Stormwater Criteria – MOE Guidelines

CVA/TRCA Stormwater Management Criteria Workshop
April 26, 2012

John Antoszek, P. Eng., Ministry of the Environment

Purpose

To present an overview of the current MOE Stormwater Management Guidelines.

Focus of Presentation:

- Chapter 2 and references/supporting documents
  - Emphasizes that criteria derived from watershed studies are preferable
- Chapter 3 and references/supporting documents
  - Guidance for development in the absence watershed studies (i.e. Table 3.2).
- Both chapters discuss the importance of preserving the pre-development hydrologic regime, and that lot level and conveyance controls (aka low impact development) are currently the best means of achieving water balance objectives
- Briefly discuss maintenance


Stormwater Management Planning and Design Manual
March 2003
Ontario
Ministry of the Environment

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Chapter 2
Environmental Planning

A process designed to assist agencies and practitioners in working together to balance social, environmental and economic needs, using an ecosystem approach.

Provides overview of the scale and degree of detail for:

- Watershed studies
- Subwatershed studies
- Environmental management plans; and,
- Environmental/stormwater management reports

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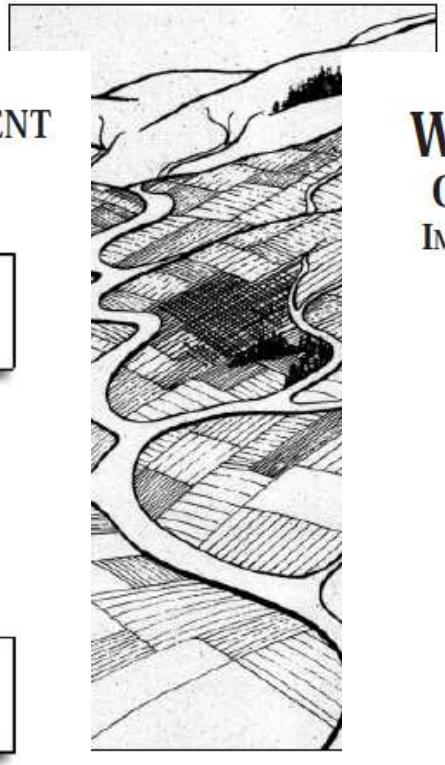
Subwatershed Planning

June 1993



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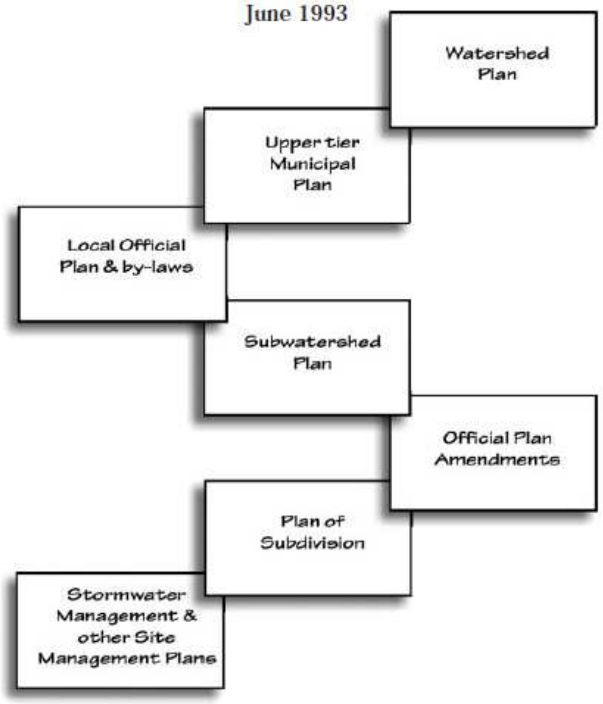
Integrating Water Management Objectives into Municipal Planning Documents

June 1993



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Watershed Management on a Watershed Basis:

Implementing an Ecosystem Approach

June 1993

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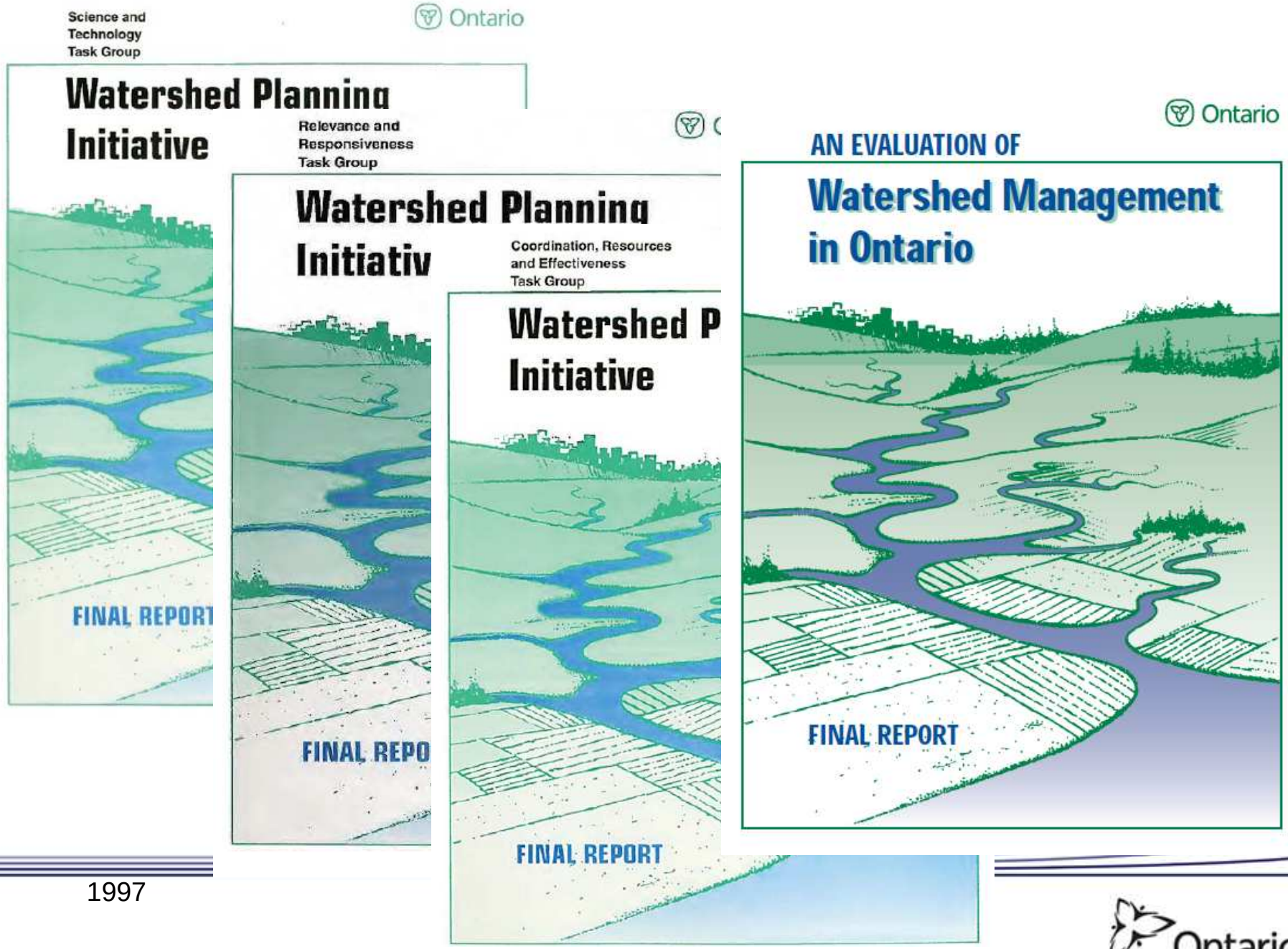

