

# **Etobicoke Exfiltration System – Water Balance Modelling**

Presented by: Bobby Pettigrew P.Eng.  
Date: October 2019  
JLR No.: 2699-01

## **Introduction**

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Why did we use the Etobicoke Exfiltration System?

What modelling did we do?

Any obstacles we had to overcome?

What was the process for the approvals side?

# Where is Barrhaven South?



## **Where is Barrhaven South?**

Ottawa Urban Boundary

Barrhaven South Expansion

- 121 ha expansion to the Urban Boundary
- Proposed 1200 residential units
- 14 ha of commercial, schools and parks

## Where is Barrhaven South?

Aggregate  
Extraction

to Jock River

to Mud Creek

to Rideau River

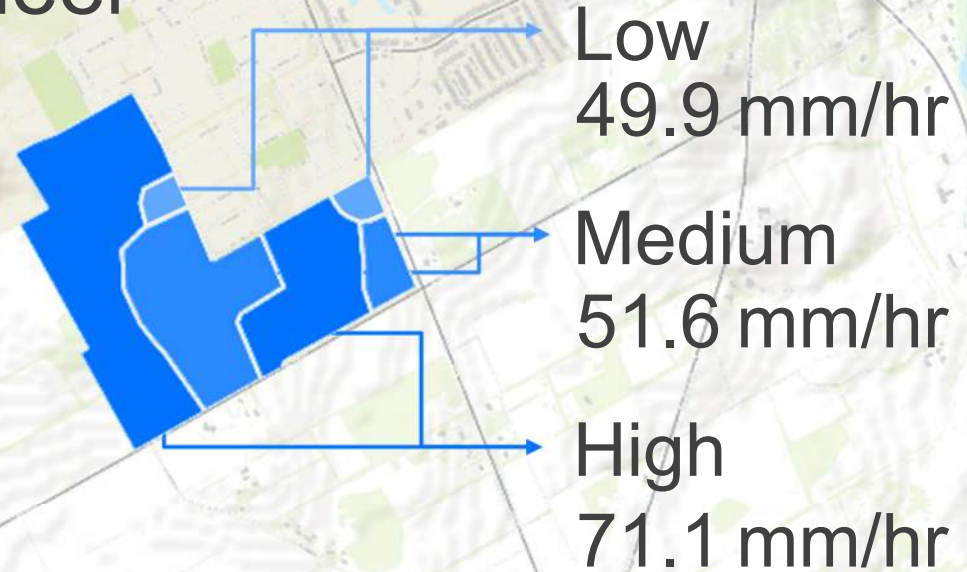
## **Where is Barrhaven South?**

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- Large underground esker present
- Important to maintain water balance
- Infiltration measures required on site

