STORMWATER MANAGEMENT POLICY MANUAL MUNICIPALITY OF MIDDLESEX CENTRE

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Please keep this Record of Revisions at the front page of the binder at all times. Number all future revisions consecutively. Place superseded pages in REVISIONS (SUPERCEDED PAGES) that follows Appendices.

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1.0 Introduction

1.1 PURPOSE OF THIS DOCUMENT

Stormwater collection and treatment is a service that is provided by a municipal government in urbanized and certain other areas within its jurisdiction. The purpose of this policy manual is to provide guidance for Middlesex Centre staff, Proponents of development, and other parties with regard to the design and operation of stormwater management (SWM) facilities throughout their lifecycle. The lifecycle of a SWM facility generally consists of the following stages:

1. Planning and Approvals;
2. Construction;
3. Pre-Municipal Assumption Operation;
4. Municipal Assumption;
5. Operation;
6. Facility Renewal; and
7. Facility Replacement.

SWM facilities are intended to be in operation for an extended period of time (greater than 25 years) prior to major renewal or replacement being required. They provide certain levels of mitigation of impacts to the environment due to urbanization of drainage areas from their previous natural or agricultural state. In all likelihood, the Municipality will be operating the facility in excess of 90% of its lifespan. Therefore, the Municipality has an interest with regard to SWM to:

1. Ensure that a Proponent who wishes to urbanize an area provides an acceptable level of protection to the public with regard to stormwater run off based on current accepted practices and the requirements of agencies having jurisdiction;
2. Ensure that a Proponent who wishes to urbanize an area provides an acceptable level of protection to the environment with regard to stormwater run off based on current accepted practices and the requirements of agencies having jurisdiction;
3. Ensure that the risk to the Municipality in operating these facilities is reasonable;
4. Ensure that the cost to the Municipality in operating these facilities is reasonable and is borne by the Proponent and/or the benefiting users;
5. Ensure that these facilities are planned, constructed and operated in a manner consistent with the Municipality's Master Servicing Plan Principles; and

6. Ensure that there is a policy in place so that all parties (municipal council, municipal staff, Proponents, regulators, members of the public, etc.) understand the roles and responsibilities that the Municipality has in this regard as well as that of the Proponent.

1.2 BACKGROUND

In Ontario, SWM is required when a rural area is urbanized and its intent is to mitigate impacts on the environment. Therefore, three aspects of SWM need to be addressed in development and these are:

- Quantity Control, which is the name given to managing the amount of runoff generated by a drainage area and generally includes attempts to limit the maximum run off flow of the developed area to the rate of flow that occurred prior to development;
- Quality Control, which is the name given to managing the quality of the runoff generated from a drainage area and generally includes attempts to allow for an extended period of detention of storm water in order to encourage the settling out of pollutants within a facility for most frequent rainfall events; and
- Enhanced Protection, which is to provide for the protection of receiving streams from excessive erosion or to changes in stream morphology (structure of the channel).

Quantity impacts result from an increase of runoff as the urban development will have more impervious surface. This increase includes the total volume, flow rate and duration of run off from a rainfall event. This can cause serious erosion problems in creeks, rivers and outfalls into the water bodies. Quality impacts are the result of “non-point” sources of pollution, which can discharge from the result of human activity. Both rural and urban areas can contribute to non-point source pollution. Stormwater contaminants may include suspended solids, microbiological contamination, organic matter, petroleum hydrocarbons, salts, nutrients, and pesticides. Enhanced protection is typically mandated by agencies having jurisdiction over the receiving stream which in the case of Middlesex Centre is taken to be the Conservation Authority in whose area the SWM facility and outlet is located.

Introduction

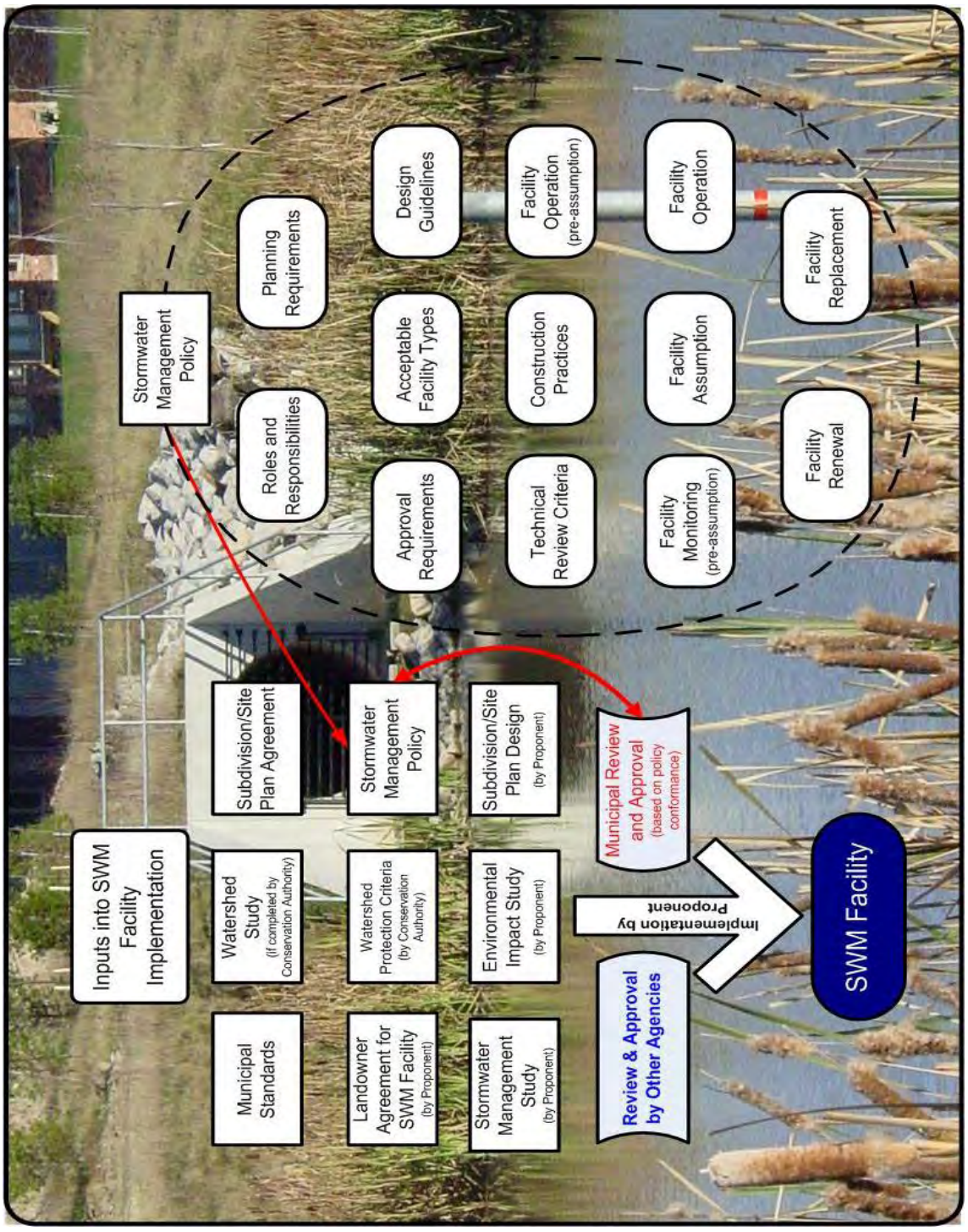

Figure 1.1 – Context of Stormwater Management Policy

1.3 INTENT OF STORMWATER MANAGEMENT IN MIDDLESEX CENTRE

When an area within the Municipality changes from rural to urban land use, stormwater management (SWM) techniques are to be used to mitigate any negative impacts due to changes in the quality and quantity of run off and excessive physical impacts on the receiving streams. This is to be accomplished through the application of current SWM practices within Ontario that rely on engineered, non-mechanical means of treatment. In addition, a net enhancement to the urban environment through the application of these standards must be achieved.

1.4 CONTEXT OF STORMWATER MANAGEMENT POLICY

The Municipality's SWM policy is one component in the process for a Proponent to have approval to build and operate a stormwater management facility. Figure 1.1 summarizes some but not necessarily all of the inputs that are required for implementation of a SWM facility.

1.5 REFERENCE TO STATUTES, REGULATIONS AND DESIGN STANDARDS

Notwithstanding any references made in this document to statutes, regulations, design standards or similar documents, it is solely the Proponent's responsibility to ensure that the most up to date and rigorous requirements are followed within this municipality, province and country as they pertain to stormwater management for their development.

