MEMO

TO: Carlo Steffanutti – Silvercreek Developments Limited

FROM: WSP Canada Inc.

SUBJECT: **Water Budget Analysis Update 35-40 Silvercreek Parkway S., Guelph, ON**

DATE: **September 29, 2022**

1.0 INTRODUCTION

This memorandum summarizes a revised water budget based on an updated Design Plan and proposed Low Impact Developments (LIDs) for the property located at 35 & 40 Silvercreek Parkway South, Guelph, Ontario (herein is referred to as "the Site").

A discussion of the Water Budget Analysis and model for the Site is provided as a part of this memorandum. Based on the Functional Servicing Report (R.J. Burnside and Associates Ltd., January 2022), it is WSP's understanding that the LID infiltration measures currently being proposed for the Site includes infiltration trenches and/or bioswales and an infiltration basin. Infiltration trenches and/or bioswales will be located within the 'Mixed Use' and 'Apartment' Blocks and the Infiltration basin will be located within the 'Storm Water Management' Block.

2.0 WATER BUDGET ANALYSIS

One of the objectives during site development is to ensure that the overall volume of groundwater recharge is not significantly impacted. The City of Guelph Development Engineering Manual (City of Guelph, January 2019) stipulates that Low Impact Development (LID) best management practices shall be used to mimic pre-development infiltration rates. Site-specific pre- and post-development water budgets were prepared to assess the effects of the proposed development on the distribution of precipitation to evapotranspiration, runoff, and infiltration. The water budget calculations are provided in **Appendix A**.

The Thornthwaite Soil Moisture Balance method was used to calculate potential and actual evapotranspiration for pervious open space areas of the Site. The calculations are based on the 1981 to 2010 climate normal data published by Environment Canada for the Fergus Shand Dam weather station. The annual precipitation for the Site based off the Fergus Shand Dam climate station is 945.9 mm/year. Using the Thornthwaite method, potential evapotranspiration is estimated to be 484.9 mm/year, or 51% of annual precipitation, soil moisture deficit is estimated at 48 mm/year, and actual evapotranspiration is estimated to be 567 mm/year, or 61% of annual precipitation. The results are presented in **Table A-1, Appendix A**.

2.1 PRE-DEVELOPMENT LAND USE AND WATER BUDGET

The total Site area is approximately 16.52 hectares (165,170 m^2) and consists of two irregular shapes located on either side of Silver Creek Parkway south. The Site is currently undeveloped open space and pre-development land coverage is currently considered to be 100% pervious. Ground surface in the open space areas has a gently rolling topography and the trees have been recently removed from the Site in preparation for development.

The pre-development water budget is provided in **Table A-3, Appendix A**. In summary, precipitation (156,234 m^3/year) is currently distributed as follows:

- 88,997 m^3/year Evapotranspiration
- 53,790 m^3/year Infiltration
- 13,447 m^3/year Runoff

2.2 POST-DEVELOPMENT LAND USE AND WATER BUDGET

It is currently proposed to develop the Site for a mixed use commercial and residential subdivision with internal roadways and full municipal services (water and sewer). The proposed development Site drawings are from Astrid J. Clos Planning Consultants (April 2022). The proposed development will include apartment blocks, townhouse blocks, storm water management blocks, mixed use blocks, an urban square park, and a neighbourhood park. Impervious coefficients for each land use block were taken from the City of Guelph Development Engineering Manual (City of Guelph, January 2019). Impervious coefficients are 0.07% for the neighbourhood park block and storm water management block; 80% for Apartment blocks, townhouse blocks; and 100% for mixed use blocks, urban square blocks, and roads and lanes. The development concept is illustrated on **Figure 1.**

The proposed development consists of the following:

Apartment Blocks (Blocks 1-3) ..... 27,700 m^2

Townhouse Blocks (Blocks 4-17) ..... 38,800 m^2

Mixed Use (Blocks 18-20) ..... 21,700 m^2

Urban Square Block (Block 21) ..... 5,720 m^2

Neighbourhood Park and Open Space (Blocks 22-24) ..... 23,950 m^2

Storm Water Management Block (Block 25) ..... 17,200 m^2

Right-of Way (Walkways and Roads) ..... 30,100 m^2

Total Area ..... 165,170 m^2

The post-development water budget, without LID mitigation measures, is provided in **Table A-4, Appendix A**. In summary, precipitation (156,234 m^3/year) would be distributed as follows:

- 24,085 m^2/year Evapotranspiration
- 15,394 m^2/year Evaporation
- 13,323 m^2/year Infiltration
- 103,433 m^2/year Runoff

3 WATER BALANCE IMPACT ASSESSMENT

With the increase in impervious areas, adding in LID measures that promote groundwater infiltration can make a significant contribution to mitigating the effects of urbanization and mimic pre-development infiltration recharge rates. Integrating LID measures into the overall site design and stormwater management plan provides opportunities for incorporating measures such as infiltration galleries into open space areas as components of the landscaping plan.

