5.0 INFILL DEVELOPMENT

5.1 General

Infill projects can range in size from a single lot to the complete redevelopment of significantly larger areas. Many forms of infill development can be more intensive than previous uses and have higher levels of imperviousness (e.g., more pavement), runoff rates, and contaminant loading per unit of area. In many cases, areas surrounding the new infill development were built before the need for stormwater controls was recognized and are already experiencing stormwater management problems. Although the development of single, individual infill sites may not have significant impacts, the development of many individual sites can have cumulative effects and exacerbate or create problems at the subwatershed and watershed level including flooding, erosion, or water quality degradation.

The focus of this chapter is on infill areas less than 5 hectares where storm sewer infrastructure exists.

Applying stormwater management practices in developed areas can be a challenge. Land availability and cost often limit stormwater management options in infill situations. Stormwater controls in infill situations are frequently implemented on private property and owners are responsible for their maintenance. Municipalities can generally require owners to maintain these controls; however, the proliferation of numerous, small, scattered facilities may be undesirable from a management and operations perspective.

The proponent is responsible for meeting all approval requirements from relevant agencies.

Some infill developments may meet the conditions of the Approval Exemption Regulation (AER). Under the AER 525 passed in September 1998, sub-sections 53 (1) and (3) of the *Ontario Water Resources Act* do not apply. Therefore, MOE approval is not required for the establishment, alteration, extension or replacement of or a change in a stormwater management facility that:

- is designed to service one lot or parcel of land;
- discharges into a storm sewer that is not a combined sewer;
- does not service industrial land or a structure located on industrial land; and
- is not located on industrial land.

Infill Development Plan/Subwatershed Rehabilitation Plan

The preparation of an Infill Development Plan or Subwatershed Rehabilitation Plan (i.e., a Subwatershed Plan for a developed area) is the preferred approach in addressing stormwater water quality and quantity concerns associated with infill development issues particularly in municipalities where significant growth is expected from infill development (See Appendix F).

These types of plans take into consideration local factors such as:

- physical conditions (e.g., practical infiltration levels);
- infrastructure capacity;
- anticipated growth due to infill or intensification; and
- the opportunities for retrofitting or rehabilitating stormwater management systems.

Appropriate planning leads to a more efficient and coordinated use of resources in implementing stormwater controls and greater watershed benefits. Typically these types of plans are lead by local municipalities and public input is an important component in establishing priorities and objectives.

5.2 Infill Development SWM Approaches

Infilling is most common in the following land use categories:

- commercial (normally processed under a site plan approval);
- industrial (normally processed under a site plan approval); and
- small residential (usually less than 6 lots – processed under a plan of subdivision application).

The cumulative effect of infill development may result in higher peak stormwater flows, increased erosion, and greater contaminant loading. Peak flow control and water quality can potentially be addressed at the site level for commercial/industrial infill. Because erosion control requires that a larger volume of runoff must be stored for an extended period (approximately 24 hours), it is more difficult in infill situations.

Although the scale of the anticipated infill development may not be sufficient to warrant the development of an Infill Development Plan or Subwatershed Rehabilitation Plan, municipalities have typically considered the following options to manage stormwater from residential and commercial/industrial infill development: no control, minimum runoff capture, conveyance/ end-of-pipe controls, and off-site systems.

5.2.1 Residential Infill

In general, SWMPs to small scale residential infill are limited to lot level controls because of the small area of land in individual ownership and the presence of existing stormwater conveyance infrastructure. In virtually all cases, having residential roof leaders discharge to ponding areas is an applicable practice (e.g., lawn). Where soils permit, soakaway pits or infiltration trenches can be used, although problems with long-term maintenance and longevity may occur because of the private ownership and potential for lack of maintenance. Reduced lot grading can be used where the soils permit, but the acceptability of this type of control should be confirmed by the local municipality (some municipal standards require a minimum 2% slope).

i) No Control

This approach is not accepted by some municipalities without at least an assessment of infiltration potential and is limited to small residential infill developments (in some cases only a single lot).

ii) Minimum Runoff Capture

Requires the proponent to capture all runoff from a small design rainfall event (typically 5 mm) and retain it on site until it infiltrates or evaporates. If feasible, lot level/source controls should be used for all residential infill to mitigate cumulative erosion impacts. Where soils and municipal by-laws permit, roof drainage to soakaway pits, infiltration trenches or cisterns, and flatter lot grading may be used. Roof leader discharge to pervious areas should be applied even to single lots unless physically infeasible.