2.0 Policy Background

2.1 SUMMARY OF ROLES AND RESPONSIBILITY

The implementation of SWM in Ontario involves the participation and co-ordination of numerous public agencies, each of whom have specific mandates towards which their comments, concerns and recommendations are aimed. Within Middlesex Centre, the following municipal and provincial agencies are involved in the review and approval of SWM in accordance with their respective mandates, as summarized below:

- Ministry of the Environment (MOE) is responsible for preparing provincial SWM design and implementation guidelines and issuance of Certificates of Approval for any collection and treatment of stormwater pursuant to Section 53 of the *Ontario Water Resources Act*;
- Ministry of Natural Resources (MNR) is charged with ensuring public safety in regards to flooding and erosion hazards, the plan review and approval responsibilities of which have been delegated to the local Conservation Authorities through Conservation Ontario;
- Conservation Authority is responsible for reviewing applications that involve development in or on Regulated Areas and permitting those that, in its opinion, incorporate measures to ensure that the control of flooding, erosion, dynamic beaches, pollution or the conservation of land will not be affected by the development within their watershed. In addition to its regulatory role, the Conservation Authority may also provide technical advice to the approval authorities (Municipality, MMAH) in regard to the aspects noted above and other technical aspects that may be of interest to its municipal partners;
- Upper-tier Municipality (Middlesex County) is responsible for approving subdivision, site plan and other *Planning Act* applications as the designated approval authorities under the Planning Act and must ensure that adequate SWM controls are in place to satisfy applicable Provincial and Municipal policies; and
- Lower-tier Municipality (Municipality of Middlesex Centre) is typically responsible for the safety, maintenance, and long-term monitoring and operation of SWM infrastructure, as they will take ownership of facilities on public land. In order to ensure that it can meet its obligations for ownership and operation, the lower tier municipality can require conditions in the subdivision and /or site plan agreement which require the Proponent to meet.

These mandates provide guidance for decision-making and the context within which each agency participates in the management of stormwater within the Municipality of Middlesex Centre.

2.2 PROVINCIAL STATUTES, REGULATIONS, STANDARDS AND GUIDELINES

Note that the current statutes and regulations and guidance documents should be reviewed periodically by all parties to confirm current provincial requirements. At present information on current statutes and regulations is published and explained on the Ontario Government's E-Laws website (www.e-laws.gov.on.ca). Generally guidance document information can be obtained on the websites of those ministries which are responsible for their preparation. For example documents created by the MOE can be found on its website (www.ene.gov.on.ca).

2.2.1 Ontario Water Resources Act (OWRA)

The purpose of the *Ontario Water Resources Act* (OWRA) is to provide for the conservation, protection and management of Ontario's waters and for their efficient and sustainable use, in order to promote Ontario's long-term environmental, social and economic well-being. This Act outlines the following headings pertaining to Ontario's waters:

- Administration;
- Waters & Water Bodies;
- Wells;
- Sewage Works;
- Water and Sewage Projects;
- Agency Agreements;
- Public Water or Sewage Service Area;
- Regulations;
- Work Done by Ministry;
- Records of Site Condition;
- Special Provisions Applicable to Municipalities, Secured Creditors, Receivers, Trustees in Bankruptcy, Fiduciaries and Property Investigators; and
- Other Miscellaneous Subjects.

The OWRA includes a general prohibition against the discharge of substances or materials into water that may "impair the quality of the water". It also states that "No person shall establish, alter, extend or replace new or existing sewage works except under and in accordance with an approval granted by a Director". Sewage projects undertaken under this Act are also subject to the requirements of the Ontario Environmental Assessment Act. Sewage works include works for the conveyance of stormwater and SWM facilities.

2.2.2 Sustainable Water and Sewage Systems Act, 2002

The intent of the *Sustainable Water and Sewage Systems Act, 2002* is to ensure that municipalities can finance municipal water and wastewater services. The Act is intended to ensure municipalities have full cost recovery in place for municipal water and wastewater services.

In compliance with this Act, there is a two step process which municipalities must undertake. Municipalities must first prepare a full cost report and the second is to prepare and implement a cost recovery plan. The report must contain the following:

- Inventory and management plan for infrastructure;
- Assessment of full costs of providing services, including operating, financing, renewal and replacement, and improvement costs; and
- Revenue obtained to provide services.

The report must be approved by the Minister of the Environment, and once completed; a Cost Recovery Plan must then be drafted and submitted to the Ministry. The regulations under this Act can also limit the maximum increase in rates that a municipality may charge for services.

This Act has been passed in the legislature, but has not been proclaimed in force as the applicable regulations have not yet been completed.

2.2.3 Environmental Protection Act

In Ontario, the principle legislation governing the environment is the province's *Environmental Protection Act* (EPA). The purpose of this document is to provide for the protection and conservation of the natural environment. A breach of the statute is considered to have occurred if an action or inaction by a person, persons or an organization has resulted in an 'Adverse Effect' on the environment. Water pollution can be defined as any use, discharge or incident involving water which causes an "adverse effect."

An "adverse effect" on the environment is defined in the act as one or more of the following:

- Impairment of the quality of the natural environment for any use that can be made of it;
- Injury or damage to property, plant or animal life;
- Harm or material discomfort of any person;
- An adverse effect on the health of any person;
- Impairment of the safety of any person;

- Rendering any property or plant or animal life unfit for human use;
- Loss of enjoyment of normal use of property; and
- Interference with the normal conduct of business.

2.2.4 Drainage Act

As most of the Municipality's area is rural and agricultural in nature, drainage issues are governed by the *Drainage Act*. SWM is intended as a municipal service provided to urbanized areas to provide certain levels of mitigation of impacts to the environment due to urbanization of drainage areas from their previous natural or agricultural state. The *Drainage Act* has no provisions in it to address SWM. Therefore, if areas are to have urban development (residential, commercial, institutional and industrial), the Municipality should, depending upon the scale of development, abandon the Municipal Drain (per *Drainage Act* definition) as allowed in Section 84 of the *Drainage Act*. The costs associated with this abandonment should be generally borne by the Proponent whose plan for the urban development initiates this requirement. Section 84 states:

> **Abandonment of all or part of drainage works**
>
> **84.** (1) Upon the written request of three-quarters of the owners of land assessed for benefit in respect of a drainage works, who, according to the last revised assessment roll, own not less than three-quarters of the area assessed for benefit as shown in the by-law or by-laws under which the drainage works exist, asking for the abandonment of such drainage works or a part thereof, the council of the initiating municipality shall forthwith notify all owners of land assessed for the drainage works by prepaid mail, at their addresses as shown in the last revised assessment roll, of its intention to abandon such drainage works, or such part thereof as is specified in the notice, unless any owner within ten days of the mailing of such notice, gives to the clerk of the municipality written notice that the owner requires a report of an engineer to be made on such proposed abandonment. R.S.O. 1990, c. D.17, s. 84 (1).
>
> **Idem**
>
> (2) The council of the initiating municipality may give notice as in subsection (1) of its intention to abandon a drainage works or such part thereof as is specified in the notice without any written request. R.S.O. 1990, c. D.17, s. 84 (2).
>
> **Engineer's report may be required**
>
> (3) If, within such period of ten days, any owner notifies the clerk, the council shall appoint an engineer to examine the drainage works and report recommendations as to the proposed abandonment, any necessary work in connection therewith, the sale of any assets, the cost of abandonment and all other appropriate matters and shall assess all costs, including the engineer's compensation, and damage allowances against persons liable to assessment in connection with the drainage works in such proportions as appear just. R.S.O. 1990, c. D.17, s. 84 (3).
>
> **Procedures on report**
>
> (4) All proceedings, including appeals, with respect to a report under subsection (1) shall be the same with necessary modifications as on a report for the construction of a drainage works. R.S.O. 1990, c. D.17, s. 84 (4).

Abandonment by council

(5) If no notice is mailed to the clerk in accordance with subsection (1) or if the engineer's report, as it may be altered on appeal, recommends the abandonment of the drainage works, the council may by by-law abandon the drainage works, and thereafter the municipality has no further obligation with respect to the drainage works. R.S.O. 1990, c. D.17, s. 84 (5).

Disbursement of remaining funds

(6) Any money remaining to the credit of the drainage works after it is abandoned shall be divided proportionately among the owners of lands and roads assessed therefore. R.S.O. 1990, c. D.17, s. 84 (6).

2.2.5 MOE 2003 SWM Manual

The basis for the SWM Planning and Facility Standards of Middlesex Centre is presently the MOE's *Stormwater Management Planning and Design Manual March 2003* (MOE 2003 SWM Manual). Should the MOE update this document, the latest version of this manual is to apply. The preface to this document describes its purpose as:

> "The "state-of-the-art" of stormwater management has been rapidly evolving and this manual is one step in this evolutionary process. The manual provides technical and procedural guidance for the planning, design, and review of stormwater management practices. It is important that the manual be viewed as a tool for understanding the performance requirements of stormwater management projects and not as a rulebook for all stormwater management solutions. The manual provides practical guidance which has been found effective in specific circumstances."

2.2.6 West Nile Virus

Recent issues such as the West Nile Virus and its potential presence in SWM facilities have been discussed in the MOE web publication *Best Practices for Reducing the Risk of West Nile Virus in Stormwater Management Ponds, March 2008*. This guidance document does not provide design based solutions which reconcile with the guidance provided in the MOE 2003 SWM Manual particularly with regard to permanent pond and safe slopes within the pond. Therefore, West Nile Virus control will need to be dealt with by active measures such as a larvicide program. It would be recommended that the SWM facility owner contact the Middlesex-London Health Unit to confirm appropriate measures required for control.

