Stormwater Management Design Criteria

for the Pinecrest Creek/Westboro Area

City of Ottawa

Final – May 2020

The SWM Criteria have been derived from detailed study documented in the following reports:
i) Pinecrest/Centrepointe SWM Criteria Study, JFSA et. al., 2010;

ii) Pinecrest Creek/Westboro SWM Retrofit Study, JFSA et. al., 2011; and

iii) Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area - Final Report, JFSA, 2019 (***NOTE: to be used as a reference document only not for SWM design criteria***).

These documents are available on request from the City of Ottawa's Drawing Information Centre: informationcentre@ottawa.ca .

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1 Introduction

The Pinecrest Creek subwatershed and adjacent Westboro catchments that drain directly to the Ottawa River are fully urbanized and were built out with little or no stormwater management (SWM). The consequences of this historical lack of SWM include:

- poor water quality in the Creek and local reach of the Ottawa River;
- increased closures of Westboro Beach during wet weather;
- on-going erosion in the Creek that has impacted infrastructure and fish habitat; and
- high peak flows that, in combination with the piping of the Creek from south of Carling Avenue to just upstream of the confluence with the Ottawa River, make the Sir John A. Macdonald Parkway susceptible to flooding.

The Pinecrest Creek/Westboro SWM Retrofit Plan, an Ottawa River Action Plan (ORAP) project, was prepared to provide a long-term plan to address these historical impacts. It was approved by Council in 2011 in report ACS2011-ICS-PGM-0114 and is currently being implemented.

While the Pinecrest Creek/Westboro SWM Retrofit Plan aims to address the impacts of existing development, the study area continues to experience growth via infill and redevelopment. The SWM Design Criteria for the Pinecrest Creek/Westboro Area (SWM Criteria) have been prepared to ensure the impacts of continued growth do not result in further negative impacts to the Creek and local reach of the Ottawa River.

The SWM Criteria provide subwatershed and catchment-specific direction related to runoff volume, water quality and water quantity control that new development located within the area shown on **Figure 1** will be required to achieve. The SWM Criteria are not “stand-alone” but are intended to augment the City of Ottawa Sewer Design Guideline and other available guidance related to the design of SWM measures.