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Watershed Plan Considerations

An integrated plan will guide local/regional governments in planning future land use, infrastructure, resource development; at the same time protecting and enhancing the environment. To include measures that will integrate:

Aquatics: the ecology and biology of aquatic systems and communities;

Water Quality: the physical, biological and chemical characteristics of surface waters;

Hydrology: the surface water flows in a watershed and influences on flows;

Stream Morphology: erosion, transfer and deposition of sediment;

Groundwater: the sub-surface water, its occurrence, movement, chemistry, factors that influence it including interactions with surface flow systems;

Terrestrial: the ecology and biology of terrestrial systems and communities, and connections to other systems outside the watershed;

Social: social values & structures, local knowledge, demographics, cultural heritage, resource use, etc;

Economics: the economic impacts of activities or plans on values;

Comprehensive Management Strategy

Consists of multiple elements that influence watershed conditions - stormwater management does not make up the entire strategy. Components include:

- Preserve terrestrial features for habitat conditions, vegetation and to protect hydrologic processes.
- Preserve surficial topography and geologic properties to maintain surface water and groundwater flow conditions.
- Preserve stream corridors for aquatic, hydrologic processes and water quality.
- Preserve and restore selected headwater systems - important to the stream corridor functions (hydrologic, geomorphology, aquatic, and terrestrial).
- Identify rehabilitation and stewardship opportunities - resiliency of the stream system.
- Protect flow conditions (base flow, bankfull flow, flood flows) and water quality.
- Minimize the threat to life, property and natural resources from flooding and erosion

Chapter 3
Environmental Design Criteria

"Urban development without watershed/ subwatershed planning is discouraged…"

"…there will be cases where a development will be allowed to proceed without a subwatershed plan." In general it will occur when:

- Proposed development is small
- The overall level of watershed development (imperviousness) is limited
- The receiving stream is not overly sensitive in terms of aquatics, geomorphology, or flooding
- The receiving stream has good water quality

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Specific stormwater management criteria

Water Balance

Water Quantity

Erosion Control/Geomorphology

Water Quality

"Although most of the discussion is focussed on end-of-pipe facilities, lot level and conveyance controls should be utilized to the extent possible…."

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INTERIM STORMWATER QUALITY CONTROL GUIDELINES FOR NEW DEVELOPMENT

May 1991

VOLUME CONTROLS

Source controls which reduce the amount of impervious area or restrict the discharge of stormwater to sewers should be used first to achieve specified volume controls. Vegetative and structural best management practices which enhance infiltration are gaining agency and public acceptance. Stormwater quality ponds should be considered as the last line of defence and applied only after all opportunities for infiltration of stormwater have been exhausted.

Water Balance

Maintain groundwater infiltration to prevent reduction in baseflow and recharge and avoid:

- Impairment of aquatic and terrestrial habitats
- Shortage of water for agricultural, domestic or other uses

Water Balance Approach:

- Evaluate pre and post development infiltration
- Determine amount of water to infiltrate to compensate for post development impervious areas or changes to vegetation