3.1 INFILTRATION DEFICIT WITHOUT MITIGATION

Based on the findings of water balance assessment, without mitigation, the proposed development would result in an infiltration decrease of approximately 40,466 m^3/year (i.e., 75% decrease compared to pre-development conditions). The reduction in infiltration can be attributed to the increase in impervious surfaces from 0% to 72% of the total Site area. Likewise, without mitigation, the increase in impervious surfaces would increase runoff from the Site by an estimated 89,985 m^3/year, which represents a 669% increase compared to pre-development runoff volumes. A summary is presented in **Table 3.1** (detailed calculations can be found in **Table A-4** in **Appendix A**).

A summary of the pre- and post-development (without mitigation measures) water budgets is provided in the following table:

Table 3.1 Summary of Pre- and Post-Development (Unmitigated) Water Budgets

	EVAPOTRANSPIRATION (M^3/YEAR)	TOTAL INFILTRATION (M^3/YEAR)	TOTAL RUNOFF (M^3/YEAR)
Pre-development	88,997	53,790	13,447
Post-development without Mitigation	24,085	13,323	103,433
% Change	**-73%**	**-75%**	**669%**
Change	**-64,913**	**-40,466**	**89,985**

3.2 INFILTRATION DEFICIT MITIGATION

The net increase in runoff generated by the proposed development provides an opportunity for maintenance of groundwater recharge through a variety of infiltration techniques. Engineering and design of the Site's stormwater management infrastructure and LIDs is provided under a separate cover in the Silvercreek Junction Functional Servicing and Stormwater Management Report prepared by R.J. Burnside and Associates Ltd (January 2022).

An overview of the proposed LID measures and assessment of their impact on the post-development water budget is provided below.

3.2.1 MITIGATION STRATEGY

The proposed mitigation assumptions were provided from the Silvercreek Junction Functional Servicing and Storm Water Management Report prepared by RJ Burnside and Associates Ltd. (January 2022). The proposed mitigation measures to achieve Infiltration targets include:

- The Apartment Blocks (1-3) and Mixed-Use Blocks (18-20) will provide its own recharge measures via underground infiltration galleries and/or bioswales. Based on email correspondence with the water resource engineer at RJ Burnside dated July 7, 2022, it is assumed that these LIDs will be sized to capture and infiltrate 95% of the average annual precipitation from the impervious areas within the Apartment Blocks (1-3) and Mixed-Use Blocks (18-20)); and,
- Runoff from the impervious areas within the Townhouse (4-17), Open Space (23-25), Parks (21-22), Right-of-Ways, and SWM Blocks (26), will be directed to an Infiltration Basin located in the SWM Block. It is assumed that all impervious area runoff from these blocks will be redirected to the Infiltration Basin, which has been sized to capture 50% of the average annual precipitation from the impervious areas (i.e., a 5mm precipitation event).

3.2.2 SUMMARY OF WATER BUDGET WITH MITIGATION

The proposed mitigation measures will significantly increase infiltration throughout the Site. The post-development water budget, with LID mitigation measures, is provided in **Table A-5, Appendix A**. In summary, precipitation (156, 234 m^3/year) would be distributed as follows:

- 24,085 m^3/year Evapotranspiration
- 15,394 m^3/year Evaporation
- 77,151 m^3/year Infiltration
- 39,605 m^3/year Runoff

A comparison of the pre-development and post-development with mitigation measures water budgets is provided in **Table 3.2** (detailed calculations can be found in **Table A-6**, **Appendix A)**.

When compared to pre-development conditions, the post-development with mitigation water budget shows an infiltration increase at the Site of 23,362 m^3/year (or a 43% increase) and an increase in runoff by 26,157 m^3/year (or a 195% increase), as summarized in the following table. The proposed LID mitigation measures are sufficient to maintain existing infiltration recharge rates at the Site. The excess runoff generated post-development will be directed to the local storm sewer system as outlined in the Silvercreek Junction Functional Servicing and Storm Water Management Report (RJ Burnside and Associates Ltd., January 2022).

Table 3.201 Summary of Pre- and Post-Development (With Mitigation) Water Budgets

	EVAPOTRANSPIRATION (M^3/YR)	TOTAL INFILTRATION (M^3/YEAR)	TOTAL RUNOFF (M^3/YEAR)
Pre-development	88,997	53,790	13,447
Post-development with Mitigation	24,085	77,151	39,605
% Change	**-73%**	**43%**	**195%**
Change	**-64,913**	**23,362**	**26,157**

4 CONCLUSIONS

A. Under current site conditions, it is estimated that about 53,790 m^3/year of water infiltrates across the Site with 13,447 m^3/year as runoff.

B. Under post-development conditions without mitigation, it is estimated that about 13,323 m^3/year of water will infiltrate across the Site and about 103,433 m^3/year will be runoff. Compared to pre-development conditions, this is an infiltration deficit of 40,466 m^3/year and 89,985 m^3/year additional runoff.