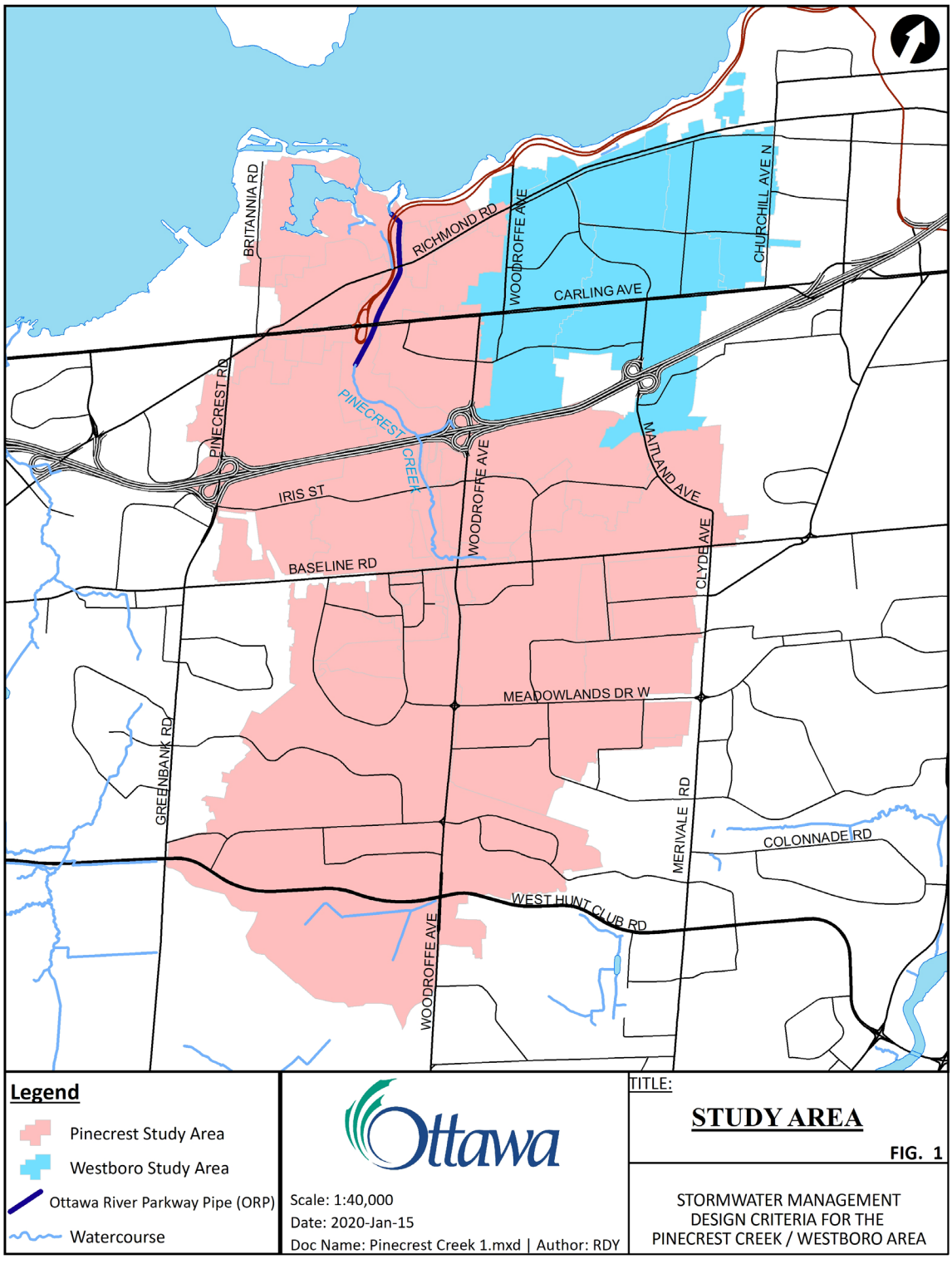

Figure 1: Study Area

2 Background

The SWM Criteria have been derived from detailed study documented in the following reports:

i) Pinecrest/Centrepointe SWM Criteria Study, JFSA et. al., 2010;

ii) Pinecrest Creek/Westboro SWM Retrofit Study, JFSA et. al., 2011; and

iii) Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area - Final Report, JFSA, 2019 (***NOTE: to be used as a reference document only not for SWM design criteria***).

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3 SWM Design Criteria for the Pinecrest Creek/Westboro Area

The SWM Criteria address water quality, water quantity and runoff volume (erosion) control requirements. These criteria have been tailored to specific constraints in the receiving watercourse or outlet, i.e., the SWM criteria to be met depend upon where the development will outlet.

A summary of the SWM criteria for the Pinecrest Creek/Westboro area is provided in **Table 1**: **SWM Design Criteria for the Pinecrest Creek/Westboro Area**.

Table 1: SWM Design Criteria for the Pinecrest Creek / Westboro Study Area

	Development Type	Runoff Volume Reduction	Water Quality	Water Quantity	
			TSS Removal	Flood Control	Erosion Control
All Locations					
Residential Development *not* subject to Plan of Subdivision or Site Plan Control approval(s)					
1	all soil infiltration rates	Direction/re-direction of downspouts/roof drainage to discharge to pervious surfaces, where possible, to reduce runoff, while meeting all other City of Ottawa lot grading requirements. Amended topsoil, or a depth of topsoil up to 300 mm, provides runoff volume reduction benefits and is encouraged (but not mandatory) as a best practice over all soft landscaped surfaces.	Not applicable	Not applicable	Not applicable
Draining to the Ottawa River					
Development subject to Plan of Subdivision or Site Plan Control approval(s) - discharging directly to the Ottawa River					
2	all soil infiltration rates	A minimum on-site retention of the 10 mm design storm; refer to LID references[(i)] for guidance on prudent approach to planning infiltration-based LID best management practices. Assumptions re: non-viability of infiltration measures must be substantiated. A green roof, rain harvesting measures and/or a combination of detention/retention measures[(ii)] could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS; some of which ma be achieved by on-site retention of first 10 mm of rainfall.	As per City of Ottawa Sewer Design Guideline	Not applicable
Draining to Pinecrest Creek					
Development subject to Plan of Subdivision or Site Plan Control approval(s) - discharging upstream of the Ottawa River Parkway pipe (ORPP) inlet					
3	all soil infiltration rates	A minimum on-site retention of the 10 mm design storm; refer to LID references[(i)] for guidance on prudent approach to planning infiltration-based LID best management practices. Assumptions re: non-viability of infiltration measures must be substantiated. A green roof, rain harvesting measures and/or a combination of detention/retention measures[(ii)] could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS; some of which may be achieved by on-site retention of first 10 mm of rainfall and detention of the 25 mm design storm[(iii)].	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha) or; ii) Requirements of City of Ottawa Sewer Design Guideline.	Control (detain) the runoff from the 25 mm design storm[(iii)] such that the peak outflow from the site does not exceed 5.8 L/s/ha.
Development subject to Plan of Subdivision or Site Plan Control approval(s) - discharging directly to the Ottawa River Parkway pi					
4	all soil infiltration rates	A minimum on-site retention of the 10 mm design storm; refer to LID references[(i)] for guidance on prudent approach to planning infiltration-based LID best management practices. Assumptions re: non-viability of infiltration measures must be substantiated. A green roof, rain harvesting measures and/or a combination of detention/retention measures[(ii)] could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS; some of which may be achieved by on-site retention of first 10 mm of rainfall.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha) or; ii) Requirements of City of Ottawa Sewer Design	Not applicable