2.3 MIDDLESEX COUNTY

Since July 1, 1998, the Province of Ontario has designated County of Middlesex as the Approval Authority for Official Plans, Official Plan Amendments and Plans of Subdivision/ Condominium within the County. Applications for local municipal Official Plan Amendments are made at the local municipality and if adopted by local Council, the Official Plan Amendment is forwarded to the County for consideration. The County is a commenting agency for local Zoning

By-laws, Consents, Minor Variances, and Site Plans. Local municipalities are required by regulation under the *Planning Act* to circulate planning applications to the County for comment. The *County of Middlesex Official Plan, August 2006* has as a general policy in Section 2.4.5.1:

> "The County shall:
>
> j) Encourage local municipalities to implement suitable and economically viable methods of reducing urban storm water run off and improve its quality in the furtherance of the Resource Management policies of this Plan. "

2.4 MIDDLESEX CENTRE

The Municipality's current Official Plan is the *Official Plan of the Township of Middlesex Centre March 31, 2009*. The purpose of the Official Plan is to provide for the orderly growth and development of the Municipality, and provide guidance in the management of change. In particular, the Official Plan includes goals and policies relating to land use, agricultural and settlement areas, the classification of a natural areas system, economic, social and servicing matters. The Official Plan uses a 20 year planning horizon, from 1999 to 2019. With regard to the Official Plan, some but not necessarily all of the portions that are relevant to SWM are as follows:

- The majority of growth within the Township will be directed to Urban Settlement Areas as established in this Plan. Such areas will accommodate growth on full municipal servicing, with such growth being permitted where adequate servicing capacities are established. More limited growth will be permitted within Community Settlement Areas, subject to issues of servicing availability and other policies of this Plan (Section 1.8 (c));
- These areas (Urban Settlement Areas) either provide or have the potential to provide full municipal services. All new proposed development shall be fully serviced by municipal water and sewage disposal systems. Urban Settlement Areas are expected to have the highest concentration and intensity of land uses, and will be the focus for future growth by accommodating a significant portion of expected growth over the Official Plan's planning period (Section 5.1.1);
- The primary municipal services in the Township are water supply, sewage disposal and storm water management (Section 9.3.1 (a));
- It is the policy of this Plan that future development within settlement areas proceed on the basis of full municipal services, with partial services potentially being permitted on an interim basis where proper justification is provided (Section 9.3.1 (c));

- The Township will undertake the preparation of Community Storm Water Management Studies in settlement areas where deemed appropriate and necessary (Section 9.3.1 (d)); and
- In processing development applications, the Township and the applicants shall have regard to the principles of storm water management so that new development does not significantly increase downstream flows above existing levels or degrade water quality (Section 9.3.2 (f)); and
- (for SPA # 3 in Delaware) The lands must be graded to control storm water run-off quantity and quality in accordance with the grading plan approved by the Township. No lot may be developed without confirmation that the creation of the lots will not prejudice future storm water management efforts of the area and depending on the scale of development, the Township may request the preparation of a Storm Water Management Study to be completed to the satisfaction of the Upper Thames River Conservation Authority prior to development preceding (Section 11 SPA # 3 (g)).

2.5 CONSERVATION AUTHORITY

2.5.1 Introduction

Figure 2.1 shows the boundaries between the various Conservation Authorities who have jurisdiction in Middlesex Centre. Table 2.1 summarizes which Conservation Authority has jurisdiction in each of the Urban and Community Settlement Areas in the municipality.

Table 2.1 Conservation Authority Jurisdiction

Settlement Area	Conservation Authority
Ilderton	Upper Thames River Conservation Authority (UTRCA)/ St. Clair Region Conservation Authority (SCRCA)
Kilworth	UTRCA
Komoka	UTRCA
Arva	UTRCA
Delaware	UTRCA, Lower Thames River Conservation Authority (LTRCA)

Both Ilderton and Delaware have a conservation boundary within their settlement areas hence the reason that more than one conservation authority is listed in Table 2.1. The role of the UTRCA, SCRCA and the LTRCA in the implementation of SWM occurs at two general levels: regulatory and advisory. From a regulatory perspective, the permission of the UTRCA, SCRCA and the LTRCA are required prior to undertaking certain works within their jurisdictions in accordance with:

Policy Background

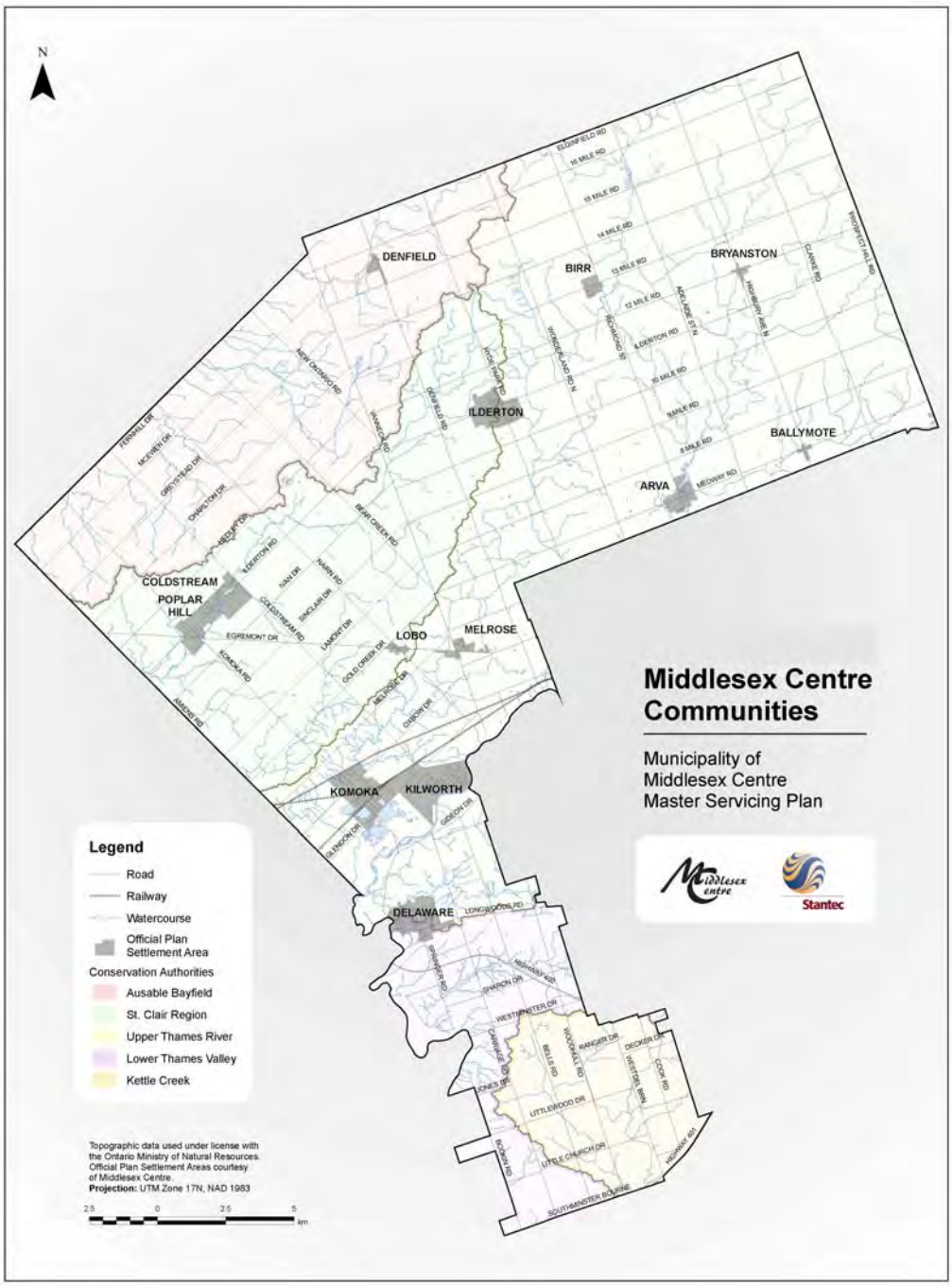

Figure 2.1 Conservation Authority Boundaries in Middlesex Centre

- *Ontario Regulation 157/06 Upper Thames River Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*;
- *Ontario Regulation 171/06 St. Clair Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*; and
- *Ontario Regulation 152/06 Lower Thames River Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*.

From an advisory perspective, the UTRCA, SCRCA and the LTRCA can provide technical comments in a review capacity to local municipalities and Provincial ministries as input to Planning Act applications and environmental assessments. Understanding the difference between these two roles, and the corresponding responsibilities both accepted by, and delegated to the UTRCA, SCRCA and the LTRCA is key to understanding their role in the review and approval process.

2.5.2 Regulatory Authority

Ontario Regulation 157/06 (O.Reg. 157/06) allows the UTRCA to prevent or restrict development in areas susceptible to flooding, erosion and other hazards, such as floodplain areas, steep slopes, wetlands and watercourses, in order to prevent the creation of new hazards or the aggravation of existing ones in their area of jurisdiction. Similarly for SCRCA and LTRCA, O.Reg. 171/06 and O.Reg. 152/06 applies respectively. Any development, a term defined to include SWM facilities and outlets, within or adjacent to such features is not permitted without the prior written permission of the Conservation Authority. Permission will only be granted if, in the opinion of the Conservation Authority, the control of flooding, erosion, dynamic beaches, pollution, or the conservation of land will not be affected by the development. In regards to SWM, a Permit is required for such activities as the construction, site grading, or any alterations associated with a SWM facility, storm sewer or outlet, including associated berming and grading if such activities occur within a Regulated Area.

