Stantec Consulting Ltd.
600 - 171 Queens Avenue London, Ontario N6A 5J7

January 12, 2023
File: 1614-14212

Attention: File Reviewer
Corporation of the City of London
Development Services
300 Dufferin Avenue
London, ON N6A 4L9

Dear Reviewer,

Reference: 1350 Wharncliffe Rd, London, Ontario Preliminary Stormwater Management Strategy

This letter outlines support for an IPR Application for the proposed development located at 1350 Wharncliffe Road in London, Ontario.

The following documents were reviewed in the preparation of this letter:

- "Dingman Creek Subwatershed: Stormwater Servicing Study", Aquafor Beech Limited, September 2020.
- "Pincombe Stormwater Management Facility No. 3 Functional Design Report", IBI Group, January 2019.
- "Addendum to the Municipal Class Environmental Assessment 'Schedule B' for Storm/Drainage and Stormwater Management Servicing Works for the White Oak Area", AECOM, September 2014.

STORMWATER MANAGEMENT CRITERIA

The SWM criteria for the Site are established as per the City of London comments in conjunction with the SWM criteria and environmental targets identified in the Dingman Sub-watershed Study and the City's Stormwater Management of the Design Specifications & Requirements manual. The SWM design criteria for the proposed development are:

- **Water Quality** – Provide sufficient treatment measures to meet the Ministry of the Environment, Conservation and Parks, (MECP) *Enhanced* (80% TSS Removal) criteria and promote the at-source removal of potential contaminants.
- **Water Quantity** – Provide sufficient water quantity control to maintain post-development peak flow rates up to the 100-year storm event to the existing flow rates or the target discharge rate allowed for the Site in the design of the downstream receiving systems.
- **Erosion and Sediment Control** – Provide appropriate erosion and sediment control during construction/area grading to protect adjacent properties from potential siltation.

- **Water-balance –** Runoff volume control hierarchy of 25 mm is to be applied utilizing mechanisms of infiltration, evapotranspiration and/or re-use to maintain local water-balance of the development area.

EXISTING DRAINAGE CONDITIONS

The existing property, approximately 4.0 ha in area, is located south of Wharncliffe Road and is bounded at the south and west side by the existing residential areas and by agricultural lands to the east. Currently the site consists of a farmstead and associated outbuildings.

Runoff from the site is split roughly in half between the Pincombe Drain and the White Oaks Drain. The north half of the site is tributary to the future White Oaks 3 – West SWM dry facility. Under the existing conditions, flows from the north half drain overland primarily to a reach of the White Oaks Drain located to the east of site. Flows from the south half drain overland and via sewer to the Pincombe stormwater management facility (SWMF) #3. Both the White Oaks Drain and the Pincombe Drain are tributary to the Dingman Creek.

PROPOSED DRAINAGE CONDITIONS

The development proposes a medium density residential block, single-family lots, associated roads, and an allowance for the Bradley Avenue extension. Site runoff will continue to be directed to the appropriate drains. The proposed drainage condition is illustrated in the attached Storm Drainage Area Figure and the areas are described below.

A100 – This 0.41 ha area is primarily made up of the future Bradley Avenue right of way (ROW) and drains to the White Oaks Drain. This area is tributary to the future White Oaks 3 – West SWM dry facility.

A101 – This 1.99 ha area includes a medium density block, part of the single-family lots, and the extension of Southbridge Avenue. This area drains to the White Oaks Drain and is tributary to the future White Oaks 3 – West SWM dry facility.

A102 – The 1.64 ha area consists of single-family lots and future Street ‘A’ and drains to Pincombe SWMF #3.

STORMWATER MANAGEMENT STRATEGY

The proposed development is within the Dingman Creek subwatershed and as such is subject to the recommendations within the Dingman Creek Subwatershed Municipal Class Environmental Assessment (DCEA).

The Pincombe SWMF #3 has capacity allowance for the southern half of the subject property as shown on City Drawing # T15501-Ph3-4P3 (attached). The assumed conditions match the proposed conditions for the single-family lots and as such the Pincombe SWMF #3 should have sufficient capacity for the design.

The Bradley Avenue extension’s drainage will be handled during the design process of the road itself and has not been covered here.

The following SWM strategy has been designed to mimic the pre-development conditions of the medium

density site prior to any development in the existing catchment and to control the peak flows from the proposed 100-year event to 2-year pre-development conditions. The strategy consists of an oil-grit separator (OGS) and on-site controls for the medium density block. Each of the pieces involved in this strategy are detailed below.

ONSITE WATER QUANTITY CONTROL FOR MEDIUM DENSITY BLOCK

The medium density block will require onsite controls that reduce the post-development flows to the levels required as laid out below.

This block will require approximately 860 m³ of onsite storage to control the 100-year post-development event to the 2-year pre-development rate of 40 l/s. These values were determined using the Modified Rational Method. The supporting calculations are attached.