Water Quantity

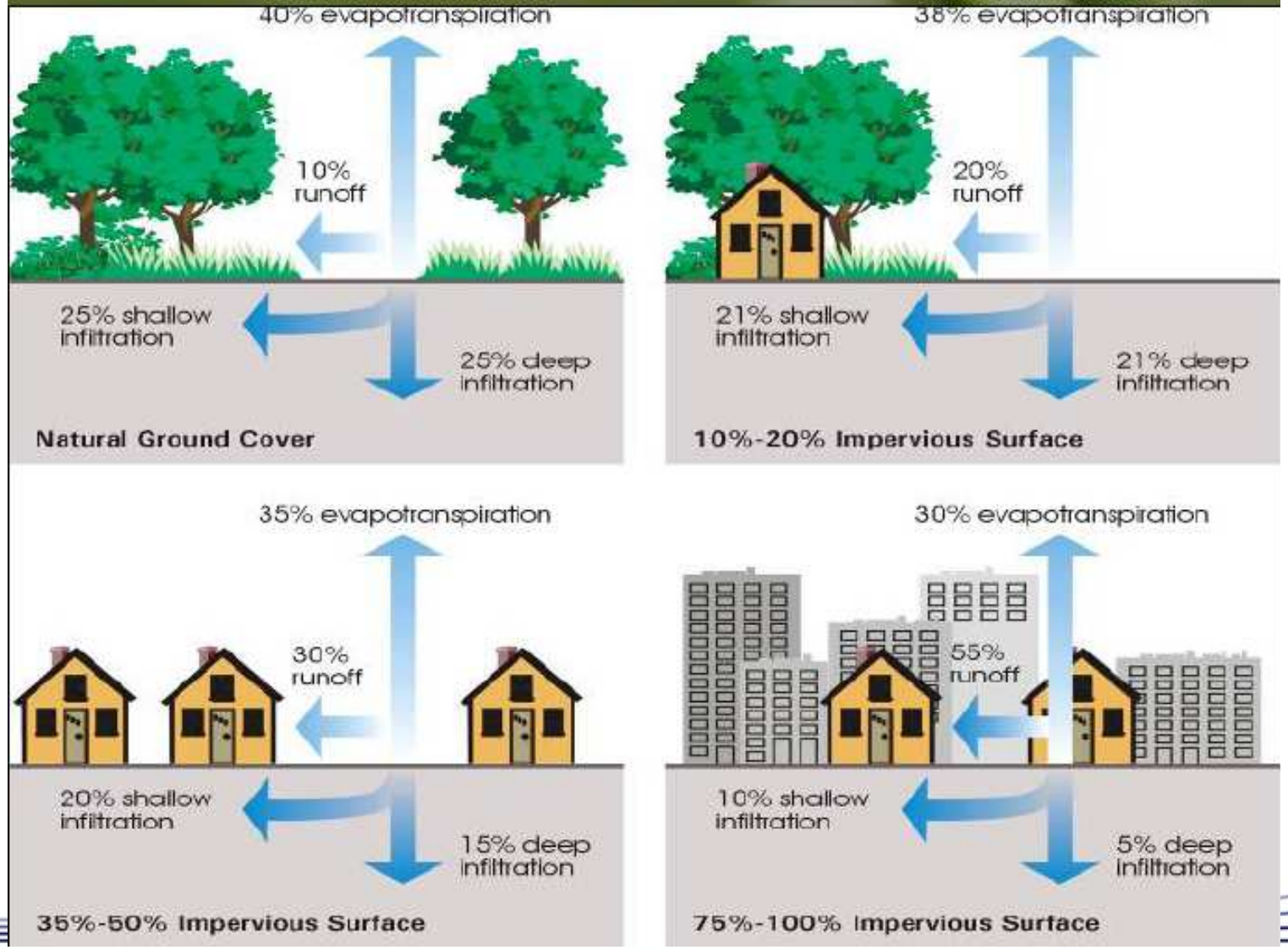
Post development, we often contend with greater volume of runoff, rapid conveyance to the stream, and increased peak flows

Typically, peak flow rates controlled to pre-development values for storms with return periods ranging from 2 to 100 years.

Occasionally, over control (rates less than pre-development) may be required:

- Flows result in destabilized streambanks
- Coincidence of peaks result in flooding

Urbanization and Runoff



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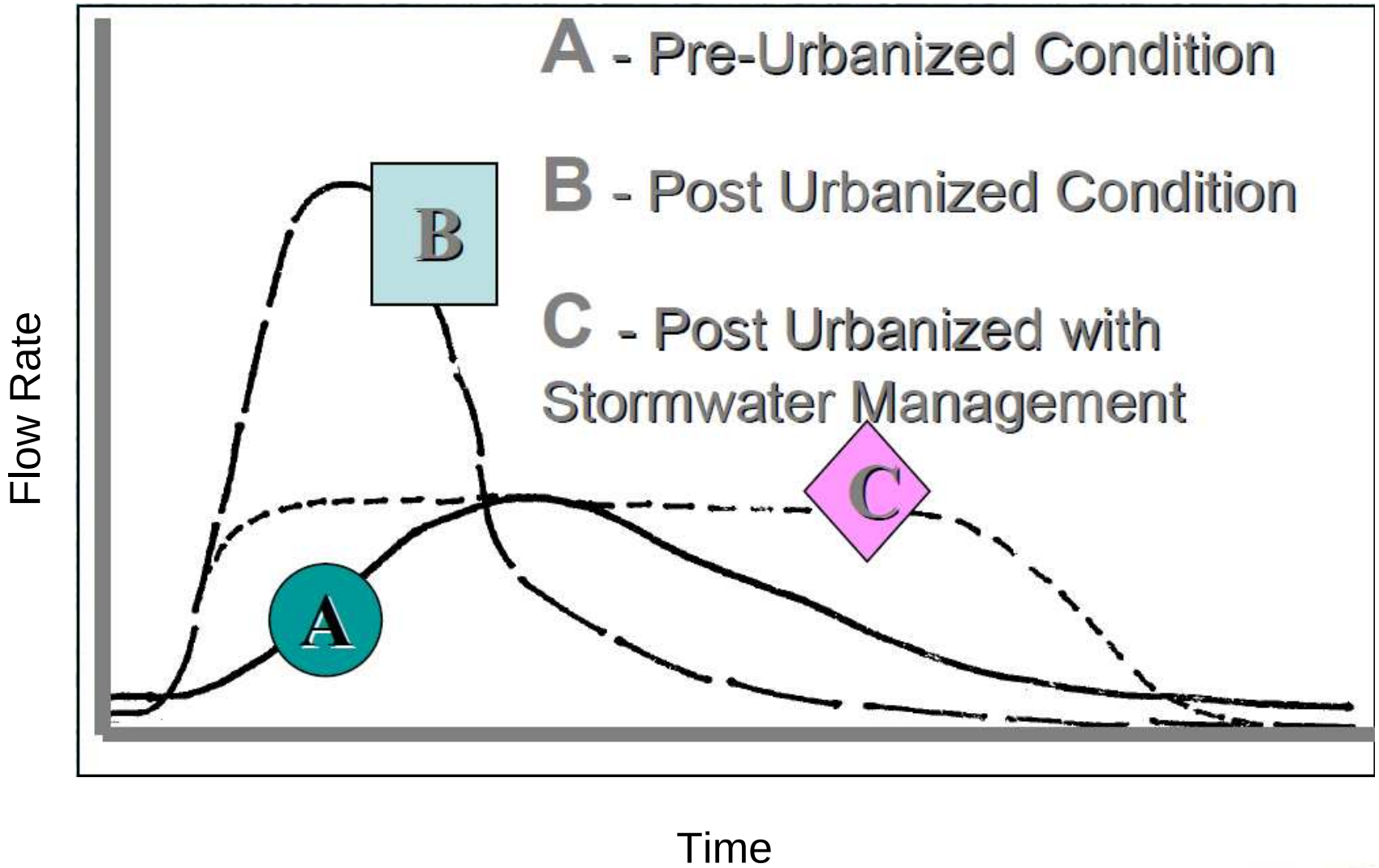
A - Pre-Urbanized Condition
B - Post Urbanized Condition
C - Post Urbanized with Stormwater Management
B
C
A
Flow Rate
Time