2.5.3 Advisory Capacity

Conservation Authorities were created by the Province in order to enforce regulations made under the *Conservation Authorities Act* to prohibit filling in floodplains below the high water mark in 1946. Since inception, their role has evolved to include the provision of leadership and management, in cooperation with the community, in the maintenance and enhancement of watershed resources. In this regard, and through various formal (i.e. Memorandum of Understanding) and informal agreements, the Conservation Authorities can provide technical review comments to local municipalities in response to applications made under the Planning

Act, such as subdivisions, site plans, and severances. These comments are generally based on their review of technical documents, such as SWM Plans and Environmental Impact Studies (EIS), typically submitted as part of a complete application to the municipality for circulation to the commenting agencies.

It is the responsibility of the Conservation Authority to review proposed plans and supporting documents to ensure compliance with applicable natural hazard policies, as outlined in the Provincial Policy Statement and local municipal Official Plans, as well as natural heritage policies where agreed to by the local municipality. A Conservation Authority's comments are provided within the context of its mandate as a watershed management agency in regards to ensuring that development is not affected by, nor negatively impacts on, natural hazards, natural heritage features, water quality and the interconnections between such features.

In regards to natural heritage and other environmental concerns, the Conservation Authority's review role is derived from various formal and informal agreements with area municipalities to undertake a technical review of development applications on their behalf.

In regards to natural hazards, a Conservation Authority's plan review authority has been delegated to them by the MNR through Conservation Ontario in regards to Policy 3.1 of the Provincial Policy Statement. As such, the Conservation Authority undertakes a technical review of planning applications to ensure compliance with the Provincial Policy Statement in regards to flooding, erosion, and other natural hazards either affecting or affected by the proposed development.

Conservation Authority comments are provided as technical advice for consideration by the County, who act as the decision making body (i.e. the approval authority) responsible for Planning Act applications. In regards to SWM, these comments are intended to advise the County as to whether the proposed SWM system will provide the necessary control of stormwater from the proposed development to ensure that the receiving environment will not be negatively impacted.

The Proponent should confirm with the Conservation Authority their role in the approval process and the requirements for their approval based on their role as a regulator and where they have assumed this role on behalf of other regulators through agreement.

2.6 MIDDLESEX-LONDON HEALTH UNIT

There may be instances when health related issues may arise with regard to a SWM Facility and where no definitive guidance is provided by Federal or Provincial regulations or guidelines or recognized municipal standards. In these instances the Municipality should be informed by guidance provided by the Middlesex-London Health Unit.

2.7 RISK MANAGEMENT

While SWM facilities are designed to reduce the risk of flooding and environmental impact, this is not the type of risk discussed in this section. This section is intended to address the issue of managing risk associated with the operation of a SWM facility.

Due to the nature and function of SWM facilities, there is an inherent risk in their operation. This risk is assumed by the Municipality on assumption of ownership of a SWM facility. SWM facilities will typically contain a permanent pool of water as well as areas which will have temporarily ponded water of various depths from time to time. Ponded water does pose risks to the public, especially children.

Potential incidents which may result in death, injury and/or property damage associated with SWM facilities include but are not limited to:

1. Drowning/submergence in water;
2. Falling from height;
3. Human/wildlife encounters;
4. Transmission of water borne diseases such as West Nile Virus;
5. Malfunction of facility due to vandalism or improper use;
6. Encroachment of private structures into facility; and
7. Odour and or flooding complaints.

The Municipality must determine the level of risk that it wishes to assume in the operation of SWM facilities based on balancing the following factors:

1. The requirement to maintain the core function of SWM facilities as engineered treatment facilities for stormwater;

2. The need to provide for public safety;

3. The integration of SWM facilities into open spaces and the natural environment which provides in general a net benefit to the community;

4. The climate of legal liability and the standard of care required by the Municipality to maintain a defendable level of due diligence; and

5. The cost associated to maintain the SWM facility based on balancing of risk factors.

The above factors must be reviewed and evaluated on a periodic basis to ensure that the Municipality's risk control strategies meet its corporate risk tolerance. Based on this review, the risk control strategies employed can be adjusted.

The general strategies to control risk that are available to the Municipality are:

1. To take measures to reduce the frequency of incident occurrence; and

2. To take measures to reduce the severity of an incident.

These risk control strategies should review and inform both the Municipality's SWM policy and the Municipality's review of specific SWM facilities. SWM Pond design features have been identified in this document to reduce the risk of injury to children (aged1 to 8 years), while maintaining facility function. In addition to these the Proponent must consider safety features to restrain access to deep standing water through a series of spatial, physical, natural and aesthetic barriers or through alternatives to direct access.

2.8 FUTURE TRENDS

At present, most guidance documents on SWM and municipal policies in Ontario focus on the early lifecycle phases of a SWM facility those being:

1. Planning and Approvals;
2. Construction;
3. Pre-Municipal Assumption Operation;
4. Municipal Assumption; and
5. Operation.

As SWM has been introduced as a major component of urban development only in the past 25 years in Ontario, the focus on these early phases is understandable to ensure its successful

implementation. However, SWM facilities age and their components and overall efficacy will deteriorate over time as to that of other infrastructure types. Therefore, Middlesex Centre should look at having policies in place to proactively address the later lifecycle phases for SWM facilities namely:

6. Facility Renewal; and
7. Facility Replacement.

An issue that will face Middlesex Centre in the long term is that the design of SWM facilities tends to promote their naturalization by native plant and animal species. In SWM facilities it is not uncommon for fish or aquatic species to have been introduced either by people or through natural processes. Plant species likewise will migrate to a SWM facility if it provides suitable habitat.

Over time, within a SWM facility increased vegetation and sediment deposition will reduce storage volume available to provide quantity control for large run off events. Efforts by the Municipality to restore the required storage volumes would typically require the SWM facility to be drained and partially reconstructed following the removal of excess vegetation and sediment. With the naturalization of SWM facilities, it would be expected that the MNR would become involved in the regulation of this practice. For example, fish which inhabit the pond (provided they are not an invasive species) would have to be removed in a “fish rescue” which is a specific protocol. Likewise there may be a requirement to review the SWM facility to confirm if any locally identified protected plant or animal species are resident prior to work commencing.

Therefore, it would be in the best interest of Middlesex Centre if its SWM Policy contained initiatives to minimize the long term complexity and costs associated with SWM Facility refurbishment.

3.0 Requirements

3.1 PLANNING REQUIREMENTS

3.1.1 Proponent Responsibility

The Proponent must undertake the required process for the approval of a subdivision or site plan which requires a SWM facility and satisfy the requirements under the *Ontario Planning Act* (OPA) as well as all of those agencies having jurisdiction in the development approval process. For other projects where a SWM facility is required, the Proponent must undertake the required process for the planning and approval through the requirements of the Ontario *Environmental Assessment Act* or the Municipal Engineers Association (MEA) *Municipal Class Environmental Assessment 2007 Update* (Class EA).

Conformance to the requirements of this policy by a Proponent does not necessarily mean nor should it be construed to mean that requirements under the other mandated approval processes required by legislation or those required by other agencies and having jurisdiction have been met by the Proponent. It is the sole responsibility of the Proponent to ensure all requirements to allow for the construction and operation of a SWM facility are met prior to it being constructed.

3.1.2 Requirement for Positive Site Drainage

The Proponent for the approval of a subdivision or site plan is responsible to identify and confirm a drainage outlet for stormwater flow. All sites must have positive drainage; that is all site run off must be conveyed off site toward an acceptable outlet. Acceptance of an outlet is at the discretion of the Municipality and any other agency or party having jurisdiction over that outlet. Any stormwater conveyance system which involves any mechanical components to convey flows is not allowed to connect to the Municipality's municipal infrastructure.

3.1.3 Prohibition on Infiltration Facilities

The Municipality considers SWM facilities which rely on infiltration as their primary method of stormwater control not to be acceptable for assumption into the Municipality's municipal infrastructure. This is due to the high risk of failure of these systems due to impairment of the pervious material over time and the fact that these facilities can provide for a ready route of surface contamination to groundwater. Infiltration facilities include but are not necessarily limited to: soak away pits, infiltration trenches, wet swales, pervious pipes\catchbasins, exfiltration systems, infiltration systems, and infiltration basins.

3.1.4 Facility Sizing and Cost Apportionment

As the Municipality will own and operate SWM facilities within Middlesex Centre unless they are on private property, it is in the interest of the Municipality to minimize the number of facilities. Therefore, Proponents need to size facilities to accommodate the ultimate urban drainage area as defined by the Municipality and to route external flows from non-urban areas through the urban stormwater conveyance system in a safe manner. With regard to the definition of an ultimate drainage area, the Municipality will typically look to define this as the upstream area from the subdivision or site plan area which are within the current settlement boundary as defined by the Official Plan and/or additional areas which have been identified as supporting future urban growth through Municipality accepted studies such as the Master Servicing Plan.

The cost for SWM facility construction including land costs are to be borne by the Proponent and in the case of multiple parties being involved it is up to them to agree to cost sharing for this undertaking amongst themselves. For larger urban drainage areas, the Municipality may at their discretion allow a SWM facility to be implemented in phases with the minimum initial phase being built for the complete drainage area of the subdivision or site plan. The Municipality may generally endorse reserves dedicated to the Proponent along future municipal right of ways in order for the Proponent to be reimbursed by future Proponents for their share of the costs of a SWM facility which has been constructed.