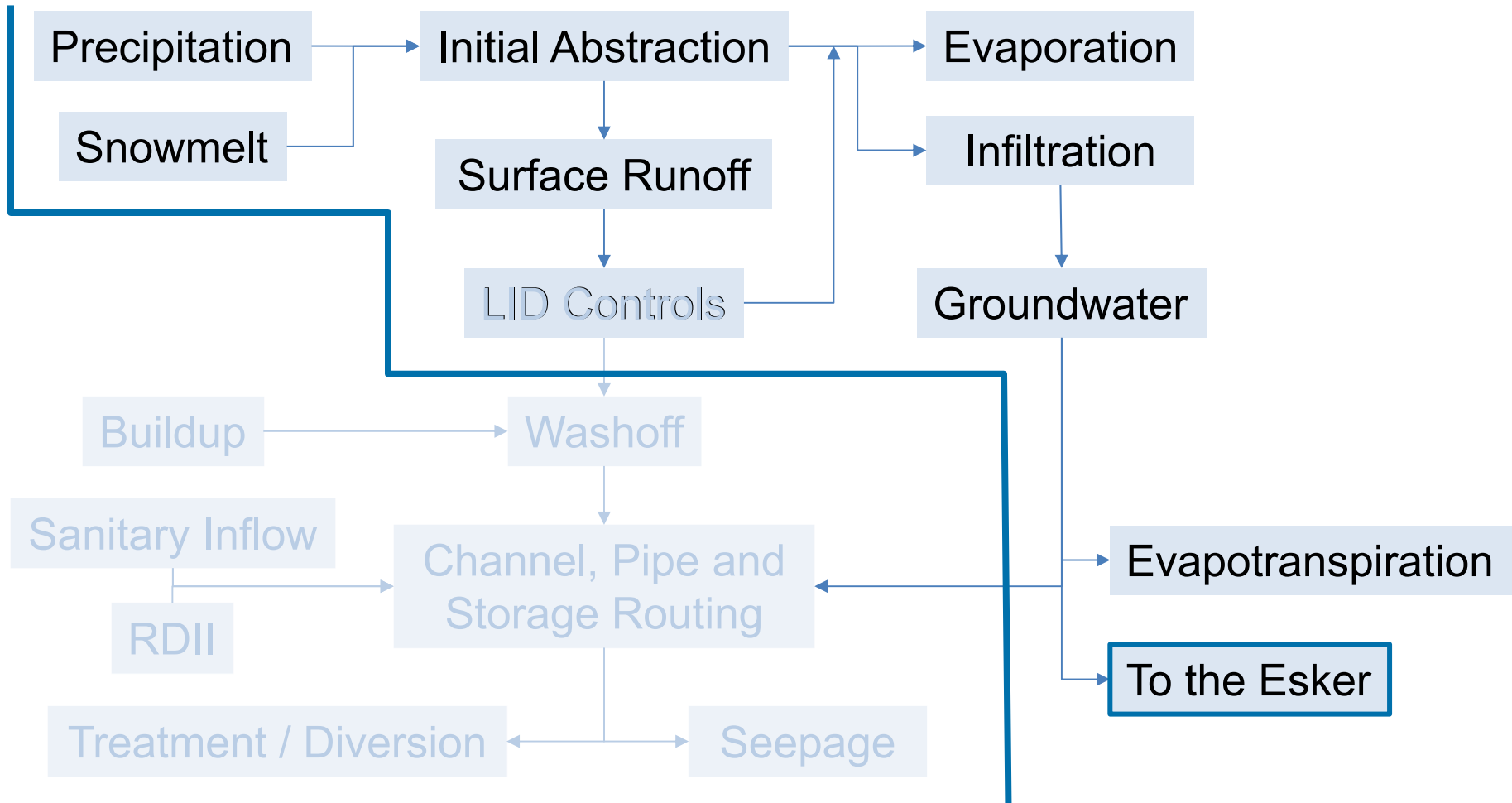
## **Water Balance Modelling - Inputs**

- Soil Infiltration Parameters identified by Geotechnical Engineer



- Conversion from field measured hydraulic conductivity to Percolation Rate

# Modelling Processes





## Water Balance Modelling - Inputs

- Four Groundwater Aquifers to represent the four hydrologic soil groups – A, B, C and D
- Values sourced from SPAW
- Two snow pack components were created
- Groundwater components added to each subcatchment

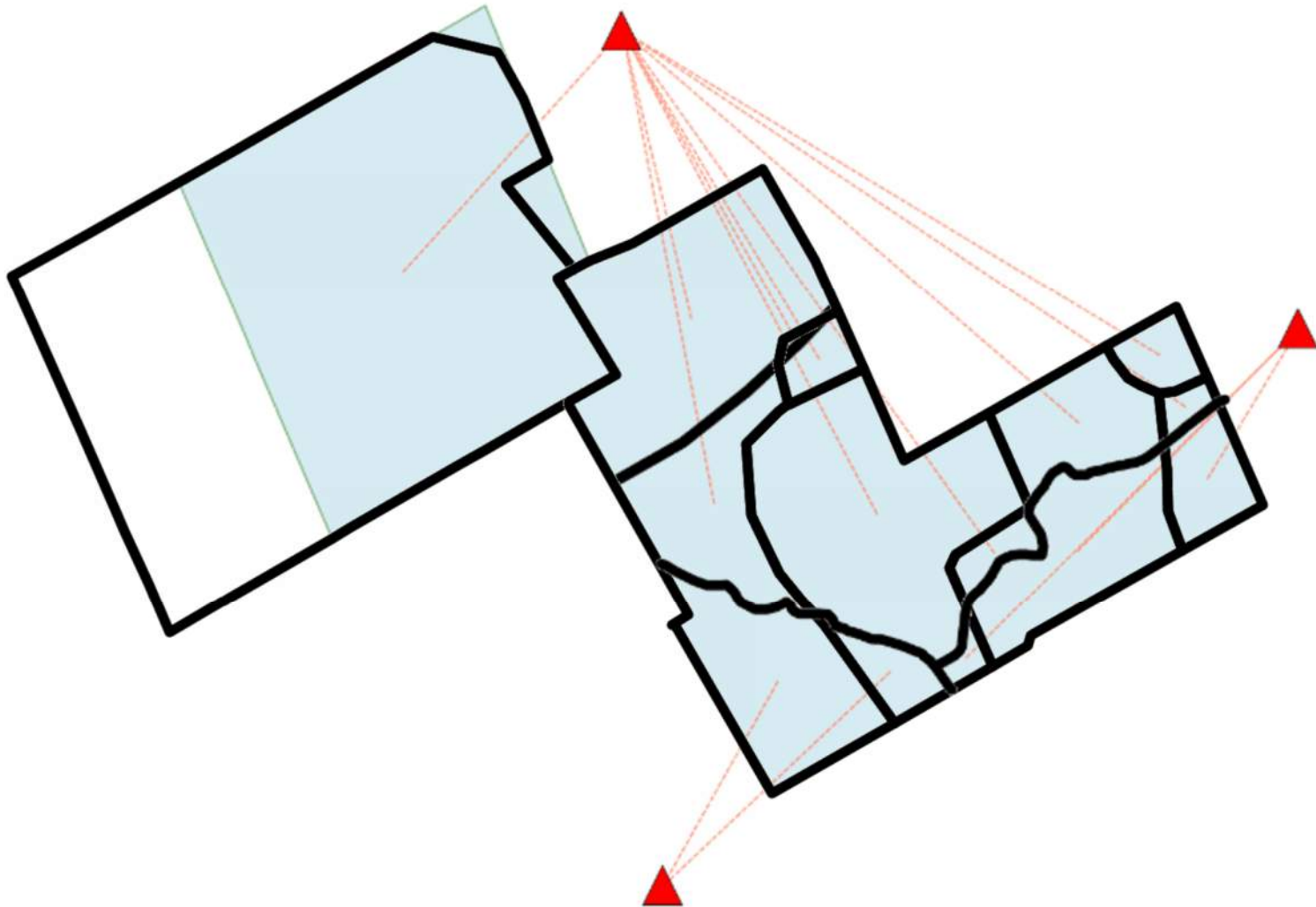
The screenshot displays the 'Aquifer Editor' window with the following parameters for Aquifer B:

Groundwater	
Aquifer Name	B
Receiving Node	Rideau_River
Surface Elevation (m)	107
A1 Coefficient	0.05
B1 Exponent	1
A2 Coefficient	0.05
B2 Exponent	1
A3 Coefficient	0
Surface Water Depth (m)	0.5
Threshold Water Table Elev	-99
Bottom Elevation (m)	-99
Initial Elevation (m)	95.5
Initial Moisture (fraction)	-99
Lateral Flow Equation	
Deep Flow Equation	
<b>Infiltration: Horton</b>	
Max. Infil. Rate (mm/hr)	20.64
Min. Infil. Rate (mm/hr)	2.4
Decay Constant (1/hr)	4.14
Drying Time (days)	7
Max. Volume (mm)	0