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Erosion Control/Geomorphology

"…approaches for the design of end-of-pipe SWM facilities for the control of in-stream erosion potential."

"…preservation or enhancement of a "stable", sustainable fluvial system and its associated habitat, aesthetic value and education-recreation potential while accommodating development needs."

- Appendix B: Proposed Protocol for Detailed Design Approach
- Appendix C: Simplified Design Approach
- Appendix D: Distributed Runoff Control (DRC) Approach

Combination of targets for

- Volume control
- Rate control

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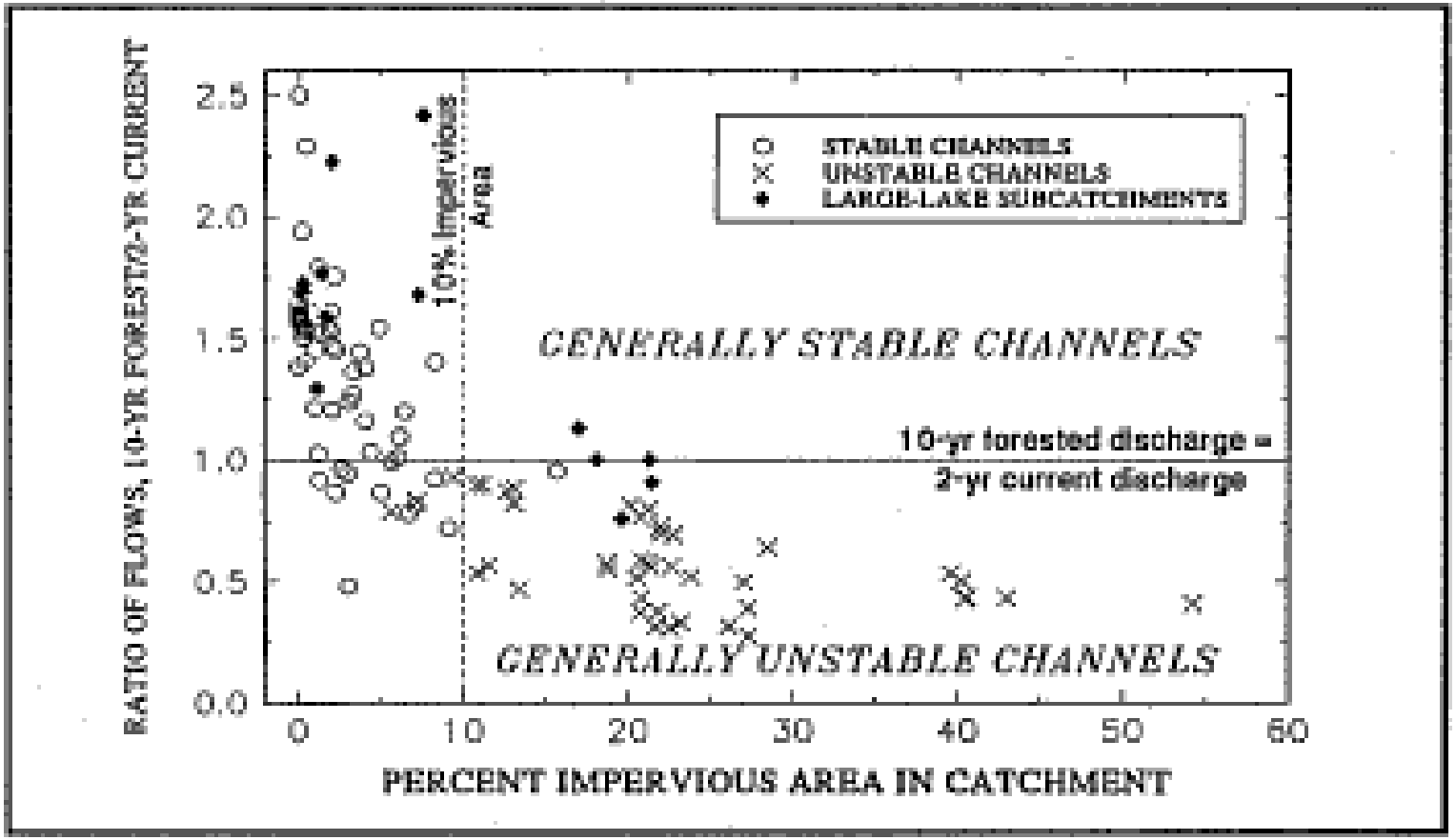

Typo on page 3-14 - reference to “figure 1.1” should be “figure 1.3”