The proposed medium density block will drain by sewer to the Southbridge Avenue extension and on to the Bradley Avenue ROW which will outlet to the White Oaks 3 – West SWM dry facility.

WATER QUALITY CONTROL FOR MEDIUM DENSITY BLOCK

An OGS unit will be proposed to treat the minor flows from the medium density block. It will be sized to achieve 80% total suspended solids (TSS) removal.

INFILTRATION AND WATER BALANCE

A water balance analysis completed as part of the current work determined that the development of the property to a residential land use with an approximate impervious coverage of 59% would result in significant impacts on the volume of water that is recharged to the groundwater system, if no infiltration augmentations were considered. The attached water balance analysis indicates that the estimated existing infiltration of 236 mm/year would see a 55% reduction to 107 mm/year, if no infiltration measures are implemented.

It is recommended that an increased topsoil depth of at least 300 mm be applied to all pervious areas under the proposed conditions. As per the *Evaluation of Residential Lot Level Stormwater Practices Technical Brief* (TRCA, 2014), increased topsoil depth of pervious areas can provide runoff reduction benefits. The study indicates that 5% reduction in runoff volume and, consequently, 5% increase in groundwater recharge can be expected as a result of applying increased topsoil depth. Therefore, the estimated groundwater recharge under the proposed conditions would be 141 mm/year. This will result in 95 mm/year infiltration deficit compared to existing conditions.

Based on the attached water balance calculations, final runoff surplus, as a result of the development, will be 411 mm/year which will be controlled in the proposed on-site storage as well as Pincombe SWMF #3. It is recommended that infiltration opportunities in the medium density block in conjunction with the proposed storage facility be considered to ensure best efforts are made to match the existing infiltration levels. However, water balance and infiltration design will need to be completed during detail design stage based on hydrogeological data.

EROSION AND SEDIMENT CONTROL PLAN

This section describes the Erosion and Sediment Control Plan that shall be implemented during and immediately after construction to reduce the possibility of sediment being deposited downstream.

TYPES OF SELECTED EROSION/SEDIMENT CONTROL METHODS

The proposed erosion and sediment control measures may include the following:

- Heavy-duty silt fencing to be erected on all Site boundaries where there is potential for runoff to be discharged offsite, to protect adjacent downstream lands from migration of sediment in overland flow. The location of this fencing will be adjacent to the limit of grading.
- Reinforced silt fencing along the southern and eastern limits of construction to be installed
- Stabilize all disturbed areas where work will not take place for a period of 30 days or more according to OPSS 572.
- Perform street sweeping as necessary to remove soil accumulation caused by construction traffic.
- Dewatering effluent discharge areas complete with sediment traps and energy diffusers shall be constructed, as necessary, within the proposed construction limits. Filter socks shall be used where necessary to further filter the discharge.
- Install and maintain catchbasin inserts at all catchbasins to prevent sediment from entering the proposed storm sewer.

The proposed temporary erosion & sediment control measures have been selected based on the Site's susceptibility to erosion, sensitivity of the downstream environment, Site slopes, and total drainage area. The proposed measures should provide adequate erosion and sediment control for the proposed project without the need for additional measures; however, the Site needs to be monitored during construction, and additional measures shall be added, if required. Such measures may include additional rows of silt fence or rock check dams in areas that are susceptible to erosion.

CONTINGENCY PLAN

The purpose of the Contingency Plan is to help minimize the risk or consequence of failure of the erosion and sediment control works. Failure could result from insufficient measures, lack of maintenance, or severe weather conditions. The Contingency Plan includes two (2) areas of consideration: the procedures that will be followed where a failure has occurred; and the contingency measures that will be implemented where there is potential for failure.

The Contractor shall be responsible for following the Contingency Plan, and shall prepare the following items:

- The Contractor will create an emergency contact list for emergency situations.
- Workers shall be on call for emergency situations for all aspects of the emergency from design to construction of emergency sediment and erosion control measures. Any associated health and safety issues are the responsibility of Contractor.

- Heavy duty silt fence, erosion control blanket, straw bales and stakes, sandbags, appropriately sized rip-rap, and clean gravel fill shall be available for emergency installation.
- Gas powered pumps, appropriately sized hoses, filtration hose socks, and filter cloth shall be available for emergency dewatering.
- Heavy equipment shall be on standby for emergency works.
- Fuel spill equipment shall be available for emergency spills of deleterious substances.
- A contact list for any further required equipment or materials shall be prepared and made available for emergency use.

Contingency Measures in Case of Failure

In the event of a failure, the Contractor shall cease all construction related work and focus on erosion and sediment control as required to effectively stabilize the Site where a failure has occurred or is imminent. The work shall be completed to the satisfaction of the Contract Administrator and any regulatory agencies that have been consulted.