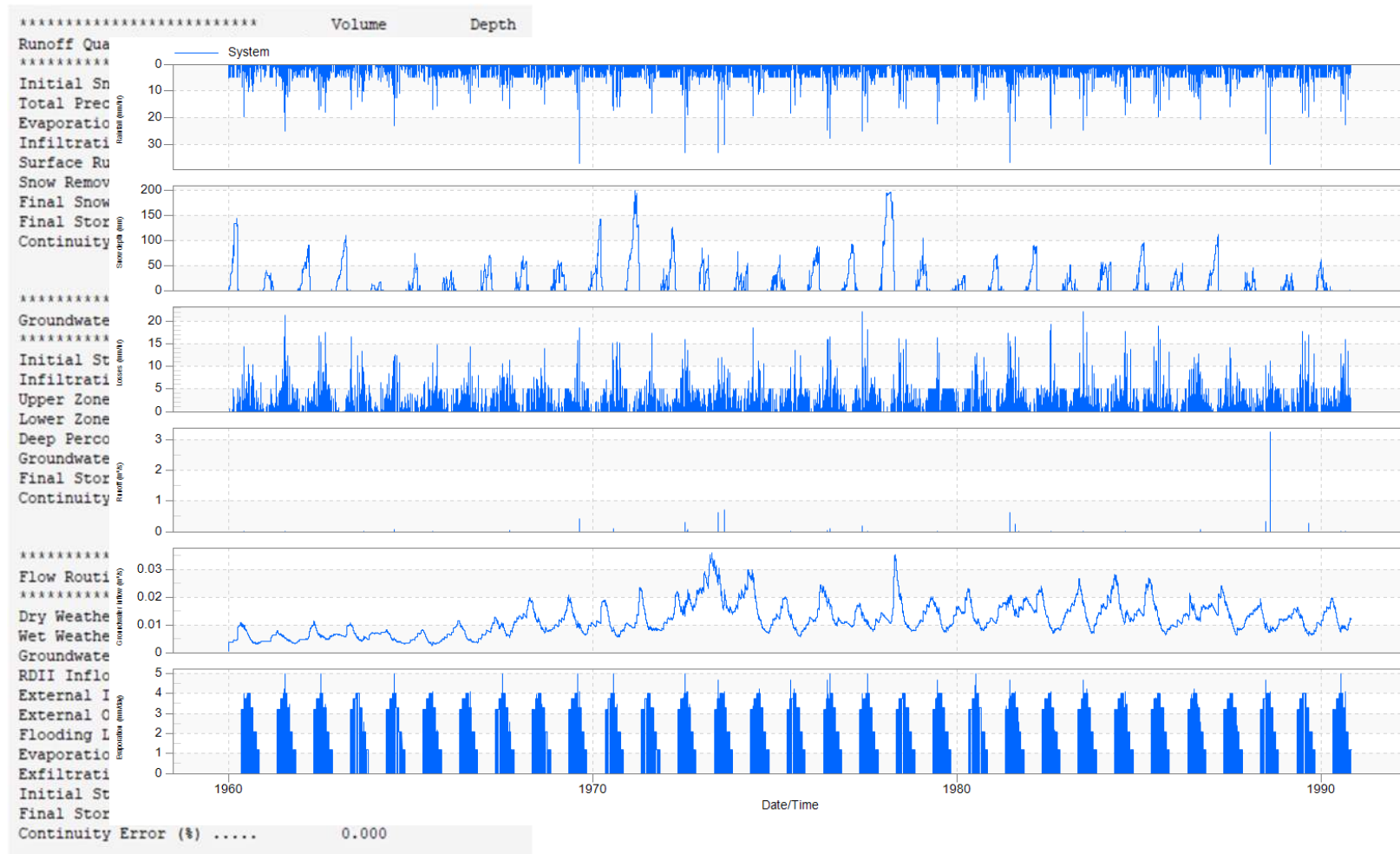
Additional windows visible include the 'Snow Pack Editor' with 'Existing\_OpenSpace' and 'Future' packs, and a 'Previous' table with values: 0.153, 0.153, 0.0, 0.05, 0.00, 0.00, 25.