C. The proposed LID mitigation measures for the Site includes underground infiltration galleries and/or bioswales within the Apartment Blocks (1-3) and Mixed-Use Blocks (18-20) and an Infiltration Basin located in the SWM Block.

D. Under post-development conditions with mitigation, it is estimated that about 77,151 m^3/year of water will infiltrate across the Site and about 39,605 m^3/year will be runoff. Compared to pre-development conditions, this is an infiltration increase of 23,362 m^3/year and 26,157 m^3/year additional runoff.

E. The proposed LID mitigation measures are sufficient to maintain existing infiltration recharge rates at the Site. Management of the additional runoff generated post-development is outlined in the Silvercreek Junction Functional Servicing and Storm Water Management Report (RJ Burnside and Associates Ltd., January 2022).

REFERENCES

Astrid J. Clos Planning Consultants (April 20, 2022). Draft Plan of Subdivision 23T-19001 Silvercreek Junction.

City of Guelph (January 2019). Development Engineering Manual, Version 2.0, City of Guelph Engineering and Transporation Services.

RJ Burnside and Associates Lt. (January 2022). Functional Servicing and Storm Water Management Report – Silvercreek Junction, Guelph, Ontario.

WSP Canada Ltd. (2018). Report on Additional Geotechnical Investigation and Summary of Previous Geotechnical Investigation Work – Silvercreek Junction, Guelph, Ontario.

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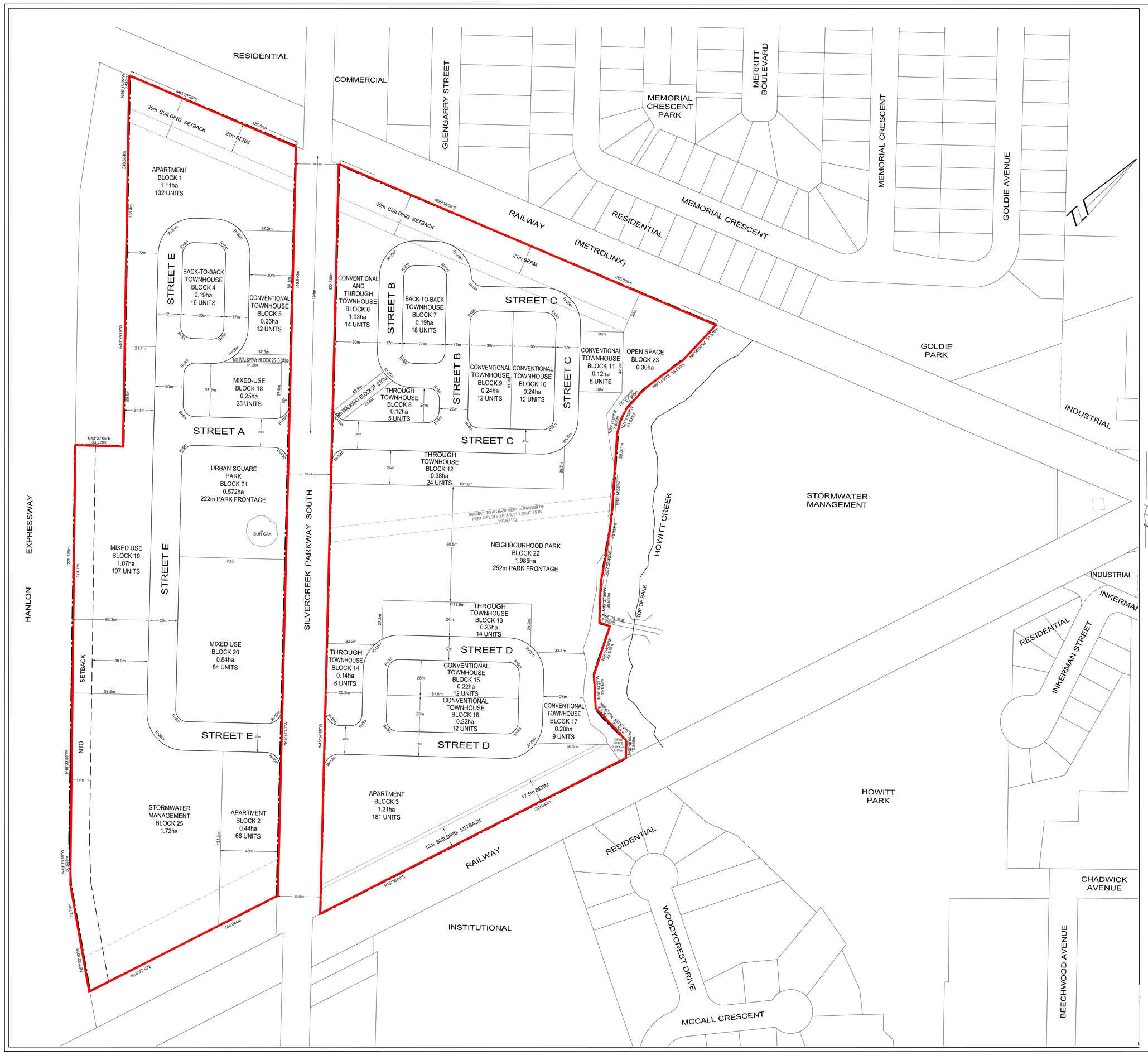
Figure 1: Site Plan
Appendix A: Water Budget Analysis