iii) Conveyance/End-of-Pipe Controls

In addition to the lot level controls, some small residential infill projects may provide the opportunity to apply conveyance controls. In situations where new stormwater infrastructure is required and soil conditions are favourable, swale drainage or pervious pipe systems may be considered for clean stormwater. The decision to implement these types of controls should be confirmed by the municipality. Generally, end-of-pipe controls are not applicable to residential infill and are rarely used.

iv) Off-Site Systems (OSS) to address cumulative stormwater impacts

On-site stormwater management is generally preferred. However, in certain situations it may be ineffective or impractical because of physical constraints. In these cases, off-site systems (OSS) may be considered for all residential infill beyond a single lot. Off-site treatment can help address water quality, erosion and flood control impacts caused by development within a watershed. Proponents are still responsible to ensure that they meet all legislative requirements including the federal *Fisheries Act*.

OSSs can be used in combination with minimum runoff capture and conveyance/end-of-pipe controls. A number of municipalities have used the approach of requesting a financial contribution toward the development of SWM at another location elsewhere in the watershed and have used various formulas to calculate required financial contribution (see Section 5.3).

5.2.2 Commercial/Industrial Infill

The opportunities to apply SWMPs to small-scale commercial/industrial infill are usually greater than those found in residential infill. However, land availability and costs as well as municipal zoning requirements (e.g., number of parking spaces, etc.) can be limiting factors. Surface SWM facilities, such as wet ponds, constructed wetlands and infiltration basins, often are not viable because of the relatively large amount of surface area required. Rooftop, parking lot and superpipe storage, while generally applicable, are not accepted by some approval agencies. Lot level controls should be used to the extent possible to supplement end-of-pipe controls. Guidance for the design and sizing of each of these types of SWMPs is provided in Chapter 4. The majority of other SWMs can be applied depending on stormwater quality, soil conditions, and the individual development's design. Table 5.1 lists the types of SWMPs that can be used in infill situations, type of control they provide, and conditions which limit their use.

i) No/Minimal Controls

This approach is normally only considered for small industrial/commercial infills comprising less than 0.3 hectares (**Note:** this cut-off may be modified to reflect specific municipal conditions and policies); and may be coupled with off-site systems (see iv below). Roof leader discharge to pervious areas should be applied if physically feasible and practical (unless there is potential for contamination from roof top). Oil/grit separators may be used for areas that have a higher potential for spills (such as gas stations).

ii) Minimum Runoff Capture

This approach requires the proponent to capture all runoff (small design rainfall event – typically 5 mm) and retain it on site (runoff volume is usually either infiltrated or evaporated). This approach may be used for clean water where soils permit and infills are greater than 0.3 hectares.

In highly impervious commercial and industrial infill developments, the potential usefulness of this approach is dependent on the ability to infiltrate the runoff where there are no concerns about groundwater contamination (i.e., stormwater must be clean).

iii) Conveyance/End-of-Pipe Controls

Certain conveyance and end-of-pipe controls are commonly used in commercial/industrial infill (Table 5.1). In most cases, quantity controls (e.g., rooftop or parking lot storage) are required for commercial/industrial infills because of sewer system capacity and flooding concerns. The use of rooftop and parking lot storage is not accepted by some approval agencies in terms of the overall flood storage requirements for a subwatershed; however, storage is often useful for municipalities due to limited sewer capacity.

End-of-pipe controls for peak flow control should be mandatory where there is concern for downstream storm sewer capacity or where there are flooding concerns and no opportunity for centralized flood control facilities. Facilities for erosion control should only be applied where there is a clear need or where there is a potential to combine the requirements for water quality/quantity and erosion control (e.g., a dry pond). Even where there is a plan for use of off-site systems (OSS) within the subwatershed, additional water quality controls may be required where there is a high potential for wash-off of contaminants (e.g., oil and grease at gas stations, etc.).

Table 5.1: SWMPs Applicable to Infill Development

SWMP Type	Type of Control	Comments
Rooftop Storage	Peak Flow	Application dependent upon building design
Parking Lot Storage	Peak Flow	Application dependent upon site grading
Superpipe Storage	Peak Flow	Application dependent upon invert of street storm sewer
Dry Pond (quantity control)	Peak Flow	Application dependent upon available surface area
Pervious Pipe	Water Quality	Application dependent upon soils. May be combined with superpipe to provide both peak flow and some water quality control
Swales*	Water Quality	Most useful where infiltration capacities are high
Pocket Wetland*	Water Quality	Requires high water table to sustain wetland
Dry Pond (24 hr. retention)	Erosion	Application dependent upon available surface area. Minimum orifice size may govern feasibility.
Dry Pond (48 hr. retention)	Water Quality and Erosion	Application dependent upon available surface area. Minimum orifice size may govern feasibility.
Infiltration Trench*	Water Quality	Application dependent upon soil infiltration capacity and protection of groundwater
Sand or Organic* Filters	Water Quality	Generally applicable
Bioretention Filters*	Water Quality	Generally applicable
Oil/Grit Separators*	Spills/Water Quality*	Generally applicable