3.2 APPROVAL REQUIREMENTS

Each SWM facility needs to be considered within the unique context of its drainage area and the general environment. Conformance with the requirements of the Municipality's SWM policy will be determined by the Director, Public Works and Engineering Department in consultation with other related Departments such as Finance and Community Services Department, and Planning and Development Services Department. The SWM Facility requirements are:

1. Ensuring compliance with all applicable municipal requirements, standards, policies and provincial legislation, thus ensuring that the life and health of the public will be adequately protected;
2. Maintaining and promoting the enhancement of urban ecosystems, including integration of SWM facilities within open space in a manner that is consistent with the Community's Natural Heritage System; and
3. Ensuring an implementation of safe, well engineered, and cost-effective stormwater management sites.

Based on Ontario Water Resources Act (OWRA) Section 53, SWM works are subject to Certificate of Approvals for this work and must be in compliance with the MOE requirements

associated with the Storm/drainage and SWM servicing works, as well as be in compliance with the Municipality's SWM design requirements as follows:

1. Permanent SWM facilities are required to be located on lands that the Proponent shall dedicate to the Municipality of Middlesex Centre.
2. Temporary SWM facilities are required to be located on lands that are dedicated to the Municipality as an easement by the Proponent to ensure that the Municipality will be able to comply with the emergency requirements in accordance with the Environmental Protection Act and Ontario Water Resources Acts.
3. Temporary SWM facilities that become permanent SWM facilities based on the Master Plan and/or Class EA recommendations will be required to be located on lands that the Proponent shall dedicate to the Municipality of Middlesex Centre.

Designs shall have due regard for appropriate provincial legislation and the Municipality's design standards policies, and guidelines.

3.3 INNOVATIVE DESIGN

SWM Designs may incorporate innovative approaches, provided the intent of the SWM Pond requirements, goals, aims and purposes derived for public benefit are achievable. Cost effectiveness shall depend on capital, Maintenance and Operations cost requirements, as well as a cost/benefit analysis of those factors which are more difficult to define from an economic perspective (i.e. safety, environmental/social benefits). Such determination and approval of intent will be at the discretion of the Director, Public Works and Engineering in consultation with other Municipality staff.

3.4 PRELIMINARY SWM SUBMISSIONS

The first level of comprehensive SWM submission typically includes a Preliminary Stormwater Management Report to accompany the initial draft plan submission and various other environmental and servicing reports. This document outlines the existing hydrologic and hydraulic conditions of the area, as well as the proposed development and associated SWM concepts. It should cover all land use and SWM issues that could affect the layout of the development. The primary objective of Middlesex Centre's review includes confirmation that the proposed Plan incorporates SWM system blocks sufficiently sized to meet environmental objectives. While recognized as a "preliminary" submission, sufficient design details should be included to provide Middlesex Centre (and other review agencies) the confidence that minor design changes associated with final design will not require significant modifications to the Draft Plan. The Preliminary SWM Report should provide:

1. A summary of the Proponent's correspondence with all agencies having jurisdiction and confirmation that consultation is being undertaken including a listing of their design and

approval requirements and the status of the Proponent's work in satisfying these requirements;

2. Definition of the catchment area and the ultimate urban catchment area based on consultation with the Municipality;
3. The characteristics of the existing conditions of the catchment area including physical parameters affecting hydrology or hydraulics, existing or approved development on or adjacent to the site, and the opportunities or constraints for stormwater management at the specific property within the context of the catchment;
4. A summary of those physical characteristics of greatest importance from a SWM perspective including the topography, soils, land use, and hydrogeological characteristics of the site and contributing drainage areas;
5. The characteristics of the watercourse receiver, including but not limited to aquatic habitat, local and/or regional significance, human and wildlife water use;
6. An assessment of the suitability or legality of the proposed outlet to accept drainage from the proposed development;
7. Proposed SWM design criteria pertaining to runoff water quality, quantity, and water balance based on the assessment of the receiving systems and associated agency discussions;
8. Proposed SWM design strategy including the details of Blocks set aside for infrastructure. This should include all lot level, conveyance, and end-of-pipe infrastructure components;
9. Proposed erosion and sediment control strategy reflective of the characteristics of both the development area and the anticipated runoff receiver;
10. Monitoring and maintenance plans proposed for implementation prior to, during, and after construction;
11. Confirmation of proposed ownership and maintenance obligations of all SWM infrastructure;
12. Plans and reports that are signed and sealed by a Professional Engineer having competence in the discipline of hydrology and SWM;
13. All detailed calculations, modelling, as well as any monitoring and calibration work completed in support of the proposed design, in sufficient detail to allow the replication and verification of all work. Further, any qualified person must be able to recognize and understand all of the methods, approaches, basic data, and rationale used in the calculations. Supporting analytic information should include:
    a. Assumptions and justification for the choice of hydrologic / hydraulic model employed,

b. All hydrologic modelling parameters including rainfall data, drainage areas, impervious ratios, infiltration parameters, initial abstraction and depression storage, basin or subcatchment lag, time of concentration (TC) or inlet times, routing, etc.,

c. With the exception of copy written or proprietary models, equations should be given for all provided calculations. Calculations are to be provided in paper and digital form. All formulae and values used by the program must be clearly identified on the paper copy,

d. Modeling schematics for each of the pre- and post-development conditions,

e. Calculations of the required storage volumes at SWM facilities,

f. Stage-storage-discharge relationships of SWM facilities,

g. Summary table(s) of the proposed operating characteristics for various design events, and

h. Analysis substantiating the capacity of proposed major overland flow routes;

14. Associated plans that illustrate the pre- and post-development drainage characteristics of the subject site and adjacent lands, proposed minor and major system drainage systems, SWM facilities, maintenance access, blocks for major flow, easements, and proposed locations of at-source controls (preliminary grading plans may be required to adequately size facilities). Preliminary design plans for SWM facilities should include spot elevations at: pond outlet, pond bottom, top of berm, side slopes, and functional planting requirements;
15. A preliminary erosion and sediment control (ESC) strategy describing existing site conditions, erosion potential, downgradient risk assessment, and anticipated controls. The site layout and facility design should reflect the potential impacts of failure of control during construction, maintainability, and potential for mitigation and restoration;
16. The anticipated monitoring programs proposed to establish baseline conditions prior to construction, to ensure that ESC systems are functioning during construction, and to confirm that the SWM facilities are functioning as designed post-construction. With respect to SWM, monitoring programs should include aspects such as water quality, hydrologic operating regimes, SWM function, and ESC measures; and
17. A summary of anticipated contents of any Final SWM documents should be provided highlighting, in particular, any design components not included within the Preliminary design documentation.

3.5 FINAL SWM SUBMISSIONS

The second level of reporting provides the final design details pertaining to the drainage and SWM components of the proposed development, including information on how draft plan conditions are being met. This will outline the performance of the proposed SWM facilities,

erosion and sediment control, and monitoring programs undertaken to date and anticipated. Barring large-scale changes in approach from that proposed and approved at preliminary stages, the completion of final design submissions should be relatively straightforward, largely representing an update to the designs previously completed. In this regard, final SWM submissions should include, but may not necessarily be limited to, the following:

1. A summary of the Proponent's correspondence with all agencies having jurisdiction and confirmation that consultation has been undertaken as a listing of their design and approval requirements and the status of these approvals including which approvals are outstanding;
2. Final definition of the catchment area and the ultimate urban catchment area based on consultation with the Municipality;
3. A final report detailing the proposed SWM system(s) and providing confirmation of all the items in the preliminary SWM or justification for any variance;
4. Final design calculations incorporating the results of the final grading and the minor system design;
5. Detailed engineering drawings for all elements of SWM system including grading and servicing plans, major/minor system layout, and functional planting and landscaping plans;
6. Final ESC strategy and plans;
7. Monitoring/maintenance plans must be prepared to highlight standard operating conditions and guide the site owner through anticipated maintenance requirements for all aspects of the stormwater management system. Maintenance plans must specify trigger point depths for the removal of sediment from the forebay and the permanent pool area that are set to ensure proper function of the SWM facility;
8. A landscaping plan for end of pipe treatment systems must be submitted for review prior to final approval. The MOE SWMP Design Manual identifies plantings as a feature that contributes to the proper function of stormwater management ponds. Appropriate planting within stormwater facilities also prevents the release of sediment into local creeks and tributaries by stabilizing the side slopes of the pond;
9. All plans and reports are signed and sealed by a Professional Engineer having competence in the discipline of hydrology and SWM;
10. The report should incorporate all detailed calculations, modelling, as well as any monitoring and calibration work completed in support of the proposed design, in sufficient detail to allow the replication and verification of all work. Further, any qualified person must be able to recognize and understand all of the methods, approaches, basic data, and rationale used in the calculations. Supporting analytic information should include:

a. Assumptions and justification for the choice of hydrologic / hydraulic model employed,
b. All hydrologic modelling parameters including rainfall data, drainage areas, impervious ratios, infiltration parameters, initial abstraction and depression storage, basin or catchment/subcatchment lag, TC or inlet times, routing, etc.,
c. With the exception of copy written or proprietary models, equations should be given for all provided calculations. Calculations are to be provided in paper and digital form. All formulae and values used by the program must be clearly identified on the paper copy,
d. Modeling schematics for each of the pre- and post-development conditions,
e. Calculations of the required storage volumes at SWM facilities,
f. Stage-storage-discharge relationships of SWM facilities,
g. Summary table(s) of the proposed operating characteristics for various design events, and
h. Analysis substantiating the capacity of proposed major overland flow routes;

11. Associated plans should illustrate the pre- and post-development drainage characteristics of the subject site and adjacent lands, proposed minor and major system drainage systems, SWM facilities, maintenance access, blocks for major flow, easements, and proposed locations of at-source controls (grading plans may be required to adequately size facilities). Final design plans for SWM facilities should include sufficient information to support construction efforts, and include design characteristics and elevations at pond outlet, pond bottom, top of berm, side slopes, and functional planting requirements. Plans depicting the extent of ponding or flooding associated with the greater of the 100-year or Regional storm events along major flow routes are also required;
12. A final erosion and sediment control (ESC) strategy describing existing site conditions, erosion potential, downgradient risk assessment, and anticipated E&S controls is also required. The site layout and facility design should reflect the potential impacts of failure of control during construction, maintainability, and potential for mitigation and restoration;
13. Draft Operations and Maintenance Manual developed by the Proponent's Consulting Engineer and accepted by the Municipality; and
14. The Final SWM Report should also detail programs undertaken to establish baseline conditions prior to construction, ensure that ESC systems are functioning during construction, and a minimum 2 year monitoring program to be undertaken prior to assumption to confirm that the SWM facilities themselves are functioning as designed post-construction. With respect to SWM, monitoring programs should include aspects such as water quality, hydrologic operating regimes, SWM function, and ESC control measures.