FIGURES



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LEGEND

SITE BOUNDARY

CLIENT:

SILVERCREEK DEVELOPMENTS LTD.

CLIENT REF. #:

PROJECT:

WATER BUDGET ANALYSIS UPDATE
35 & 40 SILVERCREEK PARKWAY SOUTH, GUELPH, ONTARIO

PROJECT NO:	DATE / DATE:
161-08980-01-600	JULY 2022

DESIGNED BY: REB

DRAWN BY: NV

CHECKED BY: PM

FIGURE NO:	SCALE:
1	AS SHOWN

TITLE:

SITE PLAN

DISCIPLINE:

ENVIRONMENT

ISSUE:	RV. #
--	
DATE OF: --	

APPENDIX

A WATER BUDGET ANALYSIS

TABLE A-1

CLIMATE NORMALS 1981-2010 (Fergus Shand Dam)

Silvercreek Junction, Guelph, ON

	Thornthwaite (1948)					
Month	Mean Temperature (°C)	Heat Index	Potential Evapotranspiration (mm)	Daylight Correction Value	Adjusted Potential Evapotranspiration (mm)	Total Precipitation (mm)
January	-7.4	0.0	0.0	0.78	0.0	67.9
February	-6.3	0.0	0.0	0.88	0.0	55.9
March	-1.9	0.0	0.0	0.99	0.0	59.6
April	5.7	1.2	26.7	1.12	29.9	74.1
May	12.2	3.9	59.4	1.22	72.4	86.9
June	17.5	6.7	86.8	1.28	111.1	83.8
July	20	8.2	99.9	1.25	124.8	89.2
August	19	7.5	94.6	1.15	108.8	96.6
September	14.9	5.2	73.3	1.04	76.2	93.1
October	8.3	2.2	39.6	0.92	36.4	77.2
November	2.1	0.3	9.3	0.8	7.5	93.0
December	-3.9	0.0	0.0	0.76	0.0	68.6
TOTALS		**35.1**	**489.4**		**567.0**	**945.9**

NOTES:

1) Water budget adjusted for latitude and daylight.
2) (°C) – Represents calculated mean of avarage daily temperatures for the month.
3) Precipitation and Temperature data is from Fergus Shand Dam Climate Station located at latitude 43°44'05.088" N , longitude 80°19'49.098" W , elevation 417.60 m.
4) The Fergus Shand Dam is a Class A Station, meaning no more than 3 consecutive or 5 total missing years between 1981 to 2010.
5) Total Water Surplus (Thornthwaite, 1948) is calculated as a total precipitation minus adjusted potential evapotranspiration.
6) Total Moisture Surplus (Thornthwaite and Mather, 1957) is calculated as total precipitation minus actual evapotranspiration.

