17 - Stormwater Management Plans

1 Purpose and Overview

This technical paper provides guidance to assist municipalities, land developers, consultants, and other proponents in planning and developing stormwater management plans for the implementation of the provisions of Section 45, 46, and 47 of the Oak Ridges Moraine Conservation Plan (ORMCP).

Many resources exist regarding the preparation of stormwater management plans. Where appropriate, the reader will be directed to existing guidance and references. This technical paper focuses on the stormwater requirements specific to the Oak Ridges Moraine.

2 Related Considerations

When preparing Stormwater Management Plans, it is suggested that the reader also review the highlighted, associated topic areas as discussed in the ORMCP, as shown in Figure 1 below.

Clean Water Act, 2006

The *Clean Water Act, 2006* was passed on October 19, 2006. Associated regulations, Director's Rules and technical modules are currently being developed. Readers of this technical paper should take note that the requirements of the *Clean Water Act, 2006* may have implications to initiatives undertaken to implement the ORMCP. Information concerning the *Clean Water Act, 2006* is available at: www.ene.gov.on.ca/en/water/.

Environmental Assessment Act, 1990

If an application pertains to a municipal sewage or water infrastructure proposal, it may be subject to the environmental assessment process and may require approval from the Minister of the Environment under the *Environmental Assessment Act.*

Further Reading

Please also refer to the additional list of resources and references listed at the end of this technical paper.

Figure 1 ORMCP Topic Areas and Linkages with Technical Paper 17 - Stormwater Management Plans

3 Requirements of the Oak Ridges Moraine Conservation Plan

The Oak Ridges Moraine Conservation Plan (ORMCP) states:

Stormwater management

45.

(1) An application for major development shall be accompanied by a stormwater management plan, as set out in section 46.

(2) Every application for development or site alteration shall demonstrate that planning, design and construction practices that protect water resources will be used, including,

a) *keeping the removal of vegetation, grading and soil compaction to a minimum;*

b) *keeping all sediment that is eroded during construction within the site;*

c) *seeding or sodding exposed soils as soon as possible after construction; and*

d) *keeping chemical applications to suppress dust and control pests and vegetation to a minimum.*

(3) *In considering an application for development or site alteration, the municipality shall seek to reduce areas with impervious surfaces and increase areas retained in a natural undisturbed state, in order to minimize stormwater volumes and contaminant loads.*

(4) *Municipal development standards shall incorporate planning, design and construction practices that will,*

a) *reduce the portions of lots and sites that have impervious surfaces; and*

b) *provide the flexibility to use alternative stormwater management techniques such as directing roof discharge to rear yard ponding areas and using grassed swales.*

(5) *Subsections (2), (3) and (4) do not apply to applications for mineral aggregate operations.*

(6) *For the purposes of stormwater management, the minimum standard for water quality is that 80 per cent of suspended solids shall be removed from stormwater runoff as a long-term average. O. Reg. 140/02, s. 45 (6).*

(7) *Despite anything else in this Plan, disposal of stormwater into a kettle lake is prohibited.*

(8) *Despite anything else in this Plan, new stormwater management ponds are prohibited with respect to land in key natural heritage features and hydrologically sensitive features.*

(9) *In subsection (8),*

"stormwater management pond" means a detention basin that temporarily stores or treats collected stormwater runoff and releases it at a controlled rate. O. Reg. 140/02, s. 45 (9).

Stormwater management plans

46.

(1) *The objectives of a stormwater management plan are to,*

a) *maintain groundwater quantity and flow and stream baseflow;*

b) *protect water quality;*

c) *protect aquatic species and their habitat;*

d) *prevent increases in stream channel erosion; and*

e) *prevent any increase in flood risk.*

(2) A stormwater management plan shall provide for an integrated treatment train approach that uses a planned sequence of methods of controlling stormwater and keeping its impact to a minimum by techniques including, without limitation,

a) lot level controls such as devices and designs that direct roof discharge to rear yard ponding areas;

b) conveyance controls such as grassed swales; and

c) end-of-pipe controls such as wet ponds at the final discharge stage.

(3) A stormwater management plan shall be prepared in accordance with the applicable watershed plan under section 24, if one exists.

Rapid infiltration basins and columns

47.

(1) Despite anything else in this Plan, new rapid infiltration basins and new rapid infiltration columns are prohibited.