Notes:

(i) Re: Infiltration measures: Beyond the targets specified in this table, the planning, design and use of these systems shall be in accordance with the guidance in the Stormwater Management Planning and Design Manual (MOE, 2003); the Low Impact Development Stormwater Management Planning and Design Guide (CVC and TRCA, 2010); the Low Impact Development Stormwater Management Planning and Design Wiki at: wiki.sustainabletechnologies.ca; and Draft No.2 Low Impact Development (LID) Stormwater Management Guidance Manual (MOECC, November 2017) or the final version of this Manual, when available. As noted in the MOECC LID SWM Guidance Manual, a prudent approach to planning infiltration-based LID best management practices on any site involves delineating catchment areas that contain high risk site activities and isolating them by applying non-infiltration-based practices to these areas.

(ii) Retention is to hold or retain stormwater on a more permanent basis such as for infiltration to the surrounding soils. Detention is the temporary storage or detaining of stormwater for eventual release to the downstream system.

(iii) 25 mm 4-hour Chicago design storm

3.1 SWM Design – General

The SWM Criteria are prescriptive targets, not "stand-alone" design guidance. These criteria are to be met in addition to those required by the City of Ottawa Sewer Design Guideline, with the most stringent requirement(s) governing.

Designers are further directed to other available guidance related to the design of SWM measures listed in the References at the end of this document.

3.2 Applicability of SWM Criteria

The SWM Criteria apply to:

- development subject to Plan of Subdivision and Site Plan Control approvals; and
- City of Ottawa (new) capital projects, but not including right-of-way renewal projects[1].

The SWM Criteria do not apply to:

- development that is not subject to Plan of Subdivision and Site Plan Control approvals (development subject only to a building permit).

However, downspouts/roof drainage should be directed to discharge to pervious surfaces, where possible, to minimize runoff, while meeting all other City of Ottawa lot grading requirements. Further, amended topsoil, or a depth of topsoil up to 300 mm, provides runoff volume reduction benefits and is encouraged (but not mandatory) as a best practice over all soft landscaped surfaces.

3.3 Quantity Control

Quantity control criteria are specified based upon the catchment's receiving watercourse (Pinecrest Creek or the Ottawa River) or storm sewer (the Ottawa River Parkway pipe (ORPP) or local storm sewer outlet). For example, there are no quantity control requirements for discharge directly to the Ottawa River, whereas the limited capacity of the ORPP requires a higher level of control to avoid increasing flood risk. (Pinecrest Creek flows are conveyed by the ORPP from just south of Carling Avenue to the Ottawa River.)

[1] Right-of-way (ROW) renewal projects will be subject to a separate screening process that will identify retrofit opportunities. The SWM objective for selected ROW renewals will be to optimize runoff volume control/treatment/attenuation subject to the existing site constraints.

3.3.1 Draining Directly to the Ottawa River

Developments serviced by outfalls draining directly to the Ottawa River (shown in **Figures 2** and **3**) shall provide sufficient quantity control storage to meet the most limiting downstream storm sewer capacity. Per the City of Ottawa Sewer Design Guideline, the capacity of the downstream receiving system shall be assessed when connecting to an existing storm sewer. The allowable release rate to the existing system is to be confirmed with the City.