TABLE A-2

Hydrologic Cycle Component Values

Silvercreek Junction, Guelph, ON

			Month												Total
			March	April	May	June	July	August	September	October	November	December	January	February	
PET - Adjusted Potential Evapotranspiration (mm)			0.0	29.9	72.4	111.1	124.8	108.8	76.2	36.4	7.5	0.0	0.0	0.0	**567.0**
P - Total Precipitation (mm)			59.6	74.1	86.9	83.8	89.2	96.6	93.1	77.2	93.0	68.6	67.9	55.9	**945.9**
P-PET (mm)			59.6	44.2	14.5	-27.3	-35.6	-12.2	16.9	40.8	85.5	68.6	67.9	55.9	-
Soil Moisture Deficit (mm)			0.0	0.0	0.0	-27.3	-62.9	-75.1	-58.2	-17.4	0.0	0.0	0.0	0.0	-
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)	Fine Sand	Δ ST (mm)	50.0	50.0	50.0	22.7	0.0	0.0	16.9	57.7	50.0	50.0	50.0	50.0	-
		AET (mm)	0.0	29.9	72.4	103.6	97.3	96.6	76.2	36.4	7.5	0.0	0.0	0.0	**519.9**
	Fine Sandy Loam, Clay	Δ ST (mm)	75.0	75.0	75.0	47.7	12.1	0.0	16.9	57.7	75.0	75.0	75.0	75.0	-
		AET (mm)	0.0	29.9	72.4	106.1	103.4	97.6	76.2	36.4	7.5	0.0	0.0	0.0	**529.4**
	Silt Loam	Δ ST (mm)	125.0	125.0	125.0	97.7	62.1	49.9	66.8	107.6	125.0	125.0	125.0	125.0	-
		AET (mm)	0.0	29.9	72.4	108.1	112.0	102.1	76.2	36.4	7.5	0.0	0.0	0.0	**544.5**
	Clay Loam	Δ ST (mm)	100.0	100.0	100.0	72.7	37.1	24.9	41.8	82.6	100.0	100.0	100.0	100.0	-
		AET (mm)	0.0	29.9	72.4	107.3	108.8	100.4	76.2	36.4	7.5	0.0	0.0	0.0	**538.8**
Moderately Rooted Crops (corn and cereal grains)	Fine Sand	Δ ST (mm)	75.0	75.0	75.0	47.7	12.1	0.0	16.9	57.7	75.0	75.0	75.0	75.0	-
		AET (mm)	0.0	29.9	72.4	106.1	103.4	97.6	76.2	36.4	7.5	0.0	0.0	0.0	**529.4**
	Fine Sandy Loam, Clay	Δ ST (mm)	150.0	150.0	150.0	122.7	87.1	74.9	91.8	132.6	150.0	150.0	150.0	150.0	-
		AET (mm)	0.0	29.9	72.4	108.6	114.1	103.2	76.2	36.4	7.5	0.0	0.0	0.0	**548.2**
	Silt Loam, Clay Loam	Δ ST (mm)	200.0	200.0	200.0	172.7	137.1	124.9	141.8	182.6	200.0	200.0	200.0	200.0	-
		AET (mm)	0.0	29.9	72.4	109.2	116.8	104.6	76.2	36.4	7.5	0.0	0.0	0.0	**552.9**
Pasture and Shrubs	Fine Sand	Δ ST (mm)	100.0	100.0	100.0	72.7	37.1	24.9	41.8	82.6	100.0	100.0	100.0	100.0	-
		AET (mm)	0.0	29.9	72.4	107.3	108.8	100.4	76.2	36.4	7.5	0.0	0.0	0.0	**538.8**
	Fine Sandy Loam	Δ ST (mm)	150.0	150.0	150.0	122.7	87.1	74.9	91.8	132.6	150.0	150.0	150.0	150.0	-
		AET (mm)	0.0	29.9	72.4	108.6	114.1	103.2	76.2	36.4	7.5	0.0	0.0	0.0	**548.2**
	Silt Loam, Clay Loam	Δ ST (mm)	250.0	250.0	250.0	222.7	187.1	174.9	191.8	232.6	250.0	250.0	250.0	250.0	-
		AET (mm)	0.0	29.9	72.4	109.6	118.4	105.4	76.2	36.4	7.5	0.0	0.0	0.0	**555.7**
	Clay	Δ ST (mm)	200.0	200.0	200.0	172.7	137.1	124.9	141.8	182.6	200.0	200.0	200.0	200.0	-
		AET (mm)	0.0	29.9	72.4	109.2	116.8	104.6	76.2	36.4	7.5	0.0	0.0	0.0	**552.9**
Mature Forest	Fine Sand	Δ ST (mm)	250.0	250.0	250.0	222.7	187.1	174.9	191.8	232.6	250.0	250.0	250.0	250.0	-
		AET (mm)	0.0	29.9	72.4	109.6	118.4	105.4	76.2	36.4	7.5	0.0	0.0	0.0	**555.7**
	Fine Sandy Loam	Δ ST (mm)	300.0	300.0	300.0	272.7	237.1	224.9	241.8	282.6	300.0	300.0	300.0	300.0	-
		AET (mm)	0.0	29.9	72.4	109.8	119.5	106.0	76.2	36.4	7.5	0.0	0.0	0.0	**557.6**
	Silt Loam, Clay Loam	Δ ST (mm)	400.0	400.0	400.0	372.7	337.1	324.9	341.8	382.6	400.0	400.0	400.0	400.0	-
		AET (mm)	0.0	29.9	72.4	110.1	120.8	106.7	76.2	36.4	7.5	0.0	0.0	0.0	**560.0**
	Clay	Δ ST (mm)	350.0	350.0	350.0	322.7	287.1	274.9	291.8	332.6	350.0	350.0	350.0	350.0	-
		AET (mm)	0.0	29.9	72.4	110.0	120.2	106.4	76.2	36.4	7.5	0.0	0.0	0.0	**559.0**

NOTES:

1) PET and P Taken from Table 1

2) Soil Moisture Deficit (mm) is a function of the accumulation of P-Pet once there is a shortage of P to satisfy PET and terminated once the defficit is eliminated

3) Water Holding Capacity (mm) of soils types taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003) and applied to March

4) Actual Evapotranspiration (AET) is a function of Adjusted Potential Evapotranspiration (PET) and change in Groundwater Storage (Δ ST) for a given soil type as shown in Table 2