(2) In subsection (1),

"rapid infiltration basin" means a basin or system of basins at or below surface grade that is constructed in porous soil and punctures through a relatively impermeable layer to gain access to a more permeable sand or gravel layer, so as to rapidly infiltrate into the ground, at a single point or area of concentration, surface runoff collected from impervious surfaces;

Section 44 of the ORMCP also states that the construction or expansion of partial sewage and water services is prohibited, except for the provisions noted. “Partial service” means connections linking a building to, (a) a communal sewage or water service or a full municipal sewage or water service, and (b) an individual on-site sewage or water system.

This technical paper should be used as a guide to develop sewage and water system plans for major developments. All information requirements of the ORMCP should be provided with the application to the appropriate approval agency. All relevant Oak Ridges Moraine (ORM) technical papers should be consulted during the preparation of the application.

4 Rationale for the Requirements

The goal of stormwater management is to maintain groundwater recharge and quality, reduce stormwater pollutant loads, protect stream channels, prevent increased overbank flooding, safely convey extreme floods and maintain the health of streams and lakes for aquatic life and human use by minimizing the effects of development on the natural hydrologic cycle. Given the importance of the Oak Ridges Moraine as a headwater, groundwater recharge area, unique approaches to stormwater management must be rigorously applied.

How does development affect the hydrologic cycle?

Humans interact with the hydrologic cycle by removing water for agricultural, domestic, and industrial uses, and some return as wastewater which may degrade water quality. Urban development interferes with the natural transfer of water between storage compartments of the hydrologic cycle. There is decreased infiltration (seepage into the soil) of precipitation and snowmelt, which leads to increased stormwater runoff. This is a direct consequence of the increase in impervious area (roads, driveways and buildings) that accompanies urban development.

5 Implementation of the Requirements

5.1 Stormwater Management/Watershed Planning

A Stormwater Management Plan must be prepared in accordance with the local Watershed Plan (ORMCP, s. 24). Watershed planning integrates environmental and land use planning, and ensures that important features and interrelated factors are identified and understood at a regional scale. Stormwater management opportunities and constraints provided by the existing natural heritage features and functional systems are identified early in the planning process (e.g. hydrologically sensitive features and minimum vegetation protection zones).

5.2 Stormwater Management Plans

5.2.1 Overview

An application for major development in the ORMCP area must be accompanied by a Stormwater Management Plan (Section 45(1)). Major development is defined as the creation of four or more lots, the construction of building(s) with a ground floor area of more than 500 m2, or the establishment of a major recreational use (Section 3(1)). Applications for mineral aggregate operations must address stormwater management, however, they are exempt from the requirements of Section 45(2), (3) and (4).

The development applicant is responsible for preparing the Stormwater Management Plan. The municipal planning approval authority is responsible for reviewing and determining the acceptability of the Stormwater Management Plan. In some cases, the conservation authority may provide technical review expertise, particularly with respect to linkages between the Stormwater Management Plan and the Watershed Plan and with respect to the effects of the Stormwater Management Plan on the management of natural hazards.

Stormwater Management Plans should be prepared in accordance with ORMCP requirements and applicable Watershed Plans (subsection 46(3)). Stormwater Management Plans should build on the recommendations of the (Sub) Watershed Plan Technical Paper, and

should be provided to support the draft plan of subdivision or site plan application. A coordinated, comprehensive approach to stormwater management along with the watershed/subwatershed plans and secondary plans is strongly encouraged. The Ministry of the Environment Stormwater Management Planning and Design Manual (March 2003) provides technical and procedural guidance for the planning, design, and review of stormwater management practices, which may be useful in developing a Stormwater Management Plan.

5.2.2 Steps for Developing a Stormwater Management Plan

1. Review background information
2. Define objectives/requirements
3. Identify stormwater management practices and options
4. Select stormwater management practices and options
5. Prepare stormwater management plan

5.2.2.1 Review Background Information

The Stormwater Management Plan should be prepared in accordance with applicable Watershed Plans. Applicants should also consider other relevant existing studies (subwatershed plan, environmental management plan), as well as specific municipal, conservation authority, provincial, and federal requirements.

5.2.2.2 Define Objectives/Requirements

Objectives for the Stormwater Management Plan should be based on ORMCP requirements (subsection 46(1)), environmental objectives identified in watershed/subwatershed plans, and other relevant policies and studies. The following must also be considered:

Natural Core Areas/Natural Linkage Areas

An application for infrastructure use (e.g. a stormwater management facility such as a wetland, infiltration basin, or stormwater management pond) within a Natural Linkage Area or Natural Core Area will not be approved unless the applicant (subsections 11 and 12 ORMCP):

- demonstrates a need for the project;
- demonstrates no reasonable alternative;
- meets all requirements outlined in s. 41 of the ORMCP.