# Water Balance Modelling - Inputs

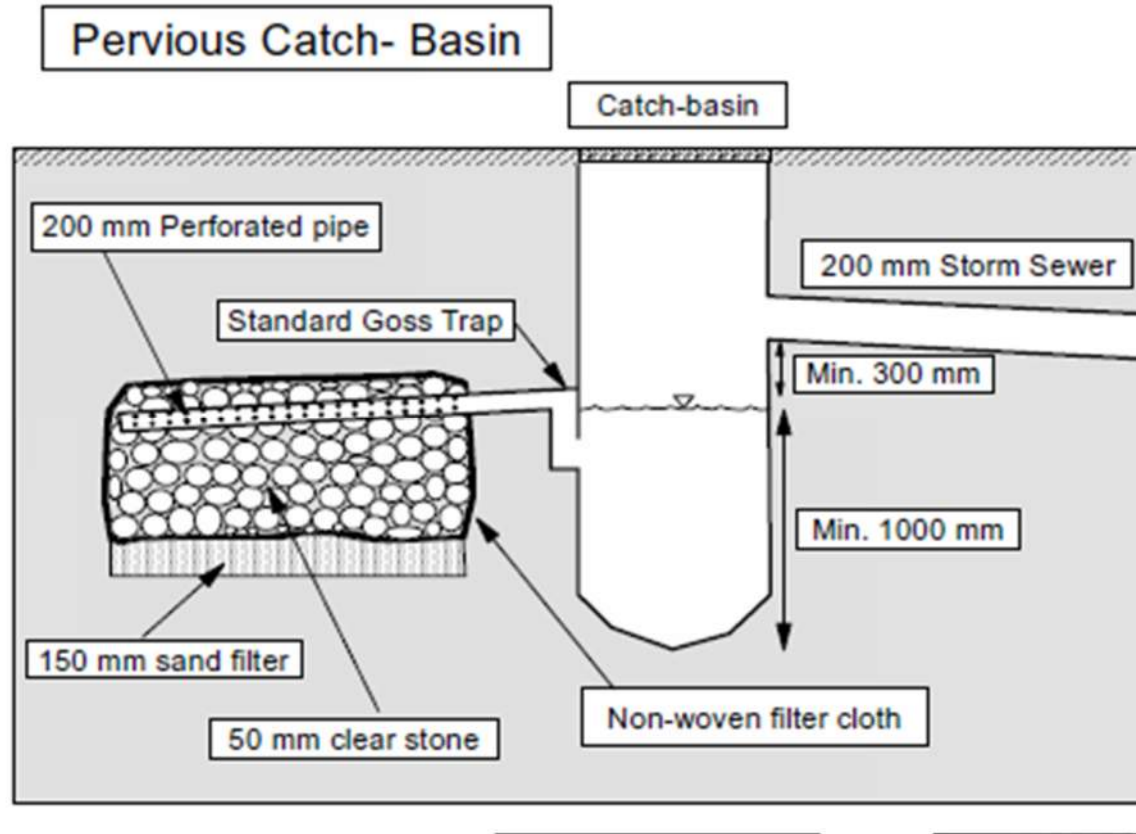
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# Water Balance Modelling - Results



# Infiltration / LID Options



## **Infiltration / LID Options**

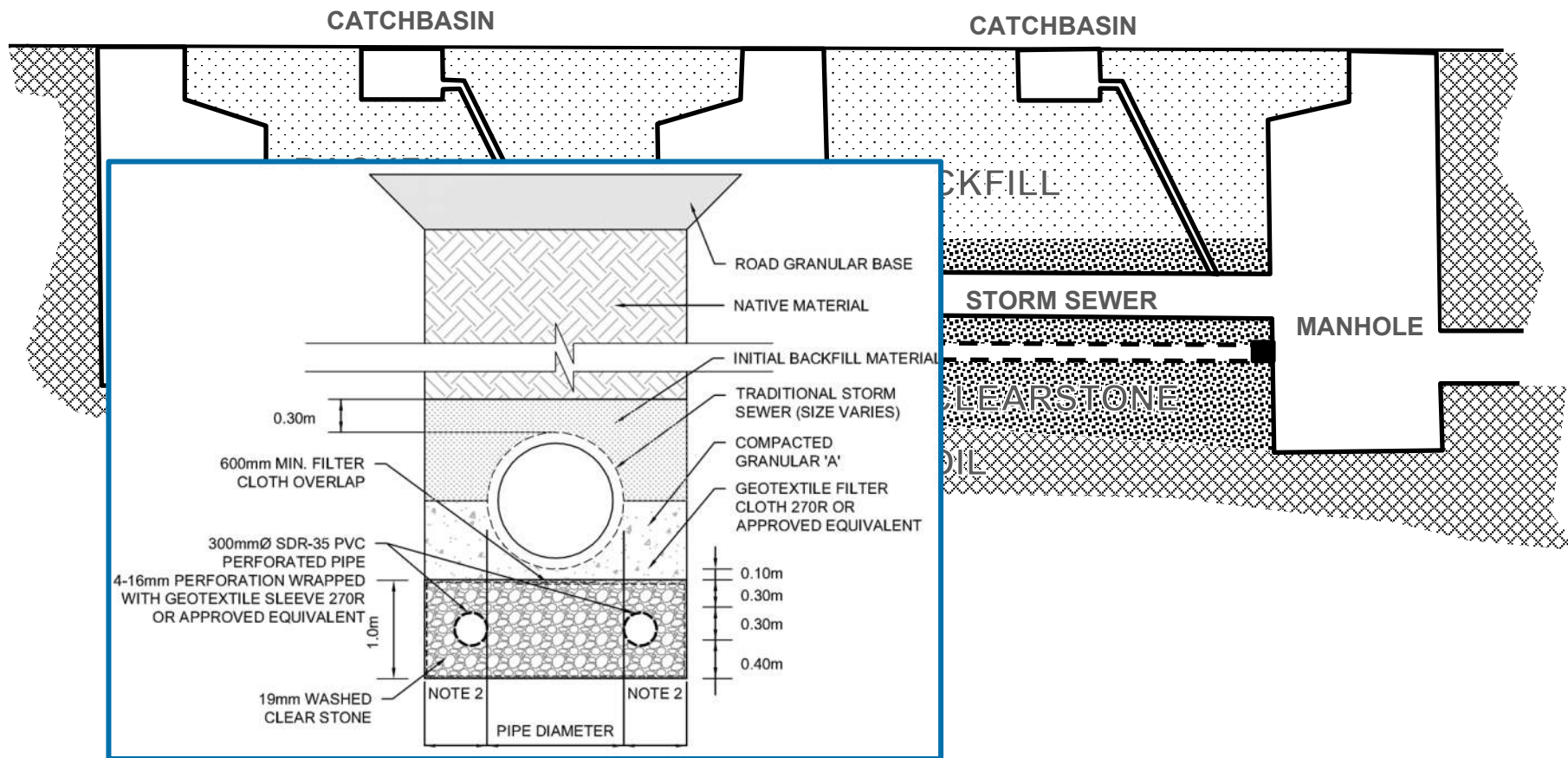
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### Outcome of discussions with the City:

