	Runoff (R)	mm/yr	840	840	840	840	840	
Volumes	Volume of runoff	m ³ /yr	6,941	314	454	316	5,812	6,896
	Volume evapotranspiration (V _{ET})	m ³ /yr	1,175	126	119	317	646	1,208
	Volume of infiltration (V _I)	m ³ /yr	142	32	24	99	0	155
TOTAL VOLUME		m ³ /yr	8,259					8,259
CHECK:	8258.9637	ppt	8259	473	597	731	6458	
		ppt	8259	473	597	731	6458	

	Pre Dev	Post Dev	+/- %		
Infiltration	142.3	155.5	9.3%	13.2	increase in infiltration
Runoff	6941.4	6895.9	-0.7%	-46	decrease in runoff