TABLE A-3
WATER BUDGET - PRE-DEVELOPMENT (Existing) CONDITIONS
Silvercreek Junction, Guelph, ON

Catchment Designation	Site	
	Open Spaces	Totals
Area (m^2)	165,170	**165,170**
Pervious Area (m^2)	165,170	**165,170**
Impervious Area (m^2)	0	**0**
Infiltration Factors		
Topography Infiltration Factor	0.25	
Soil Infiltration Factor	0.40	
Land Cover Infiltration Factor	0.15	
MOECC Infiltration Factor	0.80	
Actual Infiltration Factor	0.80	
Run-Off Coefficient	0.20	
Run-Off from Impervious Surfaces*	0.85	
Inputs (per Unit Area)		
Precipitation (mm/yr)	946	
Run-On (mm/yr)	0	
Other Inputs (mm/yr)	0	
Outputs (per Unit Area)		
Precipitation Surplus for Pervious Areas (mm/yr)	407	
Net Surplus (mm/yr)	407	
Actual Evapotranspiration (mm/yr)	539	
Evaporation (mm/yr)	142	
Infiltration (mm/yr)	326	
Runoff Pervious Areas	81	
Runoff Impervious Areas	804	
Inputs (Volumes)		
Precipitation (m^3/yr)	156,234	**156,234**
Run-On (m^3/yr)	0	**0**
Other Inputs (m^3/yr)	0	**0**
Total Inputs (m^3/yr)	**156,234**	**156,234**
Outputs (Volumes)		
Precipitation Surplus (m^3/yr)	67,237	**67,237**
Net Surplus (m^3/yr)	67,237	**67,237**
Actual Evapotranspiration (m^3/yr)	88,997	**88,997**
Evaporation (mm/yr)	0	**0**
Infiltration (m^3/yr)	53,790	**53,790**
Total Infiltration (m^3/yr)	53,790	**53,790**
Runoff Pervious Areas (m^3/yr)	13,447	**13,447**
Runoff Impervious Areas (m^3/yr)	0	**0**
Total Runoff (m^3/yr)	13,447	**13,447**
Total Outputs (m^3/yr)	**156,234**	**156,234**
Difference (Inputs - Outputs)	**0**	**0**

NOTES:
1) Evaporation from impervious areas are assumed to be 15% of precipitation for flat roofs and paved surfaces, 10% for sloped roofs
2) Infiltration Factors taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003)
3) Total outputs is equal to the sum of evapotranspiration, evaporation, total infiltration, and total runoff

TABLE A-4

WATER BUDGET - POST-DEVELOPMENT CONDITIONS WITHOUT MITIGATION

Silvercreek Junction, Guelph, ON

Catchment Designation	Apartment Blocks (Blocks 1-3)	Townhouse Blocks (Blocks 4-17)	Mixed Use Blocks (Blocks 18-20)	Urban Square Park (Block 21)	Neighbourhood Park + Open Space (Block 22-24)	Storm Water Management Block (Block 25)	Right-of-Way (Walkways and Roads)	Totals
Area (m^2)	27,700	38,800	21,700	5,720	23,950	17,200	30,100	**165,170**
Impervious Coefficient	0.80	0.80	0.93	0.93	0.50	0.50	0.65	-
Pervious Area (m^2)	5,540	7,760	1,519	400	11,975	8,600	10,535	**46,329**
Impervious Area (m^2)	22,160	31,040	20,181	5,320	11,975	8,600	19,565	**118,841**
Infiltration Factors								
Topography Infiltration Factor	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Soil Infiltration Factor	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
Land Cover Infiltration Factor	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
MOE Infiltration Factor	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Actual Infiltration Factor**	0.68	0.68	0.68	0.68	0.68	0.68	0.68	
Run-Off Coefficient	0.33	0.33	0.33	0.33	0.33	0.33	0.33	
Run-Off from Impervious Surfaces***	0.85	0.90	0.85	0.85	0.85	0.85	0.85	
Inputs (per Unit Area)								
Precipitation (mm/yr)	946	946	946	946	946	946	946	
Run-On (mm/yr)	0	0	0	0	0	0	0	
Other Inputs (mm/yr)	0	0	0	0	0	0	0	
Outputs (per Unit Area)								
Precipitation Surplus for Pervious Areas (mm/yr)	426	426	426	426	426	426	426	
Net Surplus (mm/yr)	426	426	426	426	426	426	426	
Actual Evapotranspiration (mm/yr)	520	520	520	520	520	520	520	
Evaporation (mm/yr)	142	95	142	142	142	142	142	
Infiltration (mm/yr)	288	288	288	288	288	288	288	
Runoff Pervious Areas	138	138	138	138	138	138	138	
Runoff Impervious Areas	804	851	804	804	804	804	804	
Inputs (Volumes)								
Precipitation (m^3/yr)	26,201	36,701	20,526	5,411	22,654	16,269	28,472	**156,234**
Run-On (m^3/yr)	0	0	0	0	0	0	0	**0**
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	**0**
Total Inputs (m^3/yr)	**26,201**	**36,701**	**20,526**	**5,411**	**22,654**	**16,269**	**28,472**	**156,234**
Outputs (Volumes)								
Precipitation Surplus (m^3/yr)	20,177	29,731	16,873	4,448	14,730	10,578	20,219	**116,756**
Net Surplus (m^3/yr)	20,177	29,731	16,873	4,448	14,730	10,578	20,219	**116,756**
Actual Evapotranspiration (m^3/yr)	2,880	4,034	790	208	6,225	4,471	5,477	**24,085**
Evaporation (m^3/yr)	3,144	2,936	2,863	755	1,699	1,220	2,776	**15,394**
Infiltration (m^3/yr)	1,593	2,232	437	115	3,444	2,473	3,030	**13,323**
Total Infiltration (m^3/yr)	1,593	2,232	437	115	3,444	2,473	3,030	**13,323**
Runoff Pervious Areas (m^3/yr)	767	1,074	210	55	1,658	1,191	1,459	**6,415**
Runoff Impervious Areas (m^3/yr)	17,817	26,425	16,226	4,277	9,628	6,915	15,731	**97,018**
Total Runoff (m^3/yr)	18,584	27,499	16,436	4,332	11,286	8,105	17,189	**103,433**
Total Outputs (m^3/yr)	**26,201**	**36,701**	**20,526**	**5,411**	**22,654**	**16,269**	**28,472**	**156,234**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