Any unexpected discharge of silt or sediment or other deleterious substance outside of the work limits shall be reported to the City within a period of 2 hours. If significant long-term damage to fish habitat or property is suspected, a Restoration Plan shall be developed by the Owner's Engineer. Development of the initial Restoration Plan shall begin within 24 hours of the discovery of sediment discharge, and shall be implemented as soon as possible, following consultation and approval from the MECP, UTRCA, DFO and City of London (EESD). The Plan shall address:

- Removal and disposal of sediment from outside of the work limits
- Restoration of the affected area
- Restoration of any areas disturbed through deposition or removal.

Contingency Measures Where There is a High Risk of Failure

Conditions that may potentially cause failures can be identified through two (2) methods: monitoring of the erosion and sediment control measures, and weather forecasts that anticipate severe weather conditions.

High Risk Identified through Monitoring

Where monitoring has identified a high potential for failure, steps shall be immediately taken to reduce the risk. These measures may include repair to existing measures, modification of existing measures, and the addition of new measures.

The Contractor shall document the proposed approach and submit it to the Contract Administrator for immediate review and response. Where no response is forthcoming, the Contractor shall immediately proceed with implementation.

The Contract Administrator shall immediately provide a copy of the proposed approach to the City of London. As time may be of the essence, it will be the City's responsibility to respond forthwith, otherwise the Contractor shall proceed with the proposed measures.

Severe Weather Anticipated

In cases where the weather forecast indicates that significant rainfall is expected within a 24-hour period, the Contractor shall immediately complete the following:

- Verify that all erosion and sediment control measures are secure and that there is no exposed soil that could erode and be deposited downstream
- Verify that any exposed slopes are covered with erosion control blankets or other stabilization measures
- Verify that all other measures are in good working order
- Cease all dewatering operations
- Remove all equipment and stockpiled materials to an appropriate location
- Monitor all measures during the rainfall event, and where a potential for failure is identified, take corrective measures.

The Contract Administrator shall document the status of the above-listed steps.

If unforeseen events cause the strategies set out in the Contingency Plan to be insufficient or inappropriate to meet the objective of containing sediment within the work limits, the Contractor, either independently or as directed by the Contract Administrator, shall respond in a timely manner with all reasonable measures consistent with safety, to prevent, counteract or remedy any effects on fish or fish habitat, human interest (i.e., safety, property value) and general watercourse slope stabilization.

WHEN AND WHERE DEVICES WILL BE INSTALLED

The locations of the proposed erosion and sediment control measures shall be provided at the site plan application stage. The order in which the proposed measures shall be implemented is summarized in the following table.

Table 3 – Erosion and Sediment Control Sequencing

Stage	Erosion and Sediment Control Measure
Pre-Construction	Create contact list for emergency Contingency Plan operations.
Construction	Monitor weather reports for significant precipitation events for contingency planning.
	Install heavy duty silt fencing along all the necessary Site limits.
	Install catchbasin inserts in catchbasins.
	Perform street sweeping as necessary.
	Complete final grading and perform seeding.
	Remove dewatering sediment traps and energy diffusers.
Post-Construction	Remove any remaining erosion and sediment control measures.
	In consultation with the City, reestablish any downstream area showing signs of erosion or sedimentation.

LAND SLOPES AND PROPOSED LAND ALTERATIONS

The proposed work involves residential development of the 4.0 ha property. The existing Site slopes are generally around 2%. In general, substantial alteration in the Site topography caused by the proposed Site grading is not expected.

NEED FOR ENHANCED EROSION/SEDIMENT CONTROL MEASURES

The proposed erosion and sediment control measures should convey the typical summer runoff during construction, while simultaneously preventing sediment transport. Additional measures will likely not be required. However, the Site shall be monitored during construction and additional measures (i.e., rock check dams and/or additional rows of silt fence) may be installed, at the discretion of the Contract Administrator. The triggers for the installation of enhanced erosion and sediment control measures would include breaching of the proposed erosion and sediment control measures, and / or reevaluation based on Site conditions during construction. In any event, Site conditions and erosion / sediment control measures shall be monitored on a regular basis by onsite inspection staff.

DOWNSTREAM SENSITIVITY OF WATER RESOURCES

The subject Site is located within the Dingman Creek Sub-watershed, which outlets to the Thames River. The Thames River system provides habitat for various rare fish and mollusk species and is also used as a source of drinking water and provides extensive recreational opportunities, particularly in its lower reaches. Thus, care will be required to prevent the discharge of suspended sediment from the proposed construction limits to Dingman Creek.

PROXIMITY TO ENVIRONMENTALLY SIGNIFICANT/SENSITIVE AREAS

No Environmentally Sensitive Areas (ESA) are noted in the proximity of the subject Site.

INFILTRATION MEASURES AND EXISTING GROUNDWATER LEVELS

Erosion & sediment infiltration measures shall be included in the proposed Erosion and Sediment Control Plan.