3.3.2 Draining to Pinecrest Creek

Developments draining to Pinecrest Creek (either upstream of or directly into the ORPP) shall provide sufficient quantity control storage to address the most stringent of the local sewer capacity or the flow target for the ORPP. The catchments that discharge to Pinecrest Creek upstream or directly into the ORP are identified in **Figures 2** and **3**.

To maintain existing peak flow and headwater conditions up to and including the 100-year storm at the inlet of the ORPP, development shall control the total 100-year discharge from the site to a maximum rate of 33.5 L/s/ha. This unit flow target is based upon the hydrologic (SWMHYMO) modelling conducted for the *Pinecrest/Centrepointe Stormwater Management Criteria Study (2010)* and the *Pinecrest Creek/Westboro SWM Retrofit Study (2011)*, which assessed the subwatershed conditions as of 2009. From that modelling, the existing unit flow rate, at the ORPP, for the critical design storm (24-hour 100-year SCS Type II) was found to be 33.5 L/s/ha. These results can be found in Appendix J of the *Pinecrest Creek/Westboro SWM Retrofit Study*. The *Pinecrest Creek/Westboro SWM Retrofit Study* also established erosion control and water quality targets and objectives in concert with the 33.5 L/s/ha discharge rate.

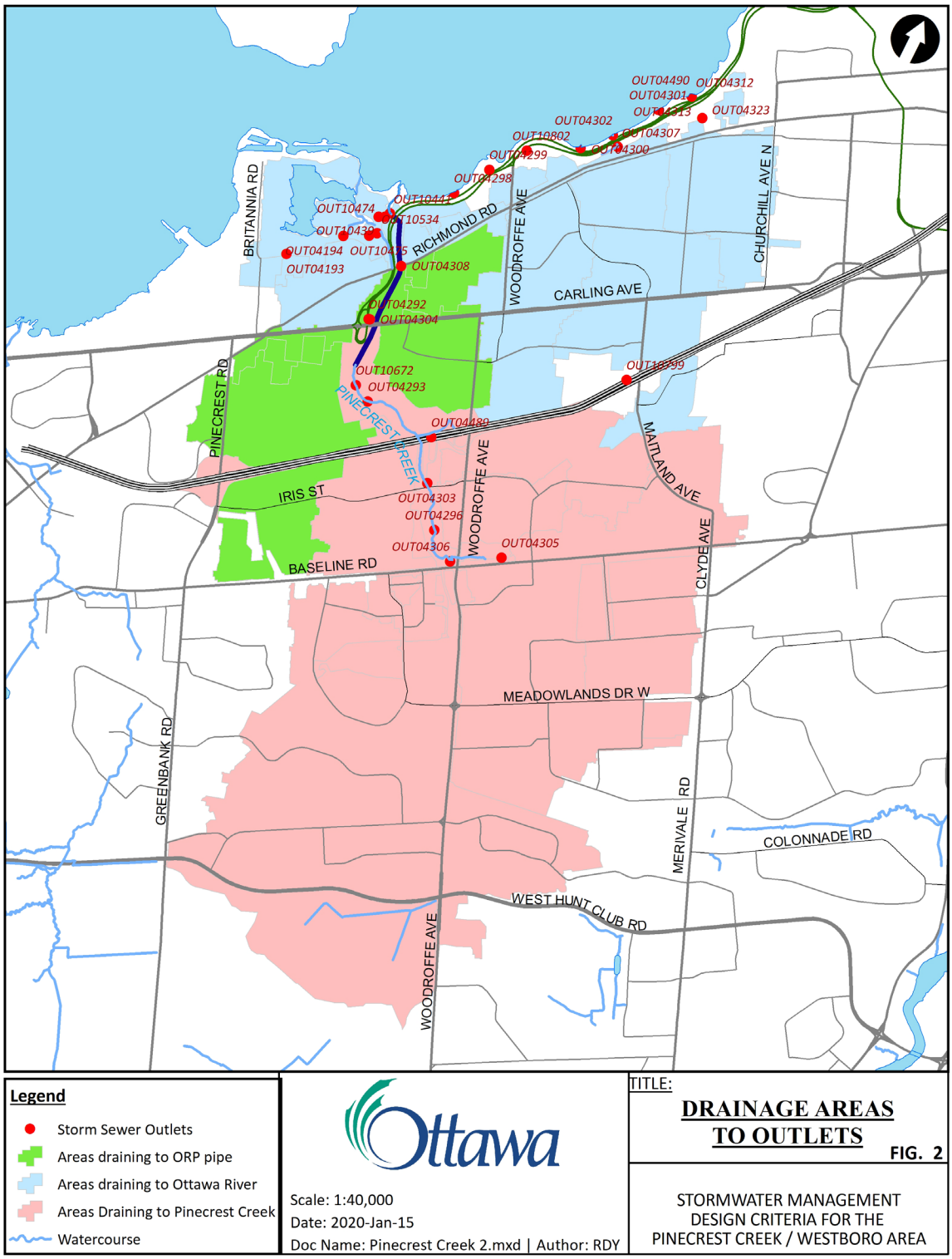

Figure 2: Drainage Areas to Outlets

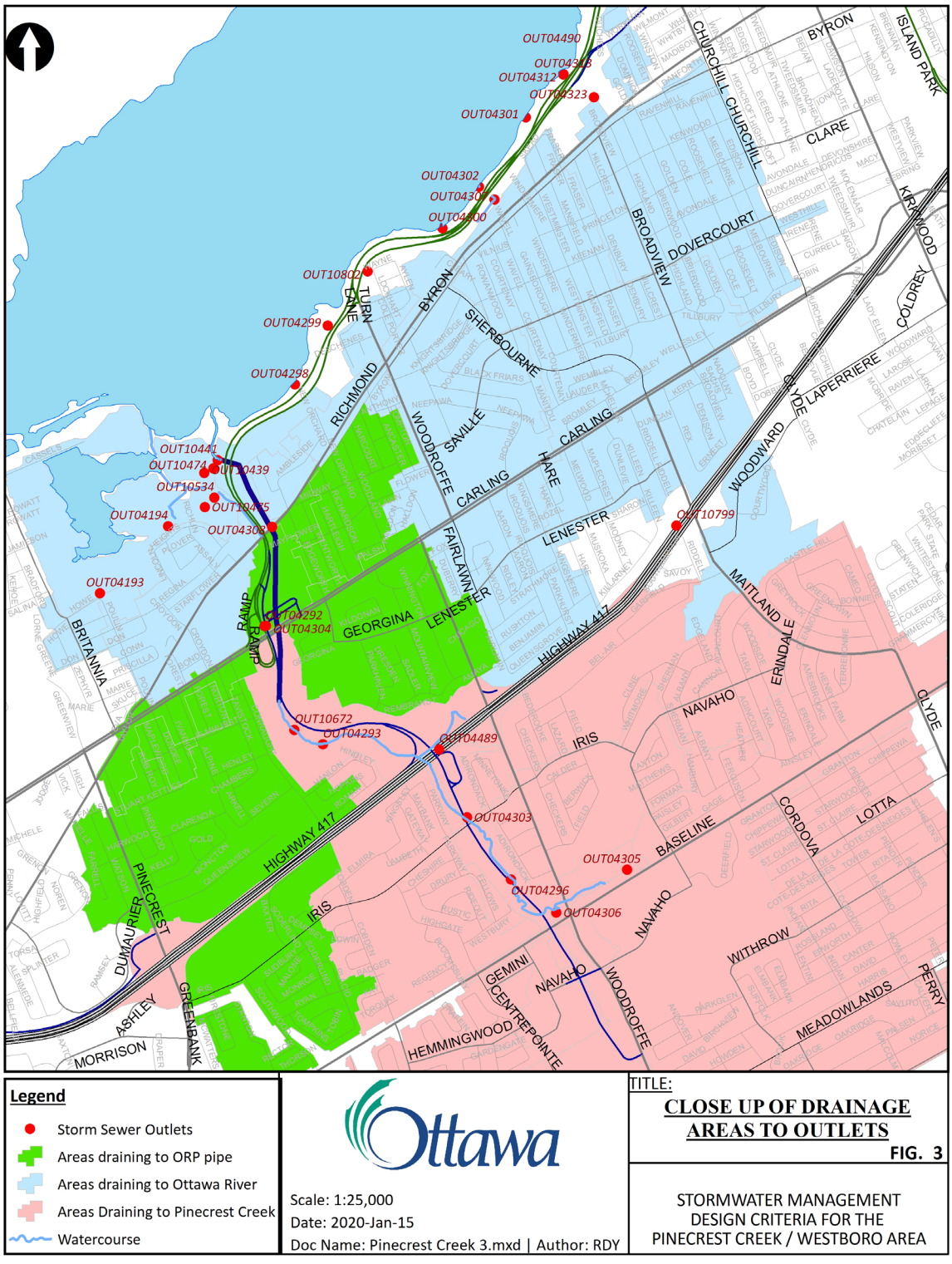

Figure 3: Close-up of Drainage Areas to Outlets

Note: Since completion of the 2010 modelling for the Pinecrest Creek subwatershed, subsequent studies resulted in a conversion of the subwatershed model from the SWMHYMO platform to PCSWMM. The PCSWMM model was used to simulate the existing peak flow and headwater conditions up to and including the 100-year storm at the inlet of the ORPP in these subsequent studies[2]. With no other changes to model parameters, the PCSWMM version calculated a unit flow rate of 36.2 L/s/ha to maintain the existing 100-year discharge at the ORPP. The storage volume requirements for