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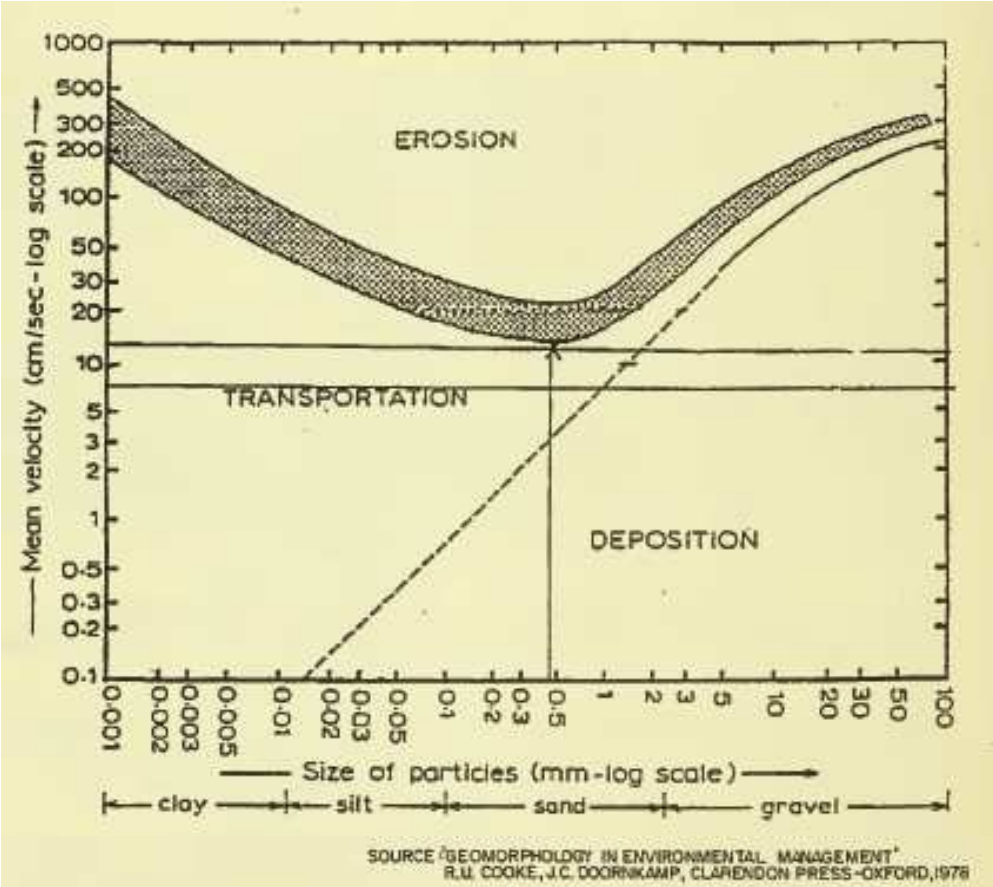

Figure 4.6 Erosion Potential Based on Soil Particle Sizes

Figure referred to on page H-9 (SWMP Sample Calculations) is figure 4.6 in 1994 Manual

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Water Quality

"…the levels of protection should be chosen to maintain or enhance the existing aquatic habitat."

"…the level of protection should be based on site-specific conditions determined through quantification of pre-development suspended solid loadings to receiving waters and the sediment characteristics of the receiving waters."

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1994 Manual: Levels of Protection (4)

Water quality criteria for various Levels of Protection were first described in 1994 manual with the caveat:

> "These water quality criteria are not intended to supersede those in the Blue Book (Water Management, Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment)"

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Table 3.2 Water Quality Storage Requirements based on Receiving Waters[1, 2]

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal 70% long-term S.S. removal	Infiltration	20	20	25	30
	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic 60% long-term S.S. removal	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

[1]*Table 3.2 does not include every available SWMP type. Any SWMP type that can be demonstrated to the approval agencies to meet the required long-term suspended solids removal for the selected protection levels under the conditions of the site is acceptable for water quality objectives. The sizing for these SWMP types is to be determined based on performance results that have been peer-reviewed. The designer and those who review the design should be fully aware of the assumptions and sampling methodologies used in formulating performance predictions and their implications for the design.*

[2]*Hybrid Wet Pond/Wetland systems have 50-60% of their permanent pool volume in deeper portions of the facility (e.g., forebay, wet pond).*

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Footnote to Table 3.2

[1]*Table 3.2 does not include every available SWMP type. Any SWMP type that can be demonstrated to the approval agencies to meet the required long-term suspended solids removal for the selected protection levels under the conditions of the site is acceptable for water quality objectives. The sizing for these SWMP types is to be determined based on performance results that have been peer-reviewed. The designer and those who review the design should be fully aware of the assumptions and sampling methodologies used in formulating performance predictions and their implications for the design.*

Chapter 4
Stormwater Management Plan and SWMP Design

Treatment train approach

Premised on providing control at the lot level and in conveyance followed by end-of-pipe controls. Required to meet the multiple objectives of water balance, water quality, and erosion and flood control in an overall stormwater management strategy.

- Lot level and conveyance controls can reduce end-of-pipe storage requirements for erosion control and are the best means of achieving water balance objectives.
- Water quality improvement and quantity control for small storms are secondary benefits.
- End-of-pipe controls are required to meet water quality, and erosion and flood control objectives in most circumstances.