DEWATERING REQUIREMENTS

The need for significant dewatering shall be determined based on geotechnical information at the site plan application stage. If dewatering in excess of 50,000 Lpd is required, the Contractor will be responsible for obtaining an MECP Permit to Take Water (PTTW). Regardless, all dewatering effluent must be discharged to a sediment trap. Under no circumstances shall dewatering effluent be discharged directly to the downstream sewer system. Both the Contractor and the Contract Administrator will be responsible for monitoring the water quality leaving the sediment traps.

If, during construction, the dewatering volume is significantly greater than initially expected, additional dewatering sediment traps shall be constructed within the proposed work limits. The exact location of the dewatering sediment traps will depend on what work has been completed and the location of the excavation to be dewatered. Thus, the locations of any additional dewatering areas shall be identified by the Owner's Engineer in consultation with the Contractor and the Contract Administrator.

SITE SOILS

The Site soils are predominantly silt loam, loam, and silty clay loam as shown on the Ontario Soil Survey Report.

PROPOSED REPORTING SYSTEM

The Contract Administrator shall prepare weekly erosion and sediment control monitoring reports for the duration of construction and submit them to the City of London by April 1, July 1, and November 1 of each year until all works and services of the plan are assumed. The Monitoring Reports should document the status of the ESC Plan, any repairs, rainfall or pumping that has occurred since the last report, and any failure of the erosion and sediment control measures shall be reported as described in the Contingency Plan.

INSPECTION REQUIREMENTS

In order to monitor the effectiveness of the erosion and sediment control measures during construction, frequent inspections will be required. The inspection activities shall include the following tasks:

- The Developer's Contract Administrator and the Developer shall inspect the erosion control works on all days when construction is active

- The Developer and Developer's Contract Administrator shall monitor weather reports on a daily basis and record daily temperatures and rainfall
- The Developer's Contract Administrator and the Developer shall inspect the erosion control works following periods of excessive precipitation (i.e., rainfall depths that exceed 25 millimeters). Any deficiencies will be corrected by the Developer within 24 hours
- The Developer's Contract Administrator will document all inspection activities in weekly erosion and sediment control inspection reports
- The Developer shall be responsible for constructing and maintaining all erosion and sediment control measures
- Maintenance will be the responsibility of the Developer and shall include maintaining all erosion and sediment control measures. These shall include, but not be limited to, the following: maintaining fencing, erosion control blankets, and dewatering traps, and removing accumulated sediment
- Prior to removal of erosion and sediment control measures, the Owner's Engineer and the City of London shall conduct a joint inspection of the construction Site to confirm that the measures can be removed and discuss the methods that will be used for removal. Removal of the erosion and sediment control measures will be the responsibility of the Owner.

SECURITY ALLOCATION FOR POTENTIAL RESTORATION WORKS

The *City of London Subdivision & Development Agreement Security Policy* (July 2014) states:

"Security for "Erosion and Sediment Control Measures" shall be provided to the satisfaction of the City, for all plans of subdivision and Site alteration agreements based on the size (in hectares) of the development as follows:

- Less than 5.0 ha - $40,000
- Greater than or equal to 5.0 ha - $60,000"

Reference: **1350 Wharncliffe Rd, London, Ontario Preliminary Stormwater Management Strategy**

1.0 CONCLUSIONS AND RECOMMENDATIONS

The above SWM strategy indicates that there is adequate space provided in the submitted draft plan to achieve the objectives and recommendations laid out in the DCEA. The designed storage targets for the medium density blocks are reasonable for their size. Further refinement of this strategy will occur through discussion with the approval authorities leading up to and during detail design.

We trust that this information adequately outlines the proposed stormwater management considerations for 1350 Wharncliffe road. If you have any questions regarding the forgoing information, please do not hesitate to contact the undersigned.

Regards,

STANTEC CONSULTING LTD.

Digitally signed by Yavarikia, Maryam
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Attachment: Proposed Storm Drainage Area Figure
City Drawing ref# T15501Ph34P3
Total Impervious Percentage Calculations
SWM Calculations
Water Balance Calculations

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Stantec
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London ON N6A 5J7
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Liability Note:

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.