Hydrologically Sensitive Features/ Natural Heritage Features

Stormwater management facilities are prohibited within a hydrologically sensitive feature, key natural heritage feature or their minimum vegetation protection zone unless the applicant (subsection 26):

- demonstrates a need for the project;

- demonstrates no reasonable alternative;
- conducts a hydrological evaluation and a natural heritage evaluation;
- meets all requirements outlined in s. 41 of the ORMCP.

However, new stormwater management ponds are prohibited within hydrologically sensitive features and key natural heritage areas (subsection 45(8)). Disposing of stormwater into a kettle lake is also prohibited (subsection 45(7)).

Landform Conservation Areas

In Landform Conservation Areas (subsection 30), an application for development or site alteration will need to identify practices that minimize disturbance and maintain landform features e.g. steep slopes, kames, kettles, ravines, and ridges. If applicable, applicants should refer to the Oak Ridges Moraine Technical Paper #4, Landform Conservation Plan and consider these practices in the development of the Stormwater Management Plan.

5.2.2.3 Identify Stormwater Management Practices and Options

Stormwater management practices that meet the objectives established in the Stormwater Management Plan need to be identified, based on ORMCP, Watershed Plan, and other applicable requirements.

A combination of lot-level, conveyance, and end-of-pipe stormwater management controls ("treatment train") (see pp. 10 and 11) is usually required to meet the multiple objectives of stormwater management, which include protecting water quality and preventing an increased risk of erosion and flooding.

Maintaining areas in a natural state is also valuable. For example, vegetated stream buffers filter pollutants, provide shade and bank stability, and reduce stormwater runoff. Other techniques that help meet stormwater management objectives, such as subwatershed projects (e.g. channel restoration), and alternate development techniques (e.g. reduced length of driveways) should also be considered in the Stormwater Management Plan. Applicants should refer to the Watershed Plan for additional information.

An initial qualitative screening of potential stormwater management practices and options can be useful in identifying Stormwater Management practice(s) that would best meet the objectives. Depending upon the complexity, undertakings may have different stages, e.g. planning, preliminary design, detailed design, and construction. The stormwater management plans should outline potential options that will be considered at various stages of the undertaking. For example, at the planning stage of a

project, the available option may be to construct a wet pond or a dry pond. Once alternatives have been identified, further assessment can be done.

5.2.2.4 Select Stormwater Management Practices and Options

Several Stormwater Management options may meet the objectives of the Stormwater Management Plan. Therefore, evaluation criteria should be used to select the preferred alternative. Examples of evaluation criteria include: potential for environmental improvement, costs (capital, operation and maintenance); ease of implementation of the option; and public acceptance. Applicants should refer to the Watershed, Subwatershed and other relevant technical papers to determine evaluation criteria. The evaluation and selection of alternatives that will be considered at various stages of the undertaking should be documented in the stormwater management plan.

Examples of Alternative Stormwater Management Techniques

Compact Building Form

Compact building forms such as townhouses, fourplexes, and clusters reduce the amount of impervious surface. It also makes more open space available, providing the potential to implement a series of smaller decentralized stormwater management practices rather than a single, large end-of-pipe facility, and improved opportunities to integrate stormwater management initiatives within the development.

Reduced Pavement Footprint

A reduction in the width of the paved cross section of the road affords benefits such as:

- a reduction in impervious area;
- an opportunity to implement stormwater management practices, such as grassed swales, within the right-of-way;
- an enhanced potential to increase canopy cover through street tree planting.

Lot Configuration and Grading

Lot configuration and grading are key factors in determining the extent to which lot-level controls, such as roof leader disconnection, vegetated filter strips and depression storage, can be implemented, as well as their effectiveness. Lot layout and grading should be defined with an emphasis not only on achieving maximum yield but also with the objective of maximizing the potential to implement lot-level controls effectively.

Grassed Swales

Not only effective in terms of stormwater quality improvement, the use of grassed swales can result in substantial savings in cost when compared with conventional storm sewer servicing. Grassed swales also provide benefits related to snow storage and groundwater recharge where appropriate soil conditions exist.