various levels of imperviousness were determined for both SWMHYMO and PCSWMM unit rates. These results were found to be within 2% of each other. The required unit flow rate, originally obtained with SWMHYMO (33.5 L/s/ha) is slightly more conservative, therefore this value will continue to be the required unit flow rate to control the 100-year discharge from the site.

The 100-year unit flow rate of 33.5 L/s/ha reflects a condition where the ORPP provides less than a 100-year level-of-service (LOS): simulation results indicate that flood flows will spill from Pinecrest Creek upstream of the ORPP inlet onto the Ottawa River Parkway. Therefore, the flood control target has been set to ensure that infill, re- and new development projects within the subwatershed do not exacerbate existing flooding conditions at the ORPP inlet.

An anticipated outcome from introducing SWM controls as development and redevelopment progress in the largely uncontrolled Pinecrest Creek subwatershed is to gradually reduce peak flood flows on Pinecrest Creek and at the ORPP. The *Pinecrest Creek/Westboro SWM Retrofit Study* also identified a suite of SWM retrofits to be incorporated within the subwatershed either on an opportunistic basis (e.g., in combination with planned road renewal projects) or as stand-alone projects such as the Baseline/Woodroffe SWM retrofit pond. SWM retrofit projects will also cumulatively reduce flood risk along the creek over time (as well as improve water quality and geomorphic stability). Therefore, while the LOS should slowly improve at the ORPP inlet as (re)developments proceed and SWM retrofits are implemented, the 33.5 L/s/ha unit flow rate will remain as the target 100-year release rate for projects within the subwatershed.

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[2] Pinecrest Creek Cumulative Impacts Study – Hydrology, Hydraulics and Water Quality, J.F. Sabourin and Associates Inc., prepared for Morrison Hershfield, December 2018.