4.0 Facility Design Guidelines

4.1 SWM FACILITY TYPES

Acceptable facility types are as follows for facilities which are to become part of Middlesex Centre's infrastructure:

1. Extended Detention Ponds for each drainage area;
2. Wet Ponds for each drainage area;
3. Constructed Wetlands for each drainage area; and
4. Combined facilities serving multiple drainage areas.

The characteristics of these facilities are detailed in Chapter 4 of the MOE 2003 SWM Manual in addition to the information provided in this document. The minimum drainage area which is required for a SWM facility to be owned by the Municipality is 5 hectares.

4.2 INFILL SITUATIONS AND MEASURES IN LIEU OF SWM FACILITIES

For situations with new development with drainage areas of less than 5 hectares or new development that is within an existing urban drainage area where SWM facilities do not exist, design or compensation measures will need to be addressed on a site by site basis by the Proponent. SWM design or compensation measures proposed by the Proponent should meet the overall intent of the Municipality with regard to its stormwater management policy and must clearly demonstrate cost effectiveness (in terms of maintenance and operations) as well as a cost/benefit analysis of those factors which are more difficult to define from an economic perspective (i.e. safety, environmental/social benefits). Such determination and acceptance will be at the discretion of the Director, Public Works and Engineering in consultation with other Municipality staff.

4.3 DESIGN GUIDELINES

4.3.1 Introduction

A Professional Water Resources Engineer (Proponent's Consulting Engineer) is responsible for recommending all SWM modeling parameters to ensure the application of adequate engineering knowledge is applied. At the same time, the Municipality's Engineer is required to review the proposed SWM systems and selection of the SWM modeling parameters/criteria to ensure compliance with Municipality and Provincial standards, requirements and practices, and also to ensure the adequate protection of the people and properties of the Municipality of Middlesex Centre.

4.3.2 Design Requirements

4.3.2.1 General

SWM facilities (temporary and/or permanent) shall meet engineering, maintenance, safety, planning, environmental, aesthetic and economic requirements. SWM Pond requirements for private property/ developments are to generally conform to the design criteria in this policy, all to the satisfaction of the Director, Public Works and Engineering.

4.3.2.2 References

The basis for implementing these requirements will be a design criteria that includes but is not limited to the following references:

1. *Infrastructure Design Standards for the Municipality of Middlesex Centre*;
2. MOE 2003 SWM Manual;
3. The SWM criteria and environmental targets for the drainage area accepted by Municipality Council;
4. Municipality of Middlesex Centre Official Plan;
5. Applicable Development Charges By-law;
6. Specific requirements as approvals for site or draft plans or stated within site control or subdivision agreements;
7. Requirements of other agencies such as the Conservation Authority having jurisdiction; and
8. All applicable municipal requirements and provincial legislation.

If two or more criterion are specified for the same design element then the most rigorous criteria is to be applied by the Proponent.

4.3.2.3 SWM Facility Inlet Pipe Design Criteria

The SWM facility inlet pipe should represent a free outlet. Therefore, the inlet pipe invert is to be above the projected 2-year storm ponding elevation. Non-compliance with this standard may create surcharge conditions within the new storm sewer system requiring additional maintenance associated with the potential sediment accumulation, as well as create potential liabilities under the Ontario Highway Act should surface ponding occur on streets. If, in rare cases, there is a need to consider deviation on the above noted design criteria, the Proponent's consulting engineer will be required to undertake an engineering analysis to demonstrate that the proposed deviation will have a minimum effect on the proposed sewer Hydraulic Grade Line and will not create an adverse effect on the system.

4.3.2.4 Specific Design Features

The following are specific design features to be incorporated into all SWM Facility designs in the Municipality of Middlesex Centre:

1. A sediment forebay is incorporated to induce treatment and improve pollutant removal by trapping larger particles near the inlet of the pond, design features to include:
    a. forebay is to be 1.2-1.5m deep to minimize potential resuspension,
    b. the sediment forebay sizing must be done in accordance with the MOE's SWM Practices Planning and Design Manual, and the sediment forebay should be constructed with a maintenance access route to permit future monitoring and maintenance as well as provide access in the event of an emergency;
2. A permanent pond depth of 1.5-2.0m is preferred with a maximum facility depth not exceeding 3.0 m with a maximum 0.3 m freeboard;
3. A positive overland flow path must be provided at the 3.3m water level;
4. The permanent pool depth in wet SWM facilities must be 1.0-1.5m deep. A naturalized low flow channel with a shallow channel depth (0.3 to 0.6m preferred) leading to the area of pond drawdown is required;
5. Level gauges must be installed in the deepest part of areas where there permanent water pooling to allow for water depth measurement in order to monitor the performance of the facility;
6. SWM facility inlet sewers must be designed to enter the facility as free outlet systems during 2-year storm events;
7. For extended detention and wet facilities 5:1 side slopes or flatter, for dry facilities 4:1 side slopes or flatter, must be applied around the perimeter of the sediment forebay and upper and lower cell;
8. Slopes may vary around a facility to create a natural appearance with the preferred slopes being maximums;
9. Steeper slopes (maximum 3:1) maybe allowed to be used when these slopes are:
    a. Representing only 15-20% from the total area,
    b. Combined with a minimum buffer of 5.0m from 0.3 m above the 100 year storm event elevation to the property line; and
    c. Combined with unfriendly vegetation;
10. The 2 year storm event extended detention and storage component of wet facilities should discharge over a 24 to 48 hour period and the quality control ponds are not allowed to be located in line;
11. The permissible discharge for all facilities is based on detailed engineering analysis;

12. All maintenance holes located within stormwater management ponds require hard surface access;
13. Consideration to provide for safe access and relatively easy means for the recovery of inlet and outlet water quality samples by the facility owner;
14. Access roads below the 100 year flood line will require a turfstone surface on a granular base. The turfstone voids shall be filled with granular A;
15. Stormwater from the forebay shall be held in a permanent wet retention pond and should be located in the facilities lower cell (assuming the general main cell design reflects an overall safety criteria of gentle slopes and aquatic safety benches or suitable barriers);
16. Any SWM facility proposed to be located within Flood Plain lands are subject to:
    a. Conservation Authority guidelines and approvals,
    b. Forebays being located above the 50 year storm line with any deviation from this requirement being subject to specific technical justifications approved by the Municipality,
    c. Main facilities being located above the 25 year flood line;
17. A naturalized landscape plan, approved by the Municipality is required for all stormwater retention and detention facilities. This landscape plan should include design measures to reduce or deter Canada Geese from using the facility as habitat based on the recommended measures in the Environment Canada publication *Canada Geese and Shoreline, Seasonal techniques to deter geese* which is attached to this document (attached as Appendix 4.1 for reference);
18. Landscape plans shall conform to the required standards of Middlesex Centre;
19. Seeding of exposed soil surfaces should be done as soon as possible after fine grading is complete;
20. All landscape treatments specified in the approved plan should be installed after seed has established, but within two years of registration of a subdivision plan or development agreement;
21. Continuous 1.6 m chain link fencing is to be provided at the property line of any residential lots, schools or child care facilities which immediately abut the SWM facility;
22. Within open space and park areas in lieu of fencing, unmowed vegetated buffers will be required around the perimeter. This buffer should be comprised of tall grasses and wild flowers, followed by trees and densely planted shrubs. A densely vegetated margin on the aquatic safety bench is to serve as an aesthetic amenity and an additional natural barrier;
23. This dense unfriendly vegetation should act as a natural barrier to all but the most determined individuals. Openings can be provided if warnings are posted advising those who approach the facility of its purpose, operation and potential safety hazards;

24. Posted warning signs should be visible at emergency access points in the event that the barrier is penetrated. The standard warning sign is shown in Figure 4.1;

Figure 4.1 Standard Middlesex Centre SWM Pond Warning Sign

25. An aquatic safety bench must be constructed around the forebay and the main treatment cells with the lower edge to be located 0.9 m above the pond bottom with a minimum 2 m width and incorporate a slope of 10:1 or flatter;
26. Pedestrian and cycle paths must always be located no lower than the 10 year storm event water elevation with at least 0.9 m freeboard from the permanent pool of water and are only permitted where the safety bench is present and have adequate signage to warn the public of potential safety hazards during pond operation;
27. Access roads below the 10 year storm event water elevation are to be posted with hazard signage. Paths below this point and leading to the lower portions of a facility to warn the public of potential safety hazards during pond operation;
28. The minimum buffer width (separation area between the SWM Facility and land features such as ESA, main watercourses, significant ecological features and open space, designation, etc.), is subject to the Official Plan requirements, Provincial and Federal Acts, Policies and Requirements; and

29. Specific requirements for the protection of adjacent natural areas may be required as outlined in the relevant Environmental Impact Statement for the development.