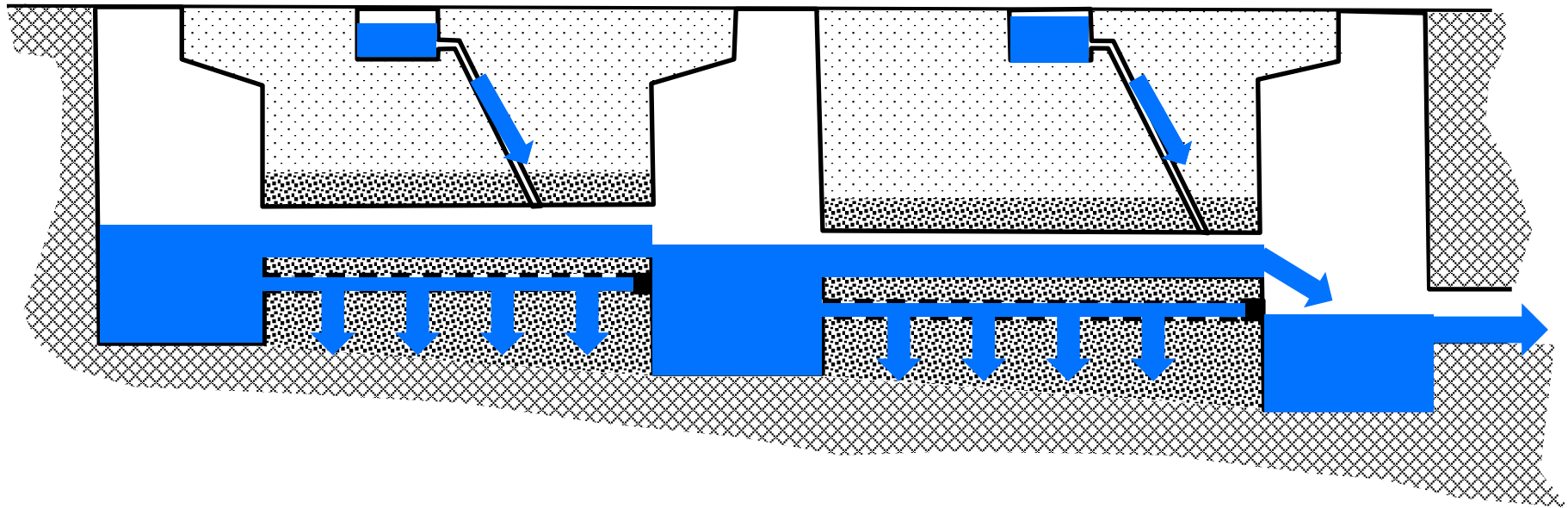
- Should achieve distributed infiltration across the three subwatersheds
- Should be accessible to the City at all times – not through private property
- Not dependent on private maintenance
- Not infiltrate salt runoff

**= Etobicoke Exfiltration System**

# Etobicoke Exfiltration System 101



# Etobicoke Exfiltration System 101



## **Applying EES to the development**

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The Master Servicing Study outlined servicing for the development

- Only use EES in local road catchments
- Size EES to capture 22mm rainfall event
- Commercial and Schools to infiltrate up to 22mm event

### **Additional benefits of EES**

- Satisfies MOE water quality volume requirements
- Reduction in downstream quantity controls
- However – no reduction in sewer sizes