Hydrologic and Hydraulic Analyses for the Pinecrest Creek Baseline/Woodroffe Stormwater Management Retrofit Pond Detailed (90%) Design, J.F. Sabourin and Associates Inc., prepared for Capital Transit Phase 2, December 2017.

Other flow restrictions, such as limiting storm sewer capacities, may also exist and should be identified by the proponent in consultation with the City.

The proponent shall, at the design stage, demonstrate that the proposed design can achieve the target release flow rates. For planning purposes, approximate on-site storage volumes to achieve the required control are provided below in **Table 2**. The approximate on-site storage volumes listed in **Table 2** were calculated using the Horton's Infiltration procedure. Designers should use the Horton's infiltration procedure for urban developments per Section 5.4.5.5 of the Sewer Design Guideline (2012), unless otherwise directed by the City.

Table 2[3]: Approximate on-site storage volume requirements to control flows to 33.5L/s/ha

(Using Horton's Infiltration Method)

Total Imperviousness (Timp)			
40%	**50%**	**75%**	**95%**
352 m^3/ha	380 m^3/ha	455 m^3/ha	535 m^3/ha

Parameters: Ximp = 30%, 40%, 65% and 95% respectively

SLPP = 1.0%, SLPPI = 0.75%

Horton's infiltration parameters (f_0, fc and DCAY and F) as per the Sewer Design Guideline (2012).

Note: The volume provided on-site to meet other design criteria (i.e., runoff volume control and/or erosion control) can provide a portion of the volume required to attenuate the 100-year event as well. The designer will need to provide detailed calculations showing how the different storage volumes and control structures (typically orifices or weirs) will interact so that the volume that is being accounted for will act as effective storage during the 100-year event.

[3] Note: This table is intended for planning purposes only. The final total volume required is to be confirmed during detailed design and may be higher.

Furthermore, the storage volumes accounted for must be provided by permanent structures that will not be removed or modified over time[4].