Porous Pavement

Although not regarded as durable and sustainable for universal application, porous pavement, in the form of granular or precast concrete unit paving can be used in appropriate areas. Such areas include the shoulder of the road to provide a transition between the traveled surface and the grassed swale, in the centre of cul-de-sacs or in parking lanes. When used in these applications, porous pavement provides practical benefits as well as benefits related to water quality improvement and aesthetics.

Pocket Detention Storage

Within the road right-of-way, there are a number of small areas well suited to the implementation of pocket detention facilities or biofilters. Cul-de-sac islands, medians, boulevards, roundabout islands, and in the case of limited access routes, leftover land within interchanges, should be considered as potential sites to detain stormwater and settle out pollutants. These areas can be paved or landscaped to integrate them into the aesthetics of a streetscape or character of the development. Although the sizes of these facilities are limited, collectively, significant stormwater management benefits can be achieved.

Tree Planting

Increasing canopy cover is a simple, effective means to intercept rainfall before it comes into contact with the ground and becomes runoff. Increased planting of large canopy trees in the vicinity of streets, parking lots and other impervious surfaces may contribute to reduced rates of runoff, in addition to affording benefits related to the production of oxygen, temperature reduction, habitat enhancement and aesthetics.

5.2.2.5 Prepare Stormwater Management Plan

Based on the information collected in the previous steps, a Stormwater Management Plan can be developed to accompany the application for major development. Some of the deliverables identified below may exist in separate plans, but in the Stormwater Management Plan they must be identified and coordinated. Included in the Stormwater Management Plan may be:

- erosion and sediment control plans;
- detailed design of stormwater management works, including connections and outfalls;
- detailed design of environmental restoration works (e.g. stream restoration works);
- location of stormwater management facilities relative to geotechnical hazard areas;
- detailed reports relating to geotechnical and water resources;
- major and minor flow systems;
- grading plan;
- revegetation and landscape plans;
- access for operation and maintenance of facilities;
- plan for implementing the stormwater works;
- operation and maintenance plan (i.e. for sediment cleanout);
- contingency plan for remediation;
- monitoring plan to determine effectiveness of measures in meeting stormwater management objectives.

It is essential that each Stormwater Management Plan describe specifically how the requirements of s. 45 and 46 of the ORMCP have been met. It may be prudent to consult with the municipality responsible for approving the major development on the level of detail desired in the submission of the stormwater management plan.

5.2.3 Special Requirements and Prohibitions

5.2.3.1 Achieving Infiltration Targets

Development tends to increase impervious surfaces, making it more difficult for water to get into the ground (decrease in infiltration).

The natural hydrologic cycle can be maintained to the greatest extent possible by lot-level infiltration controls (e.g. reduced grading to allow greater ponding of stormwater and directing roof leaders to rear yard ponding areas, soakaway pits, cisterns, or rain barrels). Because infiltration of contaminated stormwater can impair groundwater quality and tends to clog infiltration controls, infiltration controls are most suited to infiltration of relatively clean stormwater (e.g. from rooftops). Therefore, separation of rooftop drainage from road drainage (e.g. use of a third pipe) is encouraged. Natural infiltration is also encouraged. Consideration should be given to reducing salt loadings from winter maintenance of roads and parking lots.

Other infiltration techniques are encouraged provided that potential impacts on ground water quality are addressed. Infiltration is effective in reducing runoff and minimizing the amount of contamination at end-of-pipe facilities.

Nevertheless, new rapid infiltration basins (RIBs) and rapid infiltration columns (RICs) are prohibited in the ORMCP area (subsection 47). A distinction between infiltration basins and RIBs/RICs is that RIBs/RICs puncture through a relatively impermeable layer to a more permeable sand or gravel layer and rapidly infiltrate surface runoff collected from impervious areas.

Rapid Infiltration Basins and Columns

A basin/column or system of basins/columns at or below surface grade that is constructed in porous soil and punctures through a relatively impermeable layer to gain access to a more permeable sand or gravel layer, so as to rapidly infiltrate into the ground, at a single point or area of concentration, surface runoff collected from impervious surfaces.

5.2.3.2 ORMCP Minimum Water Quality Standard

The ORMCP s. 45(6) indicates that the minimum water quality standard is 80% removal of suspended solids from stormwater runoff as a long-term average. This standard corresponds to the

"enhanced level of protection" described in the Stormwater Management Planning and Design Manual (March 2003).