Notes

Legend

- OVERLAND FLOW
- PROPOSED STORM SEWER
- EXISTING STORM SEWER
- SITE BOUNDARY

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name: 161414212_c-fb	AS Dwn.	DV Chkd.	AS Dsgn.	YY.MM.DD

Permit-Seal

Client/Project

ROYAL PREMIER DEVELOPMENTS
1350 WHARNCLIFFE ROAD SOUTH

London, ON Canada

Title

STORM DRAINAGE AREA & SERVICING FIGURE

Project No.	Scale	
161414212		
Drawing No.	**Sheet**	**Revision**
1	1 of 1	0

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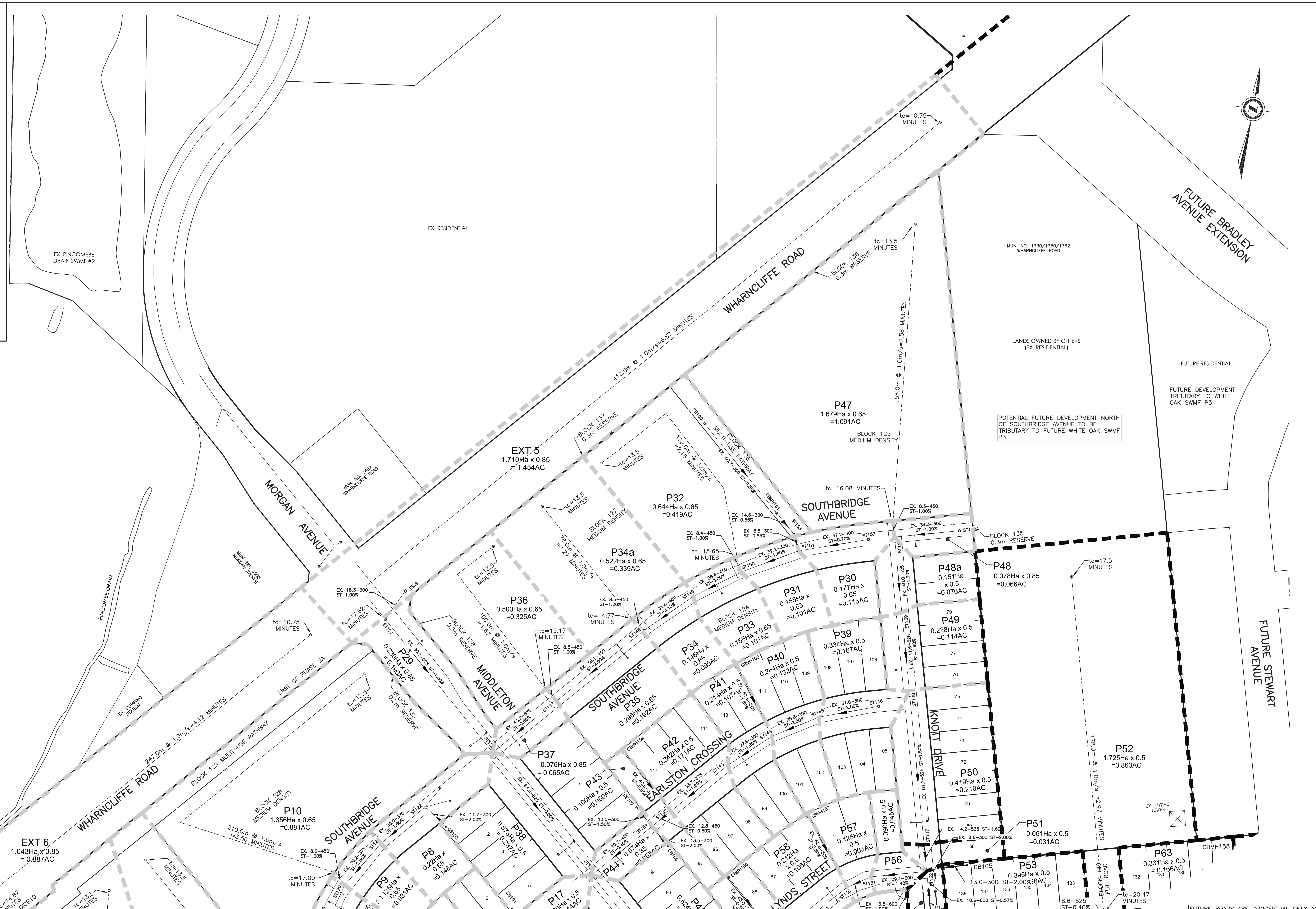
ORIGINAL SHEET - ANSI D

LEGEND

ST1	PROPOSED STORM MANHOLE & NUMBER
CBMH1	PROPOSED CATCHBASIN MANHOLE
DICBMH1	PROPOSED DITCH INLET CATCHBASIN MANHOLE
CB1	PROPOSED STANDARD CATCHBASIN
TICB1	PROPOSED TWIN INLET CATCHBASIN
CICB1	PROPOSED CURB INLET CATCHBASIN
FST1	FUTURE STORM MANHOLE & NUMBER
EX. STM MH	EXISTING STORM MANHOLE
EX. CBMH	EXISTING CATCHBASIN MANHOLE
EX. CB1	EXISTING CATCHBASIN
EX. 50.0–600 ST–0.5%	EXISTING STORM SEWER
50.0–600 ST–0.5%	PROPOSED STORM SEWER PHASE 3
	DRAINAGE AREA BOUNDARY PHASE 3
	EXISTING DRAINAGE AREA BOUNDARY PHASE 1/2