3.4 Erosion and Runoff Volume Control

Runoff volume control requirements are specified for the purposes of erosion mitigation only for those catchments that drain to the open channel portion of Pinecrest Creek located upstream of the ORPP. For catchments discharging directly to the Ottawa River, volume control requirements are specified for the water quality benefits.

3.4.1 Draining to Pinecrest Creek Upstream of the ORPP (Erosion Mitigation)

The required runoff volume control criteria were determined from hydrologic and hydraulic analyses completed during the preparation of the *Pinecrest/Centrepointe Stormwater Management Criteria Study (February, 2010)* and further analyses completed for the *Pinecrest Creek/Westboro SWM Retrofit Study (May, 2011).* Catchments draining to Pinecrest Creek upstream of the ORPP are shown on **Figures 2** and **3**.

i) To mitigate the cumulative impacts of infill and redevelopment and not aggravate existing erosion within the creek corridor, development shall capture and retain (infiltrate or abstract) the first 10 mm of rainfall. This 10 mm target can be partially achieved by the default initial abstraction (IA) values applicable in urban areas. The Sewer Design Guideline allows a designer to account for a 4.67 mm IA on all soft landscaped surfaces and a 1.57 mm IA on all hardscaped surfaces. Refer to the references cited in the notes of **Table 1** for guidance on prudent approaches to planning infiltration-based LID measures. A green roof or roofs, rainwater harvesting measures and/or a combination of retention measures could be implemented to provide further runoff volume control.

ii) In addition to the above, development shall control site runoff from the 25 mm 4-hour Chicago design storm to a maximum peak flow of 5.8 L/s/ha. This peak flow target is based on releasing 25 mm of runoff over a 24-hour time period, using a peaking factor of 2 (i.e., assuming the peak outflow is equal to twice the average outflow).

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[4] For examples of these types of calculations, refer to: Appendix B, *Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area - Final Report, JFSA, 2019* (***NOTE: to be used as a reference document only***).

Note that, as outlined in **Table 1**, all development draining to Pinecrest Creek upstream of the ORPP shall control site runoff from the 25 mm 4-hour Chicago storm to a peak unit outflow rate of 5.8 L/s/ha regardless of whether the first 10 mm of runoff volume will be retained on-site. The required on-site storage volume, to control the runoff from the 25 mm storm, will vary from site to site based on the amount of volume retained or infiltrated.

3.4.2 Draining Directly to the Ottawa River (Water Quality)

The following runoff volume control criterion applies to catchments discharging directly to the Ottawa River. Those catchments are shown on **Figures 2** and **3**.

To mitigate the cumulative impacts of infill and redevelopment and not aggravate existing water quality degradation, development shall capture and retain (infiltrate or abstract) the first 10 mm of rainfall. This 10 mm target can be partially achieved by the default initial abstraction (IA) values applicable in urban areas. The Sewer Design Guideline allows a designer to account for a 4.67 mm IA on all soft landscaped surfaces and a 1.57 mm IA on all hardscaped surfaces. Refer to the references cited in the notes of **Table 1** for guidance on prudent approaches to planning infiltration-based LID measures. A green roof or roofs, rain harvesting measures and/or a combination of retention measures could be implemented to provide further runoff volume control.

3.5 Quality Control

Enhanced level of treatment (equivalent to long-term average TSS removal of 80%) is required for water quality control. This requirement may, in some cases, be accomplished by means of conventional measures (e.g., with a combination of end-of-pipe facilities such as oil/grit separators and filters). The water quality benefits of runoff volume control are also recognized in the *Draft No.2 LID SWM Guidance Manual (MOECC, 2017*), which notes that SWM measures that achieve control of the regionally specific 90th percentile event (27mm for Ottawa) shall be considered to have achieved Enhanced level of treatment for the respective contributing drainage area.

4 References

Development of SWM design criteria:

- Pinecrest/Centrepointe SWM Criteria Study, JFSA et. al., 2010
- Pinecrest Creek/Westboro SWM Retrofit Study, JFSA et. al., 2011
- Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area - Final Report, JFSA, 2019 (***NOTE: to be used as a reference document only not for SWM design criteria***).

LID Design Guidance:

- Low Impact Development Stormwater Management Planning and Design Wiki at: https://wiki.sustainabletechnologies.ca/wiki/Main_Page
- Draft No.2 Low Impact Development (LID) Stormwater Management Guidance Manual (MOECC, November 2017) or the final version of this Manual, when available