Multi-component approach

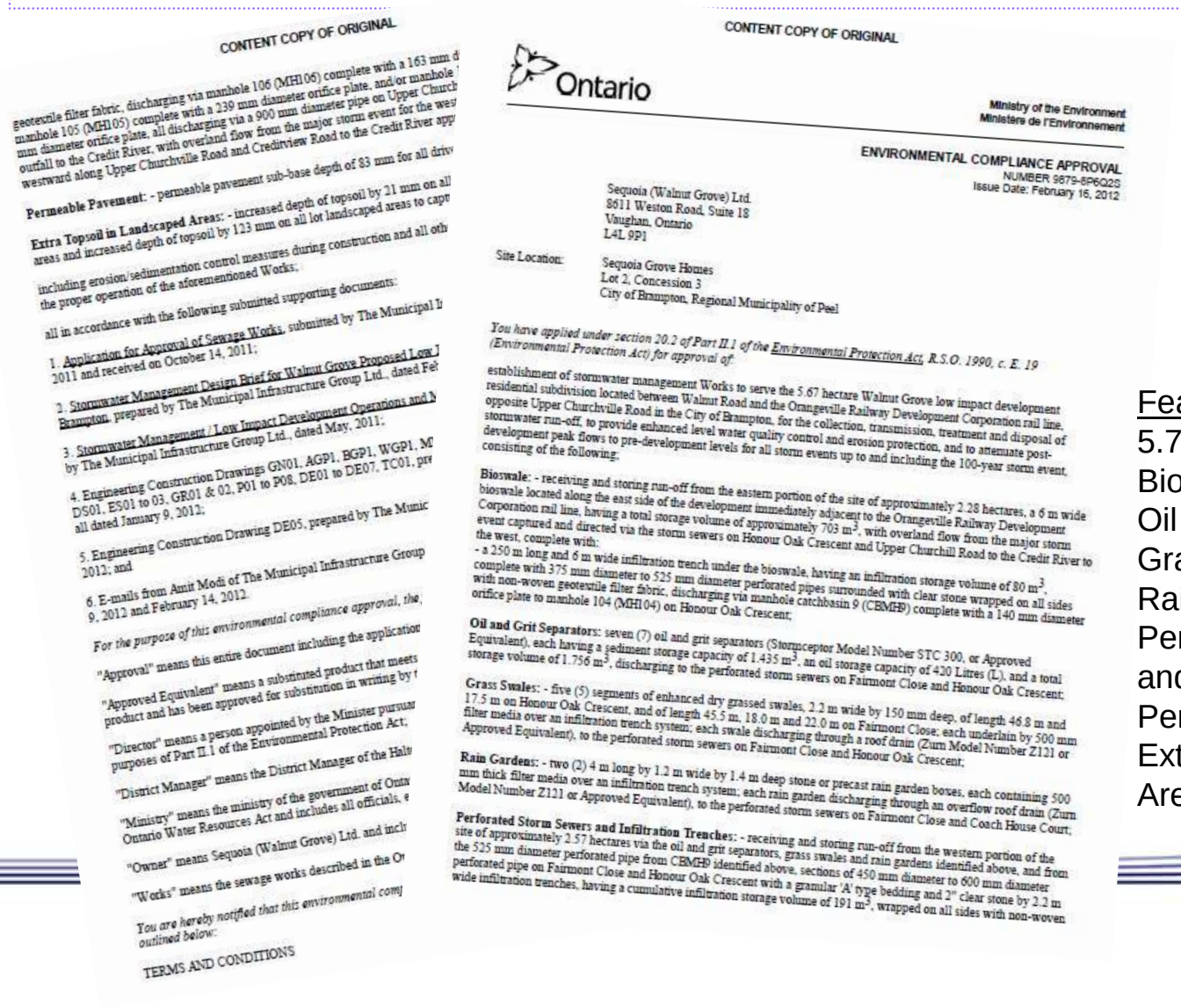
In the multi-component approach, a series of, for example, stormwater quality practices are used to meet water quality objectives.

Table 4.1: Physical Constraints for SWMP Types

SWMP	Topography	Soils	Bedrock	Groundwater	Area
wet pond	none	none	none	none	> 5 ha
dry pond	none	none	none	none	> 5 ha
wetland	none	none	none	none	> 5 ha
infiltration basin	none	loam (min. inf. rate ≥ 60 mm/h)	> 1 m below bottom	> 1 m below bottom	< 5 ha
infiltration trench	none	loam (min. inf. rate ≥ 15 mm/h)	> 1 m below bottom	> 1 m below bottom	< 2 ha
reduced lot grading	< 5%	loam (min. inf. rate ≥ 15 mm/h)	none	none	none
soakaway pit	none	loam (min. inf. rate ≥ 15 mm/h)	> 1 m below bottom	> 1 m below bottom	< 0.5 ha
rear yard ponding	< 2%	loam (min. inf. rate ≥ 15 mm/h)	> 1 m below bottom	> 1 m below bottom	< 0.5 ha
grassed swales	< 5%	none	none	none	< 2 ha
pervious pipes	none	loam (min. inf. rate ≥ 15 mm/h)	> 1 m below bottom	> 1 m below bottom	none
vegetated filter strips	< 10%	none	none	> 0.5 m below bottom	< 2 ha
sand filters	none	none	none	> 0.5 m below bottom	< 5 ha
oil/grit separators	none	none	none	none	< 2 ha

Ontario

Example Environmental Compliance Approval



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geotextile filter fabric, discharging via manhole 106 (MH106) complete with a 163 mm d
manhole 105 (MH105) complete with a 239 mm diameter orifice plate, and/or manhole
mm diameter orifice plate, all discharging via a 900 mm diameter pipe on Upper Church
outfall to the Credit River, with overland flow from the major storm event for the west
westward along Upper Churchville Road and Credirview Road to the Credit River appr

Permeable Pavement: - permeable pavement sub-base depth of 83 mm for all drive

Extra Topsoil in Landscaped Areas: - increased depth of topsoil by 21 mm on all
areas and increased depth of topsoil by 123 mm on all lot landscaped areas to capt

including erosion/sedimentation control measures during construction and all oth
the proper operation of the aforementioned Works;

all in accordance with the following submitted supporting documents:

1. Application for Approval of Sewage Works, submitted by The Municipal I
2011 and received on October 14, 2011;

2. Stormwater Management Design Brief for Walnut Grove Proposed Low I
Brampton, prepared by The Municipal Infrastructure Group Ltd., dated Feb

3. Stormwater Management / Low Impact Development Operations and M
by The Municipal Infrastructure Group Ltd., dated May, 2011;

4. Engineering Construction Drawings GN01, AGP1, BGP1, WGP1, M
DS01, ES01 to 03, GR01 & 02, P01 to P08, DE01 to DE07, TC01, pre
all dated January 9, 2012;

5. Engineering Construction Drawing DE05, prepared by The Munic
2012; and

6. E-mails from Amit Modi of The Municipal Infrastructure Group
9, 2012 and February 14, 2012.

For the purpose of this environmental compliance approval, the

"Approval" means this entire document including the application

"Approved Equivalent" means a substituted product that meets
product and has been approved for substitution in writing by

"Director" means a person appointed by the Minister pursuan
purposes of Part II.1 of the Environmental Protection Act;