Three levels of protection have been identified which maintain or enhance existing aquatic habitat: enhanced, normal, and basic protection. These levels of protection are based on a general relationship between the end-of-pipe stormwater management facilities' long-term average suspended solids removal and the lethal and chronic effects of suspended solids on aquatic life. Enhanced protection corresponds to the end-of-pipe storage volumes required for the long-term average removal of 80% of suspended solids. It corresponds to the minimum water quality standard to be used in the ORMCP area. Note that more stringent water quality requirements may be warranted based on the characteristics of the receiving water environment (e.g. to address thermal impacts).

5.2.3.3 Erosion/ Sediment Control Plan

According to the ORMCP s. 45(2), every application for development or site alteration is required to demonstrate that planning, design, and construction practices that protect water resources are used. This includes:

- keeping the removal of vegetation, grading and soil compaction to a minimum;
- keeping all sediment that is eroded during construction within the site;
- seeding or sodding of exposed soils as soon as possible after construction;
- keeping chemical applications to suppress dust, and control pests and vegetation to a minimum.

An Erosion/Sediment Control Plan, which demonstrates that these requirements are being met, should be prepared and submitted with each application for development or site alteration. The Plan should be site-specific and describe:

- the controls selected;
- how these controls will be implemented, monitored, and maintained regularly, and after rain events;
- how hydrologically sensitive features, key natural heritage features and their associated vegetation protection zones will be protected.

Mineral aggregate operations are exempt from these requirements (subsection 45(5)).

Applicants should also refer to the Watershed Plan and to applicable municipal, conservation authority, provincial, and

federal policies/guidelines for any additional requirements. If a Stormwater Management Plan is required for the development (e.g. major development), the Erosion/Sediment Control Plan should be part of the Stormwater Management Plan.

5.2.3.4 Treatment Train Approach

Section 46(2) provides for the use of an integrated treatment train approach that uses a planned sequence of methods for controlling stormwater and minimizing impacts through the use of:

- lot-level controls (e.g. devices and designs that direct roof discharge to rear yard ponding areas);
- conveyance controls (e.g. grassed swales);
- end-of-pipe controls (e.g. wet ponds at the final discharge stage).

The recommended strategy for stormwater management is to provide an integrated treatment train approach to water management that is premised on providing control at the lot-level and in conveyance followed by end-of-pipe controls. The combination of individual controls and practices ("treatment train") at lot-level, conveyance, and end-of-pipe is the only way that multiple objectives can be achieved in a given area, such as maintaining groundwater quantity and flow, protecting water quality, and preventing increased risk of erosion and flooding.

Lot-level and Conveyance Controls

Lot-level and conveyance controls include those that are applied at the individual lot-level, those that form part of the conveyance system, and those that typically serve multiple lots but are only suitable for small drainage areas (< 2 hectares). They can be divided into two categories according to their primary function. Infiltration controls (e.g. grassed swale) mitigate the effects of urbanization (e.g. increased surface runoff and reduced soil moisture replenishment) on the water balance. Storage controls (e.g. rooftop or parking lot storage) detain stormwater and reduce peak runoff rates.

The successful implementation of many lot-level and conveyance measures requires innovative design of developments. Some controls can be undertaken by homeowners, such as cisterns or rain barrels used in combination with bioretention gardens. Lot grading can be used to direct runoff to garden areas. Trickle irrigation systems may be used to make use of captured runoff in soils with lower infiltration capacities.

End-of-Pipe Controls

End-of-pipe stormwater management facilities receive stormwater from a conveyance system (ditches, sewers) and discharge the treated water to the receiving waters. The purpose of end-of-pipe stormwater management facilities is to control the impacts of urbanization, which remain after lot-level and conveyance controls have been applied. In most cases, new urban developments (unless they are small or of very low density) will require some sort of end-of-pipe stormwater management facility. Some stormwater management practices that have been applied as end-of-pipe stormwater management facilities include: wet ponds; constructed wetlands; and dry ponds. Other stormwater management practices applied in some cases as end-of-pipe facilities for smaller areas include filters and oil and grit separators.

The benefits of stormwater management strategies that use a combination of stormwater management practices and controls include:

- more effective stormwater management
- reduced land area required to implement end-of-pipe solutions
- enhanced opportunities to integrate stormwater management practices effectively as community amenities
- increased level of public awareness and involvement in the implementation and management of stormwater management initiatives.