** Should be used as part of a multi-component approach including more than one SWMP when used as a water quality control unless it is demonstrated on a case-by-case basis that the water quality criteria can be met.*

iv) Off-Site Systems (OSS) to address stormwater cumulative impacts

Off-site systems (OSS) have been used where on-site stormwater management practices are ineffective or impractical because of physical constraints. In order to try and offset stormwater impacts from the development, the project proponent may be required to make a financial contribution to a SWM system at another location within the same subwatershed. A number of municipalities have used this approach using various formulas to calculate the required financial contribution. Although on-site controls are typically preferred, an OSS can be used as an alternative to help address water quality, erosion and flood control impacts caused by development within a watershed. Proponents are still responsible to ensure that they meet all legislative requirements including the federal *Fisheries Act*.

An OSS may be considered for all commercial/industrial infills greater than 0.3 hectares if a plan for subwatershed rehabilitation is in place or a set of priority projects has been established for the subwatershed.

5.3 Off-Site Systems (OSS) and Financial Contribution

Off-site system (OSS) SWMPs are most effective within the context of an Infill Development or Subwatershed Rehabilitation Plan so that any funds collected in lieu of on-site facilities can be applied to suitable projects within the same subwatershed. If a plan has not been developed, issues of concern, priorities and suitable SWMPs to address these concerns need to be identified within the watershed. Funds should be targeted at projects identified in the Rehabilitation Plan or a priority list that addresses impacts to which infill contributes (e.g., water quality, erosion, and/or flood controls).

An off-site system (OSS) program involving financial contributions can be developed by using the *Development Charges Act, 1997*. Storm drainage is an eligible and fully fundable service under section 5(5).3 of the *Development Charges Act, 1997* (DCA). However, any determination of an appropriate "financial contribution" via the DCA for stormwater costs or any other DCA-eligible purpose must meet all the rules and requirements of that Act for determining charges.

In general, development charges may only recover the "net growth related capital costs" of eligible facilities. These eligible costs must be determined according to various rules and limitations set out in the Act covering such aspects as: the definition of "capital cost" for the DCA purposes; the "average service standards" provision (which limits chargeable costs); and various rules dealing with the allocation of costs between existing and new (re)developments where both may benefit from the works in question.

Any such provisions for development charges for stormwater facilities (related to infill development or otherwise) must be contained in a DCA by-law in effect in any given municipality and justified with supporting background study before individual charges can be imposed.

By-law provisions (the original by-laws and amendments adding any new charges) are subject to several process requirements such as public meetings and, if there are objections, to an Ontario Municipal Board (OMB) appeals process.

5.3.1 Potential Approach in Using and Financing Off-Site SWMPs

The following steps may be helpful in determining the use of Off-Site System (OSS) stormwater management practices for infill development and their funding through financial contributions. Modifications may be appropriate to meet specific conditions or policies within a municipality or region.

1) Develop Watershed Rehabilitation Plan/Priority Projects List to identify and prioritize projects in subwatershed so that an OSS approach provides a strategic benefit greater than that expected from the scattered use of site controls. Otherwise, funds collected could be spent without benefit to the subwatershed. The projects identified should be located in the same subwatershed as the source of funding and the scale of the project should reflect the expected pace of infill. The projects which make up the plan should include all types (water quality, and erosion and flood control) for which a financial contribution is to be collected.

2) Adopt a financial contribution formula which reflects the local conditions and the anticipated types of projects. A simple formula based on site area and imperviousness has been used (see section 5.4 for other examples). The unit cost portion of the formula should be tied to the type of projects which will be undertaken (e.g., if infiltration is highly desirable in an area, the unit cost may be higher because of the generally higher cost associated with this type of project).

3) Determine the basic amount (of financial contribution) applicable to individual infill projects as they occur.

4) Assess the environmental benefit of site controls compared to the strategic application of funds to priority projects because in certain situations site controls may be required. Further, many commercial/industrial sites will benefit from the installation of on-site systems for dry weather flow and spills control.

5) Adjust the basic contribution amount by recognizing the costs of implementing site-specific controls. These costs could include engineering and design costs as well as materials and construction costs. In cases where policies require on-site control devices for specific types of land use (e.g., spill control devices), the value of on-site controls may be credited at a lower level.

6) Funds collected to implement priority projects.