"District Manager" means the District Manager of the Halt

"Ministry" means the ministry of the government of Onta
Ontario Water Resources Act and includes all officials, e

"Owner" means Sequoia (Walnut Grove) Ltd. and incl

"Works" means the sewage works described in the O

You are hereby notified that this environmental com
outlined below:

TERMS AND CONDITIONS

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Ontario

Ministry of the Environment
Ministère de l'Environnement

ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER 9879-8P6Q2S
Issue Date: February 16, 2012

Sequoia (Walnut Grove) Ltd.
8611 Weston Road, Suite 18
Vaughan, Ontario
L4L 9P1

Site Location: Sequoia Grove Homes
Lot 2, Concession 3
City of Brampton, Regional Municipality of Peel

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

establishment of stormwater management Works to serve the 5.67 hectare Walnut Grove low impact development residential subdivision located between Walnut Road and the Orangeville Railway Development Corporation rail line, opposite Upper Churchville Road in the City of Brampton, for the collection, transmission, treatment and disposal of stormwater run-off, to provide enhanced level water quality control and erosion protection, and to attenuate post-development peak flows to pre-development levels for all storm events up to and including the 100-year storm event, consisting of the following:

Bioswale: - receiving and storing run-off from the eastern portion of the site of approximately 2.28 hectares, a 6 m wide bioswale located along the east side of the development immediately adjacent to the Orangeville Railway Development Corporation rail line, having a total storage volume of approximately 703 m^3, with overland flow from the major storm event captured and directed via the storm sewers on Honour Oak Crescent and Upper Churchill Road to the Credit River to the west, complete with:
- a 250 m long and 6 m wide infiltration trench under the bioswale, having an infiltration storage volume of 80 m^3, complete with 375 mm diameter to 525 mm diameter perforated pipes surrounded with clear stone wrapped on all sides with non-woven geotextile filter fabric, discharging via manhole catchbasin 9 (CBMH9) complete with a 140 mm diameter orifice plate to manhole 104 (MH104) on Honour Oak Crescent;

Oil and Grit Separators: seven (7) oil and grit separators (Stormceptor Model Number STC 300, or Approved Equivalent), each having a sediment storage capacity of 1.435 m^3, an oil storage capacity of 420 Litres (L), and a total storage volume of 1.756 m^3, discharging to the perforated storm sewers on Fairmont Close and Honour Oak Crescent;

Grass Swales: - five (5) segments of enhanced dry grassed swales, 2.2 m wide by 150 mm deep, of length 46.8 m and 17.5 m on Honour Oak Crescent, and of length 45.5 m, 18.0 m and 22.0 m on Fairmont Close; each underlain by 500 mm filter media over an infiltration trench system; each swale discharging through a roof drain (Zurn Model Number Z121 or Approved Equivalent), to the perforated storm sewers on Fairmont Close and Honour Oak Crescent;

Rain Gardens: - two (2) 4 m long by 1.2 m wide by 1.4 m deep stone or precast rain garden boxes, each containing 500 mm thick filter media over an infiltration trench system; each rain garden discharging through an overflow roof drain (Zurn Model Number Z121 or Approved Equivalent), to the perforated storm sewers on Fairmont Close and Coach House Court;

Perforated Storm Sewers and Infiltration Trenches: - receiving and storing run-off from the western portion of the site of approximately 2.57 hectares via the oil and grit separators, grass swales and rain gardens identified above, and from the 525 mm diameter perforated pipe from CBMH9 identified above, sections of 450 mm diameter to 600 mm diameter perforated pipe on Fairmont Close and Honour Oak Crescent with a granular 'A' type bedding and 2" clear stone by 2.2 m wide infiltration trenches, having a cumulative infiltration storage volume of 191 m^3, wrapped on all sides with non-woven

Features:
5.7 ha
Bioswale
Oil and Grit Separators
Grass Swales
Rain Gardens
Perforated Storm Sewers and Infiltration Trenches
Permeable Pavement
Extra Topsoil in Landscaped Areas

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Example Environmental Compliance Approval

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Ministry of the Environment
Ministère de l'Environnement

ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER 5860-8NLQ4L
Issue Date: January 31, 2012

Mactichan Inc.
28301 Centre Road
Strathroy, Ontario
N7G 3C5

Site Location: MacDonald Subdivision
Lot 22, Concession 3, Block 1, Plan 33R-13135
Township of Strathroy-Caradoc, County of Middlesex

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

sanitary and storm sewers and the establishment of stormwater management Works to serve the MacDonald Subdivision, in the Township of Strathroy-Caradoc, for the treatment and disposal of stormwater runoff from a total catchment area of 3.9 ha, to provide Enhanced Level water quality protection for all storm events up to and including the 2-year return storm and to attenuate post-development peak flows to allowable levels, discharging via existing storm sewers to the Cuddy Drain and ultimately to the East Sydenham River, for all storm events up to and including the 5-year return storm, consisting of the following:

Sanitary Sewers
sanitary sewers to be constructed on MacDonald Street and Darcy Drive (Extension);

Storm Sewers
storm sewers to be constructed on MacDonald Street, Darcy Drive (Extension), Easement (along the northern boundary of Lot 1), Easement (between Lots 7 and 8), Easement (between Lots 17 and 18), Easement (between Lots 38 and 39) and Easement (between Lots 42 and 43);