These requirements must be applied to all SWM applications. It is recognized that in some instances, unique circumstances may arise where some requirements cannot be accommodated. In these cases, the onus is on the Proponent to demonstrate how the proposed design deviates from the requirements yet still meets the intent of this overall document. Deviations must be approved by the Director, Public Works and Engineering.

4.3.2.5 Maintenance Hole Access

All maintenance holes located within stormwater management ponds require hard surface access. Access roads below the 100 year flood line will require a turfstone surface on a granular base. The turfstone voids shall be filled with Granular 'A '. For all other requirements refer to the *Infrastructure Design Standards for the Municipality of Middlesex Centre*.

4.3.2.6 Emergency Sanitary Sewer Overflow

Emergency sanitary sewer overflow (SSO) outletting upstream of the SWM facility directly to SWM Facilities is not permitted.

4.4 TECHNICAL REVIEW CRITERIA

4.4.1 SWM Facility Design Report

Stormwater conveyance systems are to be sized based upon the current requirements of the *Infrastructure Design Standards for the Municipality of Middlesex Centre*. SWM facilities are to be sized for flows using up to date versions of hydrological modeling software that is in common usage in the Province of Ontario by water resource engineers. Consultants may make use of available water resources management manuals and texts as a reference to aid in the selection of hydrologic modeling parameters. Any externally referenced material employed in parameter selection should be properly referenced in the SWM Report and included in the document appendices.

4.4.2 SWM Facility Sizing Parameters

4.4.2.1 Imperviousness

Impervious percentage is described by two parameters, Total Impervious Percentage (TIMP) and Directly Connected Impervious Percentage (XIMP) values. TIMP represents the ratio of area covered by an impervious surface (e.g. asphalt, concrete) to the entire area. XIMP represents the ratio of impervious area as directly connected to the conveyance system (parking lots, a portion of roof areas, driveways, or roads that contain catchbasins draining to the storm

sewer, etc.). In order to ensure that the proposed SWM volumes, land requirements and the size of the SWM block are estimated correctly, impervious percentage selection is extremely important. Table 4.1 below lists current Municipality of Middlesex Centre preferred TIMP and XIMP values based on land use. These allowable ranges for TIMP and XIMP should be applied at the conceptual/preliminary design stage to ensure sufficient land is allocated for the proposed facility. Adjustment of Impervious Percentage values at the functional/detailed design stage will always be considered and accepted, subject to the consulting engineer providing engineering calculations to justify the revision of these parameters.

Table 4.1 - Acceptable Ranges for Impervious Values

Land Use	TIMP (average range)	XIMP (average range)
Residential	55% 51% - 60%	45% 43% - 48%
Medium and High Density	70% 65% - 75%	55% 45% - 55%
Commercial/Industrial	75% - 90%	70% - 80%

For the Preliminary Stormwater Management Report TIMP and XIMP should be assigned the maximum (not average) imperviousness allowed by the Municipality. At the detail design stage, TIMP and XIMP can be assigned the "actual" imperviousness.

4.4.2.2 Determining Site Runoff

Site runoff for both pre-development and post-development conditions is determined by subtracting the predicted infiltration volume from the estimated total rainfall volume. There are multiple models and methods for determining infiltration and thus total runoff. Middlesex Centre will consider the following methods/models for determining infiltration and runoff:

1. SCS Method;
2. Horton Method; and
3. Green-Amp Method.

4.4.2.3 Initial Abstraction

Initial abstraction (I_a) represents the interception, infiltration, and surface depression storage of rainfall at the beginning of storm events. Middlesex Centre modeling values for I_a are summarized below for the following land covers:

1. Impervious 2 mm;
2. Pervious - lawns 5 mm;
3. Pervious - meadows 8 mm; and

4. Pervious - woods 10 mm.

The Municipality is concerned that facilities may potentially be undersized due to overestimation of initial abstraction values, resulting in overtopping of the facility during storm events. In order to consider any deviation from these recommend I_a values, the proposed SWM modeling will need to be tested in the field and technical data presented to confirm the suitability of the calibrated parameters. Any proposed deviation will need to be approved by the Director, Public Works and Engineering.

4.4.2.4 Curve Number

The curve number (CN) is a parameter used to determine the extent of rainfall that infiltrates, rather than becoming surface runoff for a given type of soil. It is a measure of a watershed's hydrologic response potential and is usually selected from available government documents and handbooks that are in common usage in the Province of Ontario. Currently, the Municipality of Middlesex Centre does not have a specific table of CN values to be used in modeling practices. However, CN values must be consistent with provincial guidelines and standard water resources management practices and correspond with the specific geotechnical conditions of proposed developments. Selection of CN should be correlated with the applied Initial Abstraction (I_a). If a hydrological software model in common usage in the Province of Ontario incorporates the CN concept by a different means, this should be stated in all submissions to the Municipality.

4.4.2.5 Design Storm Selection

In the design of individual SWM Facilities, a 3–hour Chicago Rainfall Distribution should be applied or as recommended by the Conservation Authority for the subwatershed. The Chicago distribution is widely accepted as a synthetic distribution to be used in the design of urban areas. Where:

$$\text{Rainfall intensity (mm/hr)} = \frac{A}{(t+B)^C}$$

The values for A, B and C are detailed in Table 4.2.

Table 4.2 - Chicago Storm Parameters						
	Return Period (years)					
Parameter	2	5	10	25	50	100
A	724.69	1330.31	1497.19	1455.00	1499.06	1499.53
B	5.500	7.938	7.188	5.000	4.188	3.297
C	0.800	0.855	0.850	0.820	0.809	0.794

4.4.2.6 250-Year, Larger Area Storms

The Proponent's consulting engineer is required to evaluate all applicable storms and is required to recommend the most appropriate on a case-by-case basis. For each problem (i.e. Flood Control, Erosion Control), a "critical" storm should be selected for design purposes.

4.4.3 Minimum Water Quality Storage Volumes

The water quality storage volumes per hectare are established in Table 3.2 of the MOE 2003 SWM Manual and consist of two components: 40m^3/ha of extended detention quality control storage (live storage) and the remaining portion represents permanent pool quality storage (dead storage). The required 40 m^3/ha of quality extended detention storage is constant and required in all cases. The remaining permanent pool component of water quality storage is dependent upon the following three factors:

1. Impervious percentage (TIMP, XIMP);
2. Protection Level of the Receiving Watercourse (as determined by the requirements of the Conservation Authority having jurisdiction); and
3. The proposed type of SWM facility (i.e. wet pond, dry pond, wetland).

Additional extended detention storage may be required for erosion control/stream morphology and attenuation control as per the requirements of the Conservation Authority having jurisdiction and/or to address lack of conveyance capacity in the outlet system. These parameters are to be established by the Proponent's Consulting Engineer all to the satisfaction of the Municipality.

4.4.4 SWM Facility Safety Factor

As discussed in Section 2 of this document, SWM facility refurbishment should be deferred as long as possible due to the adverse environmental impacts that this may have. Therefore to lengthen the service life, individual SWM facilities should be oversized by 10% with regard to treatment volume for the design storms selected in Sections 4.4.2 and 4.4.3.

5.0 Facility Construction and Operation to Assumption

5.1 FACILITY CONSTRUCTION

The Proponent must undertake all studies as detailed in the Final SWM Report to establish baseline conditions prior to construction and to the satisfaction of agencies having jurisdiction prior to construction commencing. The ESC plan for the development will be implemented prior to any construction activities being undertaken on site by the Proponent. The SWM facility will be constructed and made operational prior to the development's storm drainage system being constructed. The SWM facility is to be constructed in accordance with the approved drawings based upon the design parameters established in the Final SWM submission. Following construction and within four (4) weeks of commencement of operation, the Proponent is to provide a letter from the Professional Engineer(s) preparing the approved drawings for the SWM facility that it has been constructed in general conformance with the Final SWM submission and the approved drawings.

5.2 SWM FACILITY MAINTENANCE AND OPERATIONS MANUAL

Within four (4) weeks of commencement of operation, the Proponent is to provide a final Maintenance and Operations Manual for the facility prepared by the Proponent's Consulting Engineer. A sample table of contents and standard forms are attached as Appendix 5.1.

5.3 FACILITY OPERATION AND MONITORING (PRE-ASSUMPTION)

5.3.1 Facility Operation

Operation of the SWM facility, prior to the Municipality's assumption, shall be in compliance with the Maintenance and Operations Manual developed by the Proponent's Consulting Engineer and accepted by the Municipality. During the operation of the SWM facility the Proponent is to monitor depths of sediment from the forebay and the permanent pool area that are set to ensure proper function of the SWM facility as per the accepted Maintenance and Operations Manual and remove sediment immediately once these depths are met or exceeded.