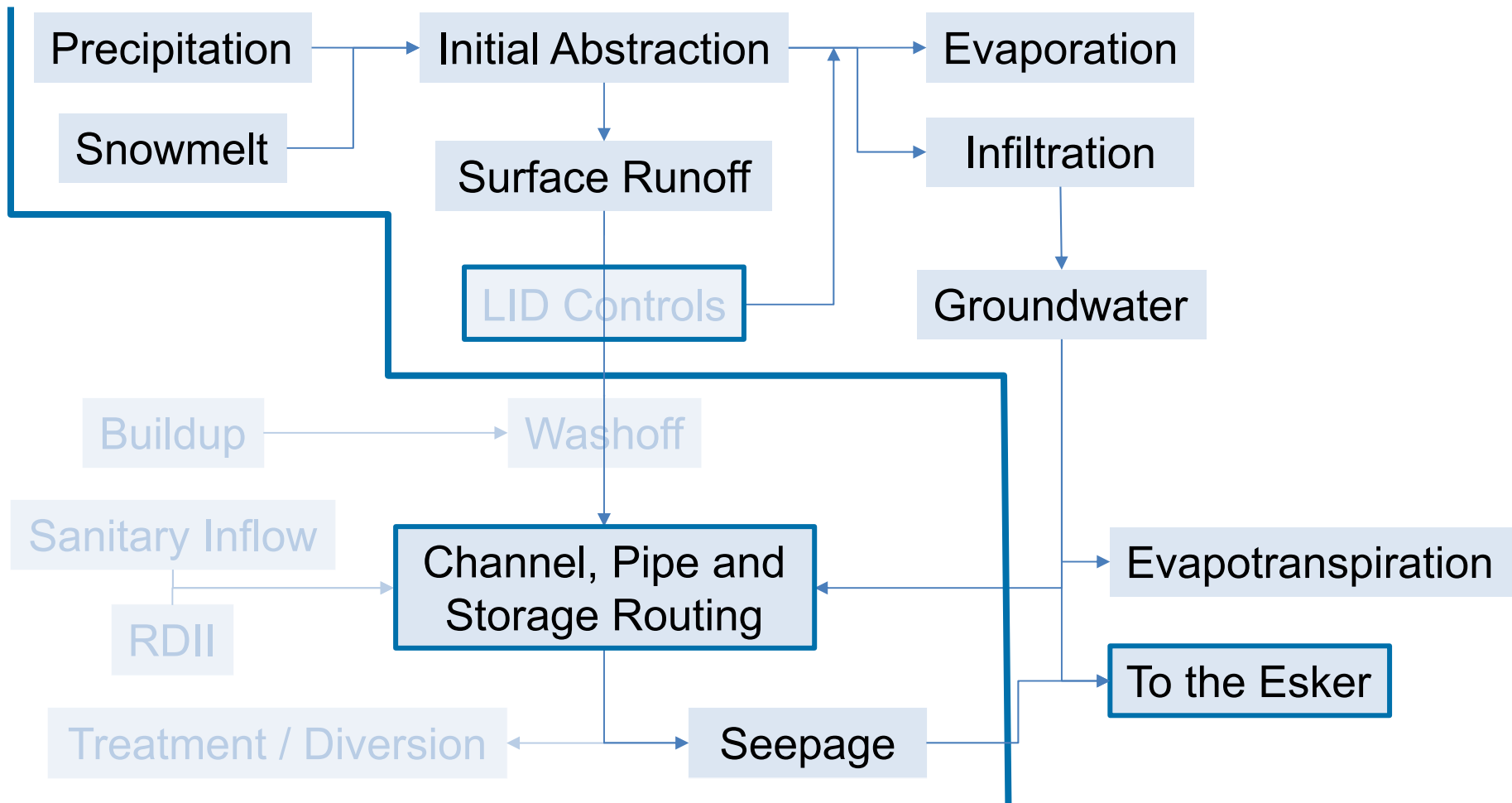


## **Modelling EES – How?**

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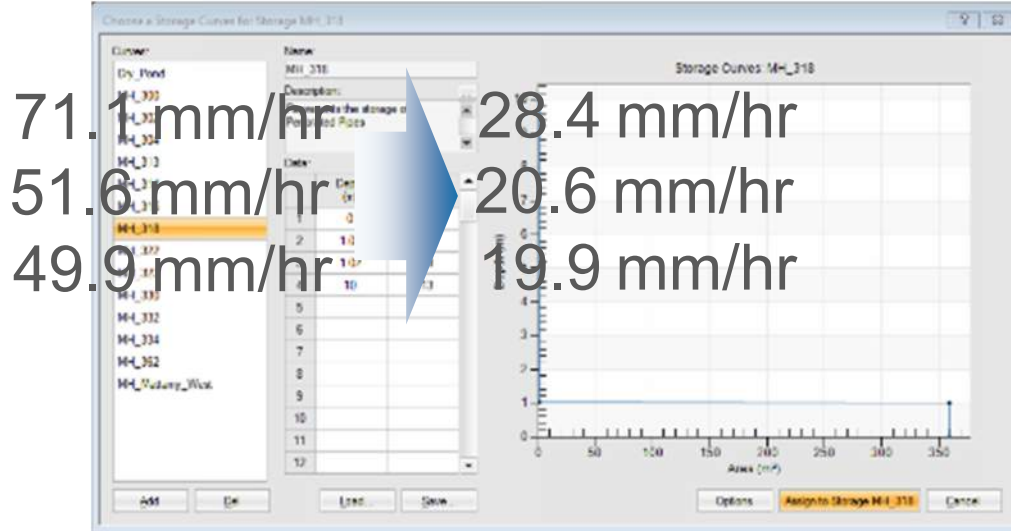
- Hydrologic or Hydraulic?

# Modelling EES – How?



# Modelling EES – How?

- Hydrologic or Hydraulic?
- Applied Seepage Rate to storage nodes
- Constant Seepage Rate
- Factor of Safety Applied



Storage: MH_318	
<b>Attributes</b>	
Name	MH_318
X-Coordinate	364867.998
Y-Coordinate	5010929.863
Description	
Tag	EES_Manhole
Inflows	NO
Treatment	NO
Invert Elev. (m)	99.042
Rim Elev. (m)	105.3
Depth (m)	f x 6.258
Initial Depth (m)	0
Surcharge Depth (m)	0
Ponded Area (m <sup>2</sup> )	0
Evap. Factor (fraction)	0
Storage Curve	TABULAR
Curve Name	MH_318
<b>Inflows</b>	
<b>Seepage</b>	
Suction Head (mm)	0
Conductivity (mm/hr)	20.64
Initial Deficit	0

# Modelling EES – How?



# Modelling EES – Results

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Initial Snow Cover .....	0.000	0.000
Total Precipitation .....	1962.021	26026.100
Evaporation Loss .....	918.830	9801.830
Infiltration Loss .....	755.646	10022.064
Surface Runoff .....	288.282	3802.572
Snow Removed .....	27.221	361.025
Final Snow Cover .....	0.000	0.000
Final Storage .....	0.000	0.000
Continuity Error (%) .....	-0.198	

*****	Volume	Depth
Groundwater Continuity	hectare-m	mm
*****	-----	-----
Initial Storage .....	431.528	5723.318
Infiltration .....	755.646	10022.064
Upper Zone ET .....	319.550	4238.162
Lower Zone ET .....	0.000	0.000
Deep Percolation .....	57.067	756.877
Groundwater Flow .....	374.887	4972.096
Final Storage .....	435.653	5778.031
Continuity Error (%) .....	0.001	