REFERENCE STORM DESIGN SHEET ON PLAN 11

DRAINAGE AREA DESIGNATION
D10
DRAINAGE AREA (Ha) — 0.60Ha x 0.5 — RUN-OFF COEFFICIENT (C)
= 0.30 AC
TOTAL A x C



EXISTING SERVICES	DRAWING #, SOURCE	DATE	AS CONSTRUCTED SERVICES	COMPLETION	DETAILS	No.	REVISIONS	DATE	CONSULTANT
					DESIGN BY JJ/CW	1	ISSUED FOR ADMINISTRATIVE REVIEW	DEC 4/20	DEVENG
					DRAWN BY CW	2	ISSUED FOR FINAL APPROVAL	JAN 8/21	DEVENG
					CHECKED BY DH	3	REVISED STREET NAMES	MAR 8/21	DEVENG
					F.BK. 1090				

FILE: DEL10-091SPH3 – AREA PLANS(2).DWG

CONSULTANT OR DIVISION
London Office
41 Adelaide St. N., Unit 71
(519) 672-8310
Paris Office
31 Mechanic St., Unit 301
(519) 442-1441
development engineering (London) Limited
CONSULTING CIVIL ENGINEERS

LICENSED PROFESSIONAL ENGINEER D. J. HOEVENAARS 100149139 Mar 8, 2021 PROVINCE OF ONTARIO

CORPORATION OF THE CITY OF LONDON DEVELOPMENT SERVICES
ACCEPTED
04/14/2021
SUBJECT TO THE CONDITION(S) IDENTIFIED IN THE ACCEPTANCE LETTER OF THE SAME DATE.
London CANADA

SCALE – 1:1000

RICHARDSON SUBDIVISION – PHASE 3
LONDON, ONTARIO
SIFTON PROPERTIES LIMITED

STORM AREA PLAN 1

PROJECT No. DEL15-091SPH3
SHEET No. 4P3
PLAN FILE No.

T15501-Ph3-4P3

Subject: **Total Impervious Percentage Calculations**
Project: **1350 Wharncliffe Rd.**
Project No.: **161414212**
Date: **November 25, 2022**

Area Name	Area (ha)	Runoff Coefficient	Impervious Percentage
A100	0.41	0.90	100%
A101	1.99	0.65	64%
A102	1.64	0.50	43%
	Composite Value	0.61	59%

Subject: **Target Flows**
Project: **1350 Wharncliffe Rd.**
Project No.: **161414212**
Date: **November 25, 2022**

Total Drainage Area: 1.99 ha
Composite Runoff Coefficient: 0.20

$$I = A/(T+B)^C$$

I = Intensity of rainfall in mm/hour
T = Time of concentration in hours

$$Q = 0.0028CIA$$

Q = Peak Discharge
C = 0.20 Runoff Coefficient
I = Rainfall Intensity
A = 1.99 Area (ha)
tc = 36.8 min

$$tc = \frac{3.26\,(1.1 - C)\,L^{0.5}}{Sw^{0.33}}$$

Airport Equation

Used if Rational Method runoff coefficient is less than 0.40.

L	250	m
Sw	2	%
C	0.2	
tc=	37	mins

Design Storm Event	A	B	C	Rainfall Intensity (mm/hr)	Peak Discharge (cms)
2-year	754.36	6.011	0.81	36.0	0.04
100-year	2619.363	10.500	0.884	86.6	0.10

Subject: **Modified Rational Method**
Project: **1350 Wharncliffe Rd.**
Project No.: **161414212**
Date: **November 25, 2022**

Drainage Area - Medium Density Block

Total Drainage Area: 1.99 ha
% Impervious: 64%

	Area (ha)	Runoff Coefficient	CA
Imp. Land	1.27	0.90	1.14624
Pervious Land	0.72	0.20	0.14328

Composite Runoff Coefficient: 0.65
Event Adjusted C: 0.81

(25% increase as per MTO guidelines for severe storm events 0.95 max)

Rainfall Intensity

$$I = A/(T + B)^C$$

I = Intensity of rainfall in mm/hour
T = Time of concentration in hours
A = 2619.363
B = 10.5
C = 0.884

Time Step 5 minutes

Storage Calculation 100-year

Target Release Rate: 0.04 m³/s max Storage= 861

Time (min.)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cu. m)	Incremental Outflow Volume (cu. m)	Storage Volume (cu. m)
45	75.2	0.337	909	107	802
50	69.7	0.312	936	119	817
55	65.0	0.291	960	131	829
60	60.9	0.273	981	143	838
65	57.3	0.257	1000	155	845
70	54.1	0.242	1018	167	851
75	51.3	0.230	1034	179	855
80	48.8	0.219	1049	191	858
85	46.5	0.208	1063	203	860
90	44.5	0.199	1076	215	861
95	42.6	0.191	1088	227	861
100	40.9	0.183	1099	239	861
105	39.3	0.176	1110	250	859
110	37.9	0.170	1120	262	858
115	36.6	0.164	1129	274	855
120	35.3	0.158	1139	286	852