5.3.2 Facility Monitoring and Reporting

Monitoring of the SWM facility prior to Municipality's assumption must:

1. Be carried out by the Proponent to demonstrate the effectiveness of the performance of these facilities in accordance with the approved design construction practices;
2. Be in compliance with the Municipality's policies and Chapter 6 of the MOE 2003 SWM Manual;

3. Be in accordance with the accepted Maintenance and Operations Manual and include semi annual review and inspection of the facility;
4. Be carried out by the Proponent, prior to the Municipality's assumption at no cost to the Municipality;
5. Include all other site specific monitoring requirements as a result of an Environmental Assessment, an Environmental Impact Study or as directed by other approving agencies for the facility or development;
6. Ensure all landscape materials are to be maintained in a healthy state in accordance with the approved landscape plan until the time of assumption; and
7. Be coordinated with the ESC plan and ensure that ESC systems are functioning during and up until completion of development construction (including lot level work) to minimize stresses on the SWM facility.

5.3.3 Sediment Monitoring, Sampling and Removal

During the operation of the SWM facility the Proponent is to monitor depths of sediment from the forebay and the permanent pool area that are set to ensure proper function of the SWM facility as per the accepted Maintenance and Operations Manual and remove sediment immediately once these depths occur.

To ensure the sediment sampling is representative, samples will be taken from at least two areas of the pond to form a composite sample for each test. However, if the physical characteristics of the sediment, such as colour, sheen, or texture of one area appear to be different from the other areas, this area should be analyzed separately.

The quality of the sediment must be analyzed prior to the removal to assess the proper disposal location. All sampling procedures and locations should be performed and selected by qualified technicians under the direction of the Proponent's Consulting Engineer based upon on-site conditions. Samples are to be submitted for analysis to an Accredited Laboratory. Sample recovery and handling (including use of required bottles provided by the laboratory and handling techniques) are to be in accordance with the procedures of the Accredited Laboratory. A formal chain of custody form from the Accredited Laboratory is to be maintained.

Sediment sampling and removal is to be undertaken with regards to the following:

1. Environmental Protection Act,
2. Regulations made under the Environmental Protection Act, specifically
    a. *Regulation 347 General — Waste Management*,
    b. *Regulation 153/04 Records Of Site Condition — Part XV.1 of The Environmental Protection Act*;

3. The MOE guidance document *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of The Environmental Protection Act*;
4. Any revisions and changes to the above act, regulation and guideline; and
5. Any other applicable statutes, regulation or by-law.

As a note to the Proponent, sediment removal may require dewatering prior to removal from site to meet the acceptance requirements of the receiver of the material. Following sediment removal, the SWM facility is to be restored including the replacement of all damaged and/or removed vegetation. As sediment removal typically requires heavy equipment all required ESC is to be in place prior to removal and to remain in place until all vegetation has sufficiently reestablished itself.

5.4 FACILITY ASSUMPTION

5.4.1 Assumption Timing and Process

At a threshold determined by the Municipality and most likely included in the Subdivision or Site Plan Agreement, the process of municipal assumption will commence. The threshold will typically be reached when most if not all of the construction work including lot level work has been completed. The monitoring program and all operations and maintenance will be the responsibility of the Proponent until the Municipality assumes the facility. The assumption process will include the following components:

1. Monitoring program undertaken by Proponent;
2. Interim SWM Facility Report(s) by Proponent;
3. Final SWM Facility Report by Proponent;;
4. Assumption preparation by Proponent;
5. Assumption inspection by Municipality;
6. Proponent correction of deficiencies identified in the assumption inspection;
7. Warranty period;
8. Transfer of C of A for SWM Facility to Municipality;
9. Warranty inspection by Municipality; and

10. Proponent correction of deficiencies identified in warranty inspection.

5.4.2 Monitoring Program

The Proponent is required to ensure that any other monitoring required by the specific requirements of the Subdivision or Site Plan Agreement and/or other approval agencies is carried out.

5.4.2.1 Minimum Monitoring Program

The process of assumption commences with a minimum two (2) year monitoring program to be undertaken by the Proponent prior to confirm that the SWM facility is functioning as designed. The Proponent shall ensure that competent staff is employed by their engineering consultant to undertake the required sampling program. Inlet and outlet grab samples are required to confirm that quality objectives are being met based on sampling for the following parameters:

1. Total suspended solids;
2. Nitrate;
3. Phosphorus; and
4. F1-F4 Petroleum Hydrocarbons.

Annual sampling to include:

1. One (1) spring sample (April 1 to May 15);
2. Five (5) summer samples (May 15 to September 30);
3. One (1) fall sample (October 1 to November 30); and
4. One (1) winter sample (December 1 to March 31).

Grab samples are to be taken within 90 minutes of the onset of a rainfall event and only when there is sufficient inlet and outlet flow to recover samples. Samples are to be submitted for analysis to an Accredited Laboratory. Sample recovery and handling (including use of required bottles provided by the laboratory and sampling techniques) are to be in accordance with the procedures of the Accredited Laboratory. A formal chain of custody form from the Accredited Laboratory is to be maintained.

During each sampling event accurate measurements of the pond water elevations and the discharge rate will be taken. Reporting for each sampling event will include rainfall data from the closest available Environment Canada or Conservation Authority rain gauge to corroborate the run off event with a rainfall event.

5.4.2.2 Standard of Treatment

If specific treatment standards are not set by the Municipality or other agencies having jurisdiction, the key but not necessarily the only standard by which the efficacy of a SWM facility will be judged is that it must provide for the removal of total suspended solids. Therefore, over a one year (four season) sampling period, the average reduction of inlet to outlet for suspended solids must be greater than 50%. Other parameters which are sampled are to be evaluated by the Proponent's Consulting Engineer to confirm if there are any concerns with the level of treatment being provided or if there are point source or non-point source pollution issues which may need to be addressed in the catchment area.

5.4.3 Interim and Final SWM Facility Report

5.4.3.1 Interim Report(s)

The Proponent's engineering consultant will prepare an annual report on the SWM facility's performance within 90 days of the anniversary date of the first sample being collected as part of the assumption monitoring program and annually until the development is ready for assumption. This report will include as a minimum the following:

1. Water Quality Sampling of Facility
    a. Summary Results,
    b. Commentary on Results (explanation of variances, treatment efficacy),
    c. Attachment of Certificates of Analysis and Chains of Custody;
2. Facility Maintenance and Condition
    a. Current Condition of Facility based on latest bi-annual inspection as per the Operations and Maintenance Manual,
    b. Summary of Biannual Condition Reports since operation,
    c. Summary of Maintenance Activities to date including but not limited to:
        i. Repairs
        ii. Sediment removal,
    d. Recommended maintenance activities to be undertaken to ensure facility is in operational condition;
3. Review of all other monitoring activities undertaken required for the SWM facility required by the specific requirements of the Subdivision or Site Plan Agreement and/or other approval agencies and the status of satisfying the conditions; and
4. Summary of actions to be taken in the second year of the monitoring program
    a. Ensure water quality results meet required treatment standard,

b. Address any noted maintenance issues,
c. Address any noted issues from other monitoring activities,
d. Plan and schedule for Proponent to prepare SWM facility for assumption by the Municipality.

Submission of this report does not mean that the Municipality necessarily accepts the contents. If the Municipality deems that it does not meet the level of detail required, the information is not complete nor are the action plans sufficiently detailed to fully review and assess the condition of the SWM facility, the Proponent at their own cost will be required to revise and resubmit this report.

5.4.3.2 Final Report

The Proponent's engineering consultant will prepare a final report on the SWM facility's performance within 90 days of the later of the second anniversary date of the first sample being collected as part of the assumption monitoring program or when the development is ready for assumption by the Municipality. This report will include as a minimum the following:

1. Water Quality Sampling of Facility from all previous reports
    a. Summary Results,
    b. Commentary on Results (explanation of variances, treatment efficacy),
    c. Attachment of Certificates of Analysis and Chains of Custody;
2. Facility Maintenance and Condition
    a. Current Condition of Facility based on latest bi-annual inspection as per the Operations and Maintenance Manual,
    b. Summary of Biannual Condition Reports since operation,
    c. Summary of Maintenance Activities to date including but not limited to:
        i. Repairs
        ii. Sediment removal,
    d. Recommended maintenance activities to be undertaken to ensure facility is in operational condition;
3. Review of all other monitoring activities undertaken required for the SWM facility required by the specific requirements of the Subdivision or Site Plan Agreement and/or other approval agencies and the status of satisfying the conditions; and
4. Summary of actions to be taken to allow for assumption by the Municipality including but not limited to
    a. Ensure water quality results meet required treatment standard,
    b. Address any noted maintenance issues,
    c. Address any noted issues from other monitoring activities,

d. Update plan and schedule for Proponent to prepare SWM facility for assumption by the Municipality.

Submission of this report does not mean that the Municipality necessarily accepts the contents. If the Municipality deems that it does not meet the level of detail required, the information is not complete nor are the action plans sufficiently detailed to fully review and assess the condition of the SWM facility, the Proponent at their own cost will be required to revise and resubmit this report.

5.4.4 Preparation for Assumption

Immediately prior to assumption the Proponent will:

1. Remove all sediment deposits from the SWM facility as per Section 5.3.3;
2. Prepare and submit the Final