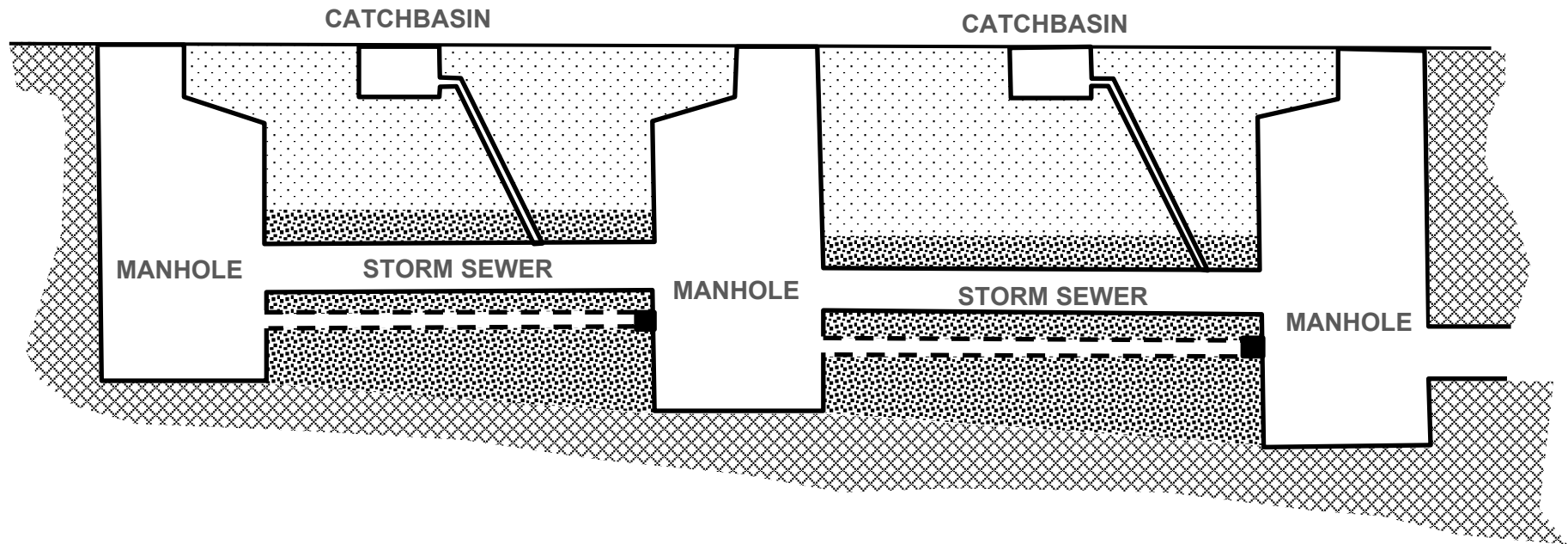
Parameter	Pre	Post
Evapotranspiration	60%	<del>27%</del>
Infiltration	40%	<del>22%</del>
Surface Runoff	0%	<del>29%</del>
Precipitation	100%	100%

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	965.292	9653.021
Groundwater Inflow .....	374.886	3748.903
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	901.452	9014.615
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	441.475	4414.793
Initial Stored Volume .....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	-0.205	



## Operations and Maintenance

Buy-in from the City's operations staff  
Spoke to TRCA and MOECC (now MOECP)

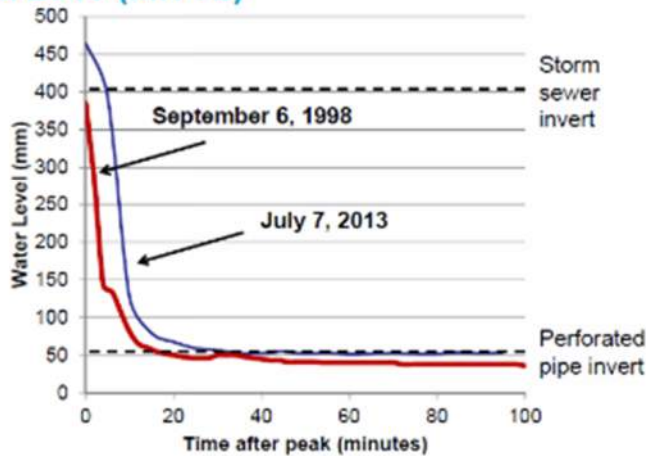


# Operations and Maintenance



### PM Water Level Drawdown Rate in 1998 and 2013 (MH 72)

- Limited maintenance
- Still infiltrating well after 14 years



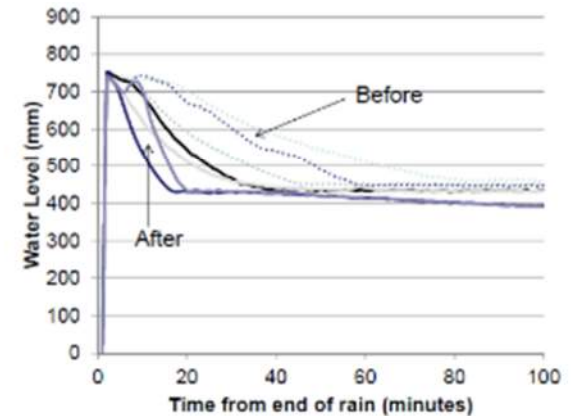
Member of Conservation Ontario

TORONTO AND REGION CONSERVATION AUTHORITY



### Queen Mary Water Level Drawdown Before and After Maintenance

- Average water level drawdown rate roughly doubled after maintenance



Member of Conservation Ontario

TORONTO AND REGION CONSERVATION AUTHORITY

Tim Van Seters, Etobicoke Exfiltration System, Ryerson University July 24, 2015

# Construction





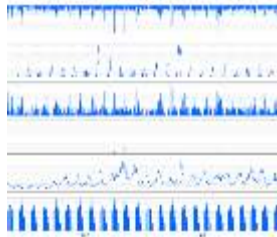
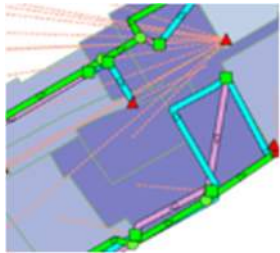
## **Next Steps**