5.2.3.5 Impervious Surfaces/Municipal Development Standards

In order to minimize stormwater volumes and contaminant loads, municipalities must seek to reduce areas with impervious surfaces and increase natural areas retained in a natural undisturbed state when considering development or site alteration applications (subsection 45(3)). Reference should also be made to the Watershed Plan and the technical paper on Subwatersheds (Impervious Surfaces) to determine requirements relating to impervious surfaces.

As well, ORCMP (Section 45(4)) requires that municipal development standards should incorporate planning, design and construction practices that:

- reduce the portions of lots and sites that have impervious surfaces;
- provide the flexibility to use alternative stormwater management techniques, such as directing roof discharge to rear yard ponding areas and using grassed swales.

Listed in the box on Page 9 are some examples of alternative stormwater management techniques, which could be incorporated into municipal development standards. These techniques assist in reducing impervious surfaces, expanding stormwater management options, and providing stormwater benefits. Many of the alternative stormwater management activities (i.e. grassed swales, tree planting) have been long accepted best management practices that have been adopted widely by agricultural operations.

5.3 Monitoring

Figure 2 shows a suggested hierarchy of monitoring related to the water provisions of the ORMCP. The scope of monitoring will vary for each program or project based on the requirements of the ORMCP, environmental targets identified in a plan, and specific conditions of an approval.

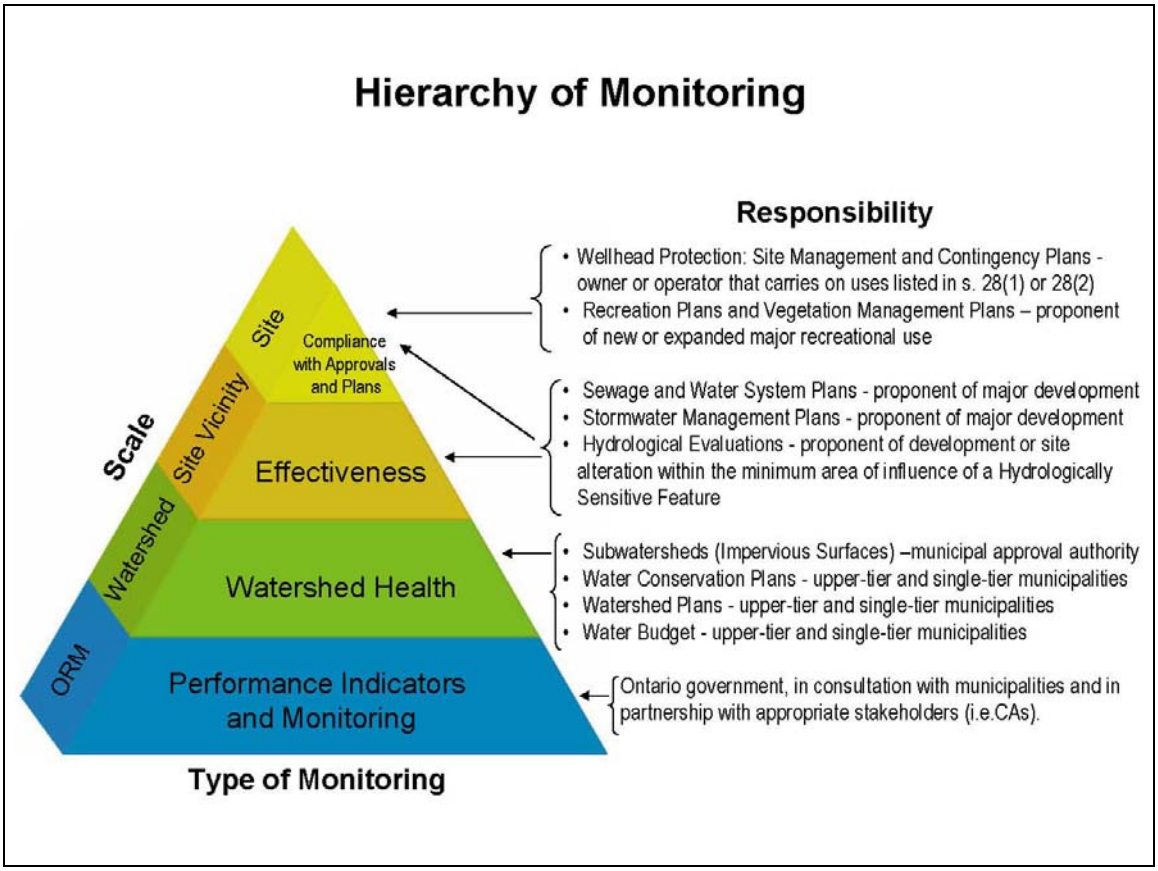
It is suggested that details of the monitoring to be undertaken, such as the frequency at which samples will be collected or observations made, the locations to be monitored, the methods to be used, and the duration of monitoring be designed to suit the specific needs of the particular program or project.