5.4 Examples of Cost Calculation Methods

Various methods for calculating the amount of a financial contribution have been used in different jurisdictions. The Facility Cost and Area/Imperviousness methods are described below.

The approaches described have not been specifically assessed for compliance or compatibility with the *Development Charges Act*. Municipalities should work with their municipal solicitors to produce a legally sound development charge under the DCA.

In cases where a long-term stormwater management master plan and/or rehabilitation plan has not been completed, the Area/Imperviousness Method (5.4.2) is the most commonly used because of its simplicity and its link to the expected volume of water which will be generated. Depending on formulas used and local information, these methods can result in substantially different financial contribution requirements. Individual municipalities must, therefore, establish their own specific formulas to reflect equitable payments within the context of stormwater management facilities in their own area.

Municipalities periodically update cost factors used as better information becomes available and cost estimates change. In all cases, a municipality may choose to require on-site SWM controls rather than accepting financial contribution for off-site systems.

5.4.1 Facility Cost Method

Under the facility cost method, a SWMP design concept and cost is estimated based on similar projects. The required financial contribution is equal to the estimated cost of the facility (can exclude or include land costs). In most cases a wet pond concept is used for the estimate (even if this type of SWMP is not practical). For conditions where infiltration is practical, an infiltration trench design may be used for costing. The preparation of the cost estimate is normally the responsibility of the proponent, but is subject to municipal approval. The facility cost method has not been used extensively because of the effort required to establish the cost basis for facilities. However, some examples do exist.

City of Mississauga

The City of Mississauga has undertaken a number of studies and assessments to determine a Development Charges Levy for infill and “green fields” development. Mississauga now uses the Facility Cost Basis method to calculate financial contribution and links it to their Development Cost Levy. In developing the current approach, Mississauga identified the following:

- Erosion Control and Conveyance – Identified Projects;
- Erosion Control – Future Work;
- Stormwater Management Measures;
- Water Quality Control; and
- Future Oversizing.

Project costs were estimated for each category, and in the case of stormwater measures, land costs were also included (due to tableland placement of ponds). Based on this, a total development charges levy of $35,100/hectare ($21,700/gross hectare) was established.

5.4.2 Area/Imperviousness Method

Municipalities should be careful to ensure that any use of financial contribution models based on area/imperviousness method outlined below fit the rules and requirements of either:

(i) DCA regarding imposing a growth related SWM capital cost charges on new (re)developments; or

(ii) Planning Act regarding requiring a "payment in lieu of on-site SWM facilities" as a condition of a (re)development approval under that Act.

The area/imperviousness method is linked to the level of imperviousness, runoff, or contaminant-producing potential of the site. This is the simplest calculation method, and there are several variations that have been used by municipalities in Ontario.

Town of Markham
Most of the older parts of Markham are served by stormwater management facilities designed according to less stringent criteria when the areas were originally developed. Quality control was not practised before the 1990s; therefore, most of these areas are served by quantity control ponds which only minimize downstream flooding.

Older developed areas may offer opportunities for redevelopment or infill development that would be subject to current stormwater management standards for quantity, quality, and erosion controls. Although it may be possible to accommodate such controls on-site, there is the potential that on-site controls could lead to the proliferation of small and inefficient stormwater facilities.

The Town of Markham has developed an approach in conjunction with the Toronto and Region Conservation Authority (TRCA) to upgrade existing stormwater management facilities within the older parts of the Town to current standards (Town of Markham Stormwater Retrofit Study, 1999). Ten existing quantity ponds were identified and retrofitting costs ranged from $11,000 to $317,000 per pond for a total of $1,538,000. Existing uncontrolled storm sewer outfalls in the older parts of the Town were also assessed to determine the feasibility of constructing new facilities at these locations.

The TRCA commissioned a report entitled "Financial Contribution Toward Stormwater Controls" which provided estimates on the amount of money a development would have to contribute towards an off-site stormwater management project rather than undertaking on-site controls. The contribution was determined by undertaking a survey of costs for similar projects in the Greater Toronto Area and establishing an average cost per impervious hectare for developable land (Table 5.2).

Table 5.2: Average Unit Cost ($/Impervious Hectare (ha))

Pond Scenario	Construction ($)	10% Design and Review ($)	3% GST ($)	Total ($)
Quality Only	19,290.17	1,929.02	636.58	21,855.77
Quality and Quantity	25,645.40	2,564.54	846.30	29,056.24

City of Belleville

The City of Belleville estimates financial contribution (FC) based on the number of impervious hectares being developed and currently uses a factor amount of $10,000.

$$FC = (\text{Area (ha)} \times \%\ \text{Imperviousness} \times \text{Factor (\$/ha)}) + \$10{,}000$$