NOTES:

1) Evaporation from impervious areas are assumed to be 15% of precipitation for flat and paved surfaces, 10% for sloped roofs
2) Post-development infiltration is reduced by 5% due to soil compaction from construction
3) Infiltration Factors taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003)
3) Total outputs is equal to the sum of evapotransporation, evaporation, total infiltration, and total runoff
4) Impervious coefficients are taken from the City of Guelph Development Engineering Manual (January 2019).

TABLE A-5
WATER BUDGET - POST-DEVELOPMENT CONDITIONS WITH MITIGATION
Silvercreek Junction, Guelph, ON

Catchment Designation	Apartment Blocks (Blocks 1-3)	Townhouse Blocks (Blocks 4-17)	Mixed Use Blocks (Blocks 18-20)	Urban Square Park (Block 21)	Neighbourhood Park + Open Space (Block 22-25)	Storm Water Management Block (Block 26)	Right-of-Way (Walkways and Roads)	Totals
Area (m^2)	27,700	38,800	21,700	5,720	23,950	17,200	30,100	**165,170**
Percentage Impervious	0.80	0.80	0.93	0.93	0.50	0.50	0.65	-
Pervious Area (m^2)	5,540	7,760	1,519	400	11,975	8,600	10,535	**46,329**
Impervious Area (m^2)	22,160	31,040	20,181	5,320	11,975	8,600	19,565	**118,841**
Infiltration Factors								
Topography Infiltration Factor	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Soil Infiltration Factor	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
Land Cover Infiltration Factor	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
MOE Infiltration Factor	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Actual Infiltration Factor**	0.68	0.68	0.68	0.68	0.68	0.68	0.68	
Run-Off Coefficient	0.33	0.33	0.33	0.33	0.33	0.33	0.33	
Run-Off from Impervious Surfaces***	0.85	0.90	0.85	0.85	0.85	0.85	0.85	
Inputs (per Unit Area)								
Precipitation (mm/yr)	946	946	946	946	946	946	946	
Run-On (mm/yr)	0	0	0	0	0	0	0	
Other Inputs (mm/yr)	0	0	0	0	0	0	0	
Outputs (per Unit Area)								
Precipitation Surplus for Pervious Areas (mm/yr)	426	426	426	426	426	426	426	
Net Surplus (mm/yr)	426	426	426	426	426	426	426	
Actual Evapotranspiration (mm/yr)	520	520	520	520	520	520	520	
Evaporation (mm/yr)	142	95	142	142	142	142	142	
Infiltration (mm/yr)	288	288	288	288	288	288	288	
Infiltration from Infiltration Gallery (mm/yr)	764	0	764	0	0	0	0	
Infiltration from Infiltration Basin (mm/yr)	0	426	0	402	402	804	402	
Runoff Pervious Areas (mm/yr)	138	138	138	138	138	138	138	
Runoff Impervious Areas (mm/yr)	804	851	804	804	804	804	804	
Runoff Directed to Infiltration Gallery (mm/yr)	764	0	764	0	0	0	0	
Runoff Directed to Infiltration Basin (mm/yr)	0	426	0	402	402	402	402	
Inputs (Volumes)								
Precipitation (m^3/yr)	26,201	36,701	20,526	5,411	22,654	16,269	28,472	**156,234**
Run-On (m^3/yr)	0	0	0	0	0	0	0	**0**
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	**0**
Total Inputs (m^3/yr)	**26,201**	**36,701**	**20,526**	**5,411**	**22,654**	**16,269**	**28,472**	156,234
Outputs (Volumes)								
Precipitation Surplus (m^3/yr)	20,177	29,731	16,873	4,448	14,730	10,578	20,219	**116,756**
Net Surplus (m^3/yr)	20,177	29,731	16,873	4,448	14,730	10,578	20,219	**116,756**
Actual Evapotranspiration (m^3/yr)	2,880	4,034	790	208	6,225	4,471	5,477	**24,085**
Evaporation (m^3/yr)	3,144	2,936	2,863	755	1,699	1,220	2,776	**15,394**
Infiltration (m^3/yr)	1,593	2,232	437	115	3,444	2,473	3,030	**13,323**
Infiltration from runoff redirected to Infiltration Gallery's (m^3/yr)	16,926	0	15,415	0	0	0	0	**32,341**
Infiltration from runoff redirected to the Infiltration Basin (m^3/yr)	0	0	0	0	0	31,487	0	**31,487**
Total Infiltration (m^3/yr)	18,519	2,232	15,851	115	3,444	33,961	3,030	**77,151**
Runoff Pervious Areas (m^3/yr)	767	1,074	210	55	1,658	1,191	1,459	**6,415**
Runoff Impervious Areas (m^3/yr)	891	13,212	811	2,139	4,814	3,457	7,865	**33,190**
Total Runoff (m^3/yr)	1,658	14,287	1,022	2,194	6,472	4,648	9,324	**39,605**
Total Outputs (m^3/yr)	**26,201**	**23,489**	**20,526**	**3,272**	**17,840**	**44,300**	**20,606**	156,234
Difference (Inputs - Outputs)	**0**	**13,212**	**0**	**2,139**	**4,814**	**-28,030**	**7,865**	**0**