The Ontario government, in consultation with municipalities, shall over time identify performance indicators for monitoring the effectiveness of the ORMCP (see the Implementation section of the ORMCP). The Province, in partnership with appropriate stakeholders, shall establish a monitoring network to collect, summarize, and evaluate performance indicator data to:

- assess changes in the ecological integrity of the Moraine;
- assess the effectiveness of the policies of the Plan in achieving the Plan's vision and objectives;
- help identify improvements that would address problems encountered in implementing the Plan.

In addition to satisfying the needs of local watershed plans or specific projects, monitoring at the other scales (i.e. at the site, site vicinity, and watershed scales) may provide valuable information that will contribute to the overall monitoring of the ORMCP.

Figure 2 Hierarchy of monitoring related to the water provisions of the ORMCP



When preparing Stormwater Management Plans, it is suggested that proponents of major development, which may include municipalities or land developers, include in their plans an outline of proposed monitoring to be undertaken during and after development.

Although it is not specified as a requirement in the ORMCP, monitoring of the site during the construction phase, as well as ongoing monitoring after construction, is suggested to assess whether the major development is consistent with the Stormwater Management Plan. Monitoring of the site and site vicinity may be used to evaluate the effectiveness of the stormwater management practices and assess whether the objectives are being met:

- to maintain groundwater quantity and flow and stream baseflow;
- to protect water quality;
- to protect aquatic species and their habitat;
- to prevent increases in stream channel erosion; and
- to prevent any increase in flood risk.

It is suggested that the Stormwater Management Plan also specify who will take responsibility for the monitoring after development. The proponent of major development may be required to conduct monitoring as a condition of site plan approval. Where the approval authority is responsible for approving the major

development, monitoring by the approval authority would be at the discretion of the approval authority.

6 Next Steps

Stormwater management practices should be evaluated for their effectiveness on the Oak Ridges Moraine. In accordance with the Watershed Plan, the effectiveness of stormwater management practices should be monitored, and where needed, changes made to ensure that objectives are being met.

Public education programs within municipalities can help to educate the public on the role they can play in the application of complementary measures. A significant challenge in designing and implementing a stormwater management strategy that incorporates lot-level techniques and other source controls, is that many of these initiatives will be implemented on lands held in private ownership. Consequently, maintenance and the long-term effectiveness of the system are contingent on the actions of the landowner. Landowner education is key to ensuring that systems remain effective over time. The successful application of lot-level landscape solutions therefore requires the commitment of the municipality and the establishment of creative partnerships between the developer, municipality and landowners to realize consistent ecological, economic and social benefits over the long term.

7 References and Resources

Erosion and Sediment Control Plans

Ontario Ministry of the Environment. 1995.
Guideline B-6 Guidelines for Evaluating Construction Activities Impacting on Water Resources.
www.ene.gov.on.ca/envision/gp/B6.pdf

Stormwater Management Plans

Ontario Ministry of the Environment. March 2003.
Stormwater Management Planning and Design Manual.
www.ene.gov.on.ca/envision/gp/4329eindex.htm

General References

Ontario Ministry of the Environment. 2003.
Understanding Stormwater Management: An Introduction to Stormwater Management Planning and Design.
www.ene.gov.on.ca/en/water

Ontario Ministry of the Environment, Environment Canada, Toronto and Region Conservation Authority et al., 2001.
Stormwater Pollution Prevention Handbook.
www.ene.gov.on.ca/envision/water/stormwaterpph.htm

Stormwater Assessment and Monitoring Program (SWAMP)
www.civil.ryerson.ca/stormwater

Center for Watershed Protection (US). www.cwp.org

Stormwater Manager's Resource Center (US). www.stormwatercenter.net

Ontario Ministry of Agriculture, Food and Rural Affairs. 1993.
Ontario Environmental Farm Plan.
www.omafra.gov.on.ca/english/environment/efp/efp.htm