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### Monitoring of system

- Three flow monitoring locations for three years

Expansion to next phases within the urban expansion area

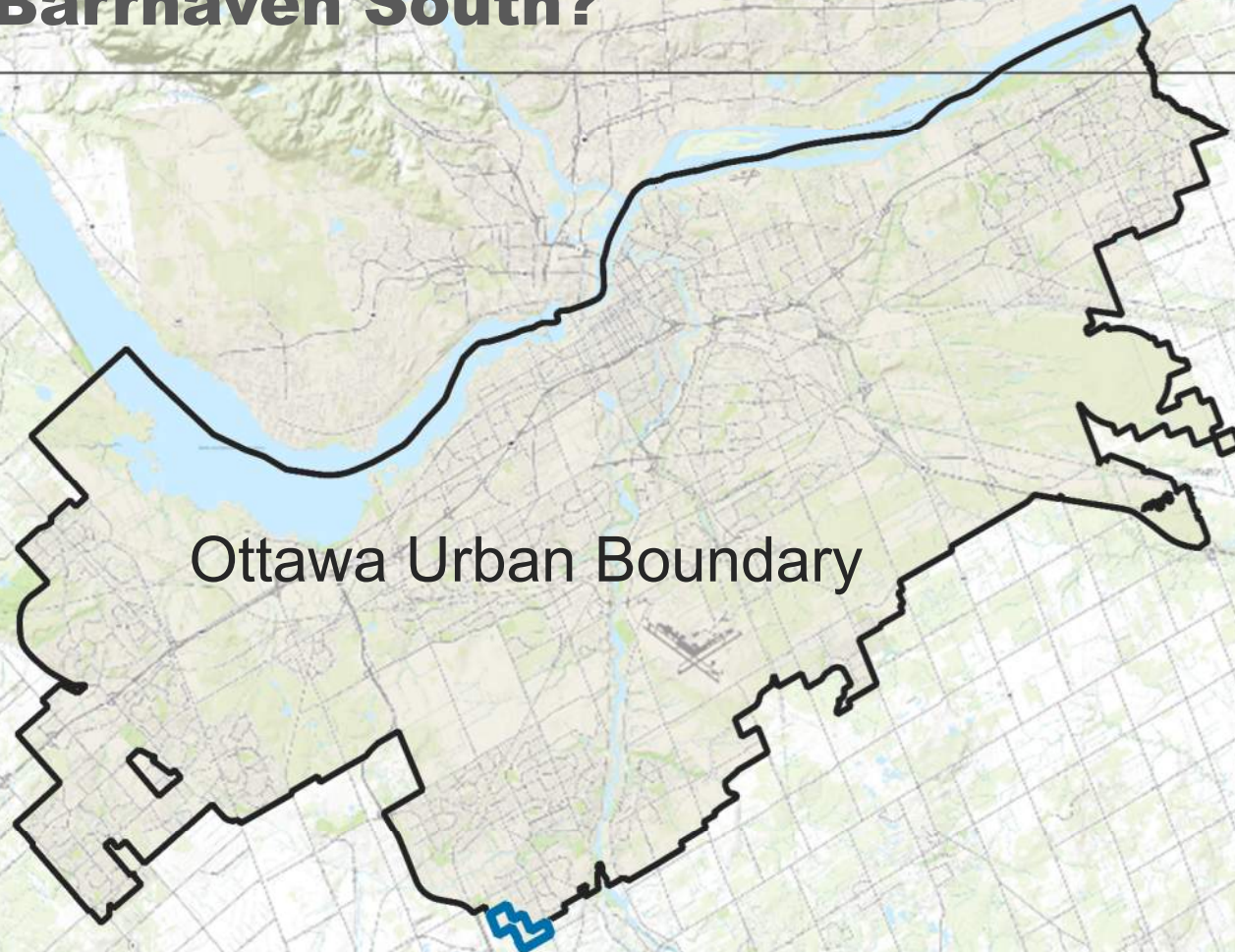


# Thank you

Contact Information:  
Bobby Pettigrew P.Eng.  
Senior Water Resources Engineer  
613-728-3571  
[bpettigrew@jlrichards.ca](mailto:bpettigrew@jlrichards.ca)

# Where is Barrhaven South?

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Ottawa Urban Boundary

Barrhaven South Expansion

## **Construction**

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Where there are multiple connections the perforated pipes had to be squeezed up with Y connections to fit into the manhole

Contractor had concerns laying pipe on the clear stone and so Granular A was added to the top of the layer of clearstone

# Modelling EES – Results

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Initial Snow Cover .....	0.000	0.000
<b>Total Precipitation .....</b>	<b>1962.321</b>	<b>26026.100</b>
Evaporation Loss .....	218.039	2891.832
Infiltration Loss .....	755.646	10022.064
Surface Runoff .....	965.292	12802.588
Snow Removed .....	27.221	361.025
Final Snow Cover .....	0.000	0.000
Final Storage .....	0.000	0.000
Continuity Error (%) .....	-0.198	

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Lower Zone ET .....	0.000	0.000
Deep Percolation .....	57.067	756.877
Groundwater Flow .....	374.887	4972.096
Final Storage .....	435.653	5778.031
Continuity Error (%) .....	0.001	

Parameter	Pre	Post
Evapotranspiration	60%	
Infiltration	40%	
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Precipitation	100%	100%

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Groundwater Inflow .....	374.886	3748.903
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External Inflow .....	0.000	0.000
External Outflow .....	901.452	9014.615
Flooding Loss .....	0.000	0.000
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