Monthly Water Balance Analysis - Main Site

161414212 1350 Wharncliffe Road

Existing Condition

Main Site Area (ha)	4.0	
Land Description Factors		
Topography	0.30	
Soils	0.20	
Cover[1]	0.05	
Sum (Infiltration Factor)	0.55	
Soil Moisture Capacity (mm)[2]	125	
Site Area	3.6	
Percentage of Total Site Area	90%	

Land Cover Descriptions

Shallow rooted crops

Silt loam, silty clay loam

Relatively Flat

90% **CHECK SUB AREA PERCENTAGES!**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Comment
Climate Data (Data from LONDON INT'L AIRPORT - Climate Normals from 1981-2010)														
Average Daily Temperature (°C)	-5.6	-4.5	-0.1	6.8	13.1	18.3	20.8	19.7	15.5	9.2	3.4	-2.6	**7.9**	Daily average temperature in each month
Precipitation (mm)	74.2	65.5	71.5	83.4	89.8	91.7	82.7	82.9	103.0	81.3	98.0	87.5	**1011.5**	
Evapotranspiration Analysis														
Saturation Vapour Pressure (mb)	4.02	4.37	6.07	9.89	15.10	21.08	24.63	23.01	17.65	11.65	7.80	5.04		
PET (Malstrom, 1969) (mm/month)	0.00	0.00	0.00	40.46	61.78	86.24	100.75	94.12	72.18	47.66	31.91	0.00	**535.1**	
Infiltration - PET (mm)	74.20	65.50	71.50	42.94	28.02	5.46	-18.05	-11.22	30.82	33.64	66.09	87.50		
Weighted Soil Storage Capacity (mm)	112.50	112.50	112.50	112.50	112.50	112.50	112.50	112.50	112.50	112.50	112.50	112.50		
Actual Soil Moisture (mm)	112.50	112.50	112.50	112.50	112.50	112.50	94.45	83.23	112.50	112.50	112.50	112.50		Assume April soil moisture is at max capacity (i.e., saturated)
Change in Soil Moisture (mm)	0.00	0.00	0.00	0.00	0.00	0.00	-18.05	-11.22	29.27	0.00	0.00	0.00		
Actual Evapotranspiration (mm)	**0.00**	**0.00**	**0.00**	**40.46**	**61.78**	**86.24**	**100.75**	**94.12**	**72.18**	**47.66**	**31.91**	**0.00**	**535.1**	
Recharge/Runoff Analysis														
Surplus	74.2	65.5	71.5	42.9	28.0	5.5	0.0	0.0	1.5	33.6	66.1	87.5	**476.4**	
Deficit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Weighted Infiltration Factor	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50		Based on MOE SWM Manual (2003)
Runoff (mm)	**0.00**	**0.00**	**0.00**	**172.53**	**14.15**	**2.76**	**0.00**	**0.00**	**0.78**	**16.99**	**33.38**	**0.00**	**240.6**	Assume no runoff in sub-zero months
Recharge (mm)	**0.00**	**0.00**	**0.00**	**169.11**	**13.87**	**2.70**	**0.00**	**0.00**	**0.76**	**16.65**	**32.72**	**0.00**	**235.8**	
													0	Balance Check

Volume-Based Balance (m^3)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Precipitation	3,001	2,649	2,892	3,374	3,632	3,709	3,345	3,353	4,166	3,289	3,964	3,539	40,915	1012 mm/year
Evapotranspiration	0	0	0	1,637	2,499	3,488	4,075	3,807	2,920	1,928	1,291	0	21,645	535 mm/year
Runoff	0	0	0	6,979	572	112	0	0	32	687	1,350	0	9,731	241 mm/year
Groundwater Recharge	0	0	0	6,840	561	109	0	0	31	674	1,323	0	9,539	236 mm/year
													0	Balance Check

Notes:

1 - cover for the majority subject site is agricultural land

2 - soil moisture capacity is based on coverage

Monthly Water Balance Analysis - Main Site

161414212 1350 Wharncliffe Road

Proposed Condition

Land Cover Descriptions

Urban lawn

Silt loam, silty clay loam

Relatively Flat

Main Site Area (ha)	4.0		
Impervious Cover	59%		
Land Description Factors			**Impervious**
Topography	0.30		-
Soils	0.20		-
Cover[3]	0.05		-
Sum (Infiltration Factor)	0.55		-
Soil Moisture Capacity (mm)[4]	125		-
Site Area	1.6		2.40
Percentage of Total Site Area	41%		59%