Stormwater Management Works

- a 72 m long, 2.35 m wide and 1.3 m deep exfiltration system (Etobicoke Exfiltration System) located along Darcy Drive (Extension), from approx. 90 m north of the intersection of Darcy Drive (Extension) and Darcy Drive (South) to Darcy Drive (South), designed to accommodate up to and including the 2-year return storm runoff from a catchment area of 1.94 ha, having an active storage volume of 73 m^3, consisting of two (2)-200 mm diameter perforated exfiltration pipes, each wrapped with an external geotextile sleeve and plugged at the downstream end, located beneath and on opposite sides of a 450 mm diameter overflow storm sewer, all pipes installed within a 1.3 m deep trench of 19 mm diameter clear stone wrapped with geotextile filter cloth, discharging via a 300 mm diameter storm sewer located along Darcy Drive (Extension) to an existing 300 mm diameter storm sewer located along Darcy Drive (South);
- a 50 m long, 2.35 m wide and 1.3 m deep exfiltration system (Etobicoke Exfiltration System) located along MacDonald Street, from approx. 50 m west of the intersection of MacDonald Street and Darcy Drive (Extension) to Darcy Drive (Extension), designed to accommodate up to and including the 2-year return storm runoff from a combined catchment area of 1.85 ha (including the catchment area served by the exfiltration system (Etobicoke Exfiltration System) described below), having an active storage volume of 55 m^3, consisting of two (2)-200 mm diameter perforated exfiltration pipes, each wrapped with an external geotextile sleeve and plugged at the downstream end, located beneath and on opposite sides of a 450 mm diameter overflow storm sewer, all pipes installed within a 1.3 m deep trench of 19 mm diameter clear stone wrapped with geotextile filter cloth, discharging to an exfiltration system (described below);
- a 42 m long, 2.5 m wide and 1.45 m deep exfiltration system (Etobicoke Exfiltration System) located along Darcy Drive (Extension), from approx. 43 m north of the intersection of Darcy Drive (Extension) and MacDonald Street to

Features:
3.9 ha
Exfiltration System

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Maintenance

Maintenance is a necessary and important aspect of urban SWMPs design.

One of the main reasons for SWMP failures and/or poor performance is lack of maintenance.

Designers should give thought to future, long-term maintenance during the design of SWMPs.

LSRCA Pond Study Results

- Of the 114 SWP 90 (79%) were Level 1,
- In 2010, only 39 SWP (40%) remain at Level 1,
- A total of 51 SWP now at lower design Level
  - 26 dropped 1 level
  - 11 dropped 2 levels
  - 2 dropped 3 levels
  - 12 no longer provide any quality benefit

D. Lembcke, B. Ginn, S. Lynn, R. Bolton
http://www.lsrca.on.ca/pdf/reports/stormwater_maintenance.pdf

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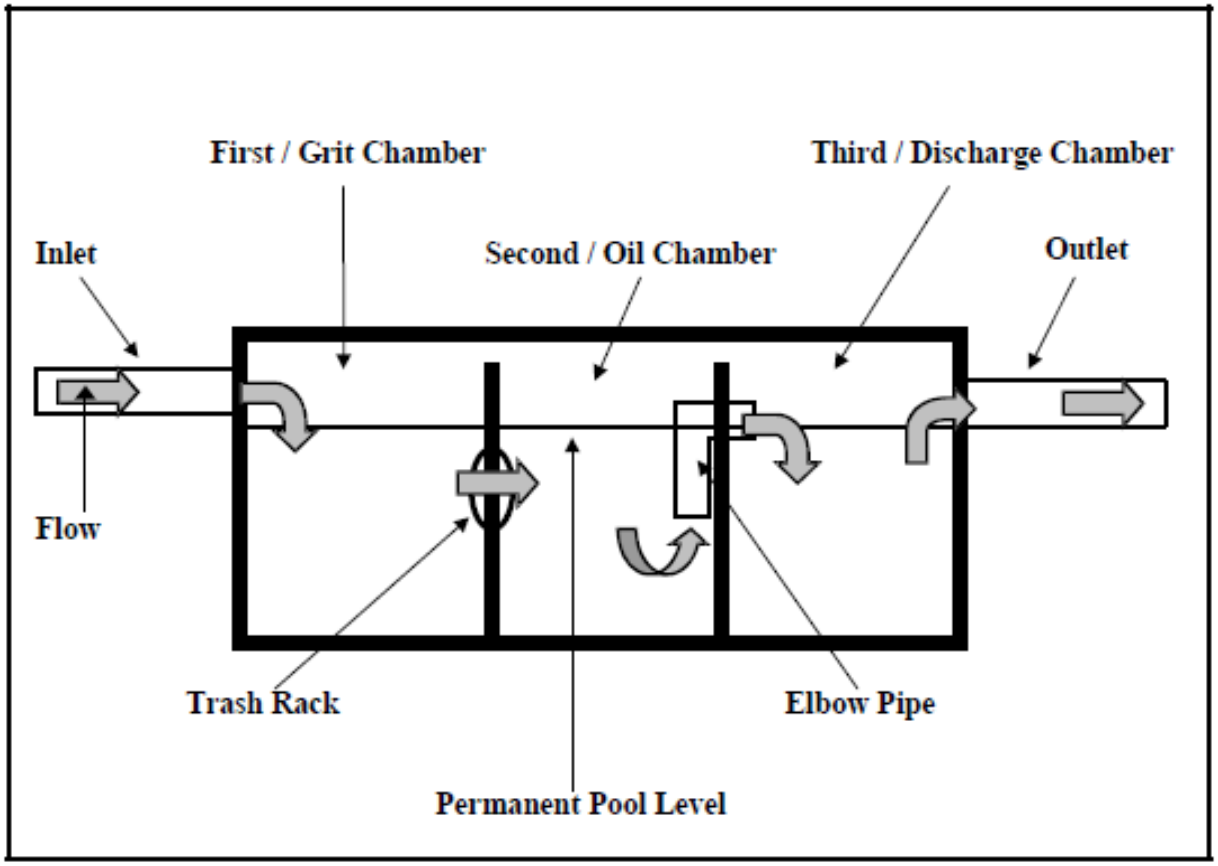

Figure 1 : Design of a three-chamber OGS

PERFORMANCE ASSESSMENT OF TWO TYPES OF OIL & GRIT SEPARATOR FOR STORMWATER MANAGEMENT IN PARKING LOT APPLICATIONS

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Summary

- Criteria derived from watershed studies are preferable
- Urban development without watershed/ subwatershed planning is discouraged because cumulative effects may not be identified and addressed
- Lot level and conveyance controls (low impact development) should be utilized to the extent possible
- More effort on water balance and erosion control is needed
- Maintenance is required for all stormwater management facilities