NOTES:
1) Evaporation from impervious areas are assumed to be 15% of precipitation for flat and paved surfaces, 10% for sloped roofs
2) Post-development infiltration is reduced by 5% due to soil compaction from construction
3) Infiltration Factors taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003)
3) Total outputs is equal to the sum of evapotransporation, evaporation, total infiltration, and total runoff
4) Impervious coefficients are taken from the City of Guelph Development Engineering Manual (January 2019).
5) Mitigative Measures: Infiltrationn galleries will be installed within the mixed use blocks and apartment blocks to infiltrate roof runoff. an infiltration basin within the storm water management block will retain and infiltrate site runoff

TABLE A-6

WATER BUDGET SUMMARY

Silvercreek Junction, Guelph, ON

Characteristic	Site						
	Pre-Development	Post-Development	Change (Pre- to Post-)	% Change (Pre- to Post-)	Post-Development with Mitigation	Change (Pre- to Post- with Mitigation)	% Change (Pre- to Post- with Mitigation)
Inputs (Volumes)							
Precipitation (m^3/yr)	156,234	156,234	0	0%	156,234	0	0%
Run-On (m^3/yr)	0	0	0	0%	0	0	0%
Other Inputs (m^3/yr)	0	0	0	0%	0	0	0%
Total Inputs (m^3/yr)	**156,234**	**156,234**	0	**0%**	**156,234**	0	**0%**
Outputs (Volumes)							
Precipitation Surplus (m^3/yr)	67,237	116,756	49,519	74%	116,756	49,519	74%
Net Surplus (m^3/yr)	67,237	116,756	49,519	74%	116,756	49,519	74%
Actual Evapotranspiration (m^3/yr)	88,997	24,085	-64,913	-73%	24,085	-64,913	-73%
Evaporation (m^3/yr)	0	15,394	15,394	>100%	15,394	15,394	>100%
Infiltration (m^3/yr)	53,790	13,323	-40,466	-75%	13,323	-40,466	-75%
Infiltration from runoff redirected to Infiltration Gallery's (m^3/yr)	0	0	0	0%	32,341	32,341	>100%
Infiltration from runoff redirected to the Infiltration Basin (m^3/yr)	0	0	0	0%	31,487	31,487	>100%
Total Infiltration (m^3/yr)	53,790	13,323	-40,466	-75%	77,151	23,362	43%
Runoff Pervious Areas (m^3/yr)	13,447	6,415	-7,032	-52%	6,415	-7,032	-52%
Runoff Impervious Areas (m^3/yr)	0	97,018	97,018	>100%	33,190	33,190	>100%
Total Runoff (m^3/yr)	13,447	103,433	89,985	669%	39,605	26,157	195%
Total Outputs (m^3/yr)	**156,234**	**156,234**	**0**	**0%**	**156,234**	**0**	**0%**

NOTES:

1) Total Outputs is equal to the sum of evapotranspiration, evaporation, total infiltration, and total runoff