100% **OK**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Comment
Climate Data (Data from LONDON INT'L AIRPORT - Climate Normals from 1981-2010)														
Average Daily Temperature (°C)	-5.6	-4.5	-0.1	6.8	13.1	18.3	20.8	19.7	15.5	9.2	3.4	-2.6	**7.9**	Daily average temperature in each month
Precipitation (mm)	74.2	65.5	71.5	83.4	89.8	91.7	82.7	82.9	103.0	81.3	98.0	87.5	**1011.5**	
Evapotranspiration Analysis														
Saturation Vapour Pressure (mb)	4.02	4.37	6.07	9.89	15.10	21.08	24.63	23.01	17.65	11.65	7.80	5.04		
PET (Malstrom, 1969) (mm/month)	0.00	0.00	0.00	40.46	61.78	86.24	100.75	94.12	72.18	47.66	31.91	0.00	**535.1**	
Infiltration - PET (mm)	74.20	65.50	71.50	42.94	28.02	5.46	-18.05	-11.22	30.82	33.64	66.09	87.50		
Weighted Soil Storage Capacity (mm)	125.00	125.00	125.00	125.00	125.00	125.00	125.00	125.00	125.00	125.00	125.00	125.00		
Actual Soil Moisture (mm)	125.00	125.00	125.00	125.00	125.00	125.00	106.95	95.73	125.00	125.00	125.00	125.00		Assume April soil moisture is at max capacity (i.e., saturated)
Change in Soil Moisture (mm)	0.00	0.00	0.00	0.00	0.00	0.00	-18.05	-11.22	29.27	0.00	0.00	0.00		
Actual Evapotranspiration (mm)	**0.00**	**0.00**	**0.00**	**40.46**	**61.78**	**86.24**	**100.75**	**94.12**	**72.18**	**47.66**	**31.91**	**0.00**	**535.1**	
Recharge/Runoff Analysis - Pervious Areas														
Surplus	74.2	65.5	71.5	42.9	28.0	5.5	0.0	0.0	1.5	33.6	66.1	87.5	**476.4**	
Deficit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Weighted Infiltration Factor	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55		Based on MOE SWM Manual (2003)
Runoff (mm)	**0.00**	**0.00**	**0.00**	**153.74**	**12.61**	**2.46**	**0.00**	**0.00**	**0.70**	**15.14**	**29.74**	**0.00**	**214.4**	Assume no runoff in sub-zero months
Recharge (mm)	**0.00**	**0.00**	**0.00**	**187.90**	**15.41**	**3.01**	**0.00**	**0.00**	**0.85**	**18.50**	**36.35**	**0.00**	**262.0**	
													0	Balance Check

Volume-Based Balance (m^3)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Precipitation	**3,001**	**2,649**	**2,892**	**3,374**	**3,632**	**3,709**	**3,345**	**3,353**	**4,166**	**3,289**	**3,964**	**3,539**	**40,915**	
Evapotranspiration	0	0	0	668	1,019	1,423	1,662	1,553	1,191	786	526	0	8,829	
Total Evap	**0**	**0**	**0**	**668**	**1,019**	**1,423**	**1,662**	**1,553**	**1,191**	**786**	**526**	**0**	**8,829**	218 mm/year
Pervious Runoff	0	0	0	2,536	208	41	0	0	11	250	491	0	3,537	87 mm/year
Impervious Runoff	0	0	0	9,152	2,151	2,196	1,981	1,986	2,467	1,947	2,347	0	24,226	599 mm/year
Total Runoff	**0**	**0**	**0**	**11,688**	**2,359**	**2,237**	**1,981**	**1,986**	**2,478**	**2,197**	**2,838**	**0**	**27,764**	686 mm/year
Groundwater Recharge from Pervious Areas	**0**	**0**	**0**	**3,100**	**254**	**50**	**0**	**0**	**14**	**305**	**600**	**0**	**4,323**	107 mm/year
													0	Balance Check
Infiltration Augmentation														
Groundwater Recharge from the increased topsoil[5]	**0**	**0**	**0**	**584**	**118**	**112**	**99**	**99**	**124**	**110**	**142**	**0**	1,388	34 mm/year - Assuming a minimum of 300 mm topsoil will be added to all pervious areas
Final Recharge	**0**	**0**	**0**	**3,685**	**372**	**161**	**99**	**99**	**138**	**415**	**742**	**0**	**5,711**	141 mm/year
Final Runoff	**0**	**0**	**0**	**11,104**	**2,241**	**2,125**	**1,882**	**1,886**	**2,355**	**2,087**	**2,696**	**0**	**26,375**	652 mm/year
Final Recharge Surplus	0	0	0	-3,156	-189	52	99	99	107	-258	-582	0	-3,828	-95 mm/year
Final Runoff Surplus	0	0	0	4,125	1,668	2,013	1,882	1,886	2,323	1,400	1,346	0	16,644	411 mm/year

Notes:

soil moisture capacity is based on coverage

cover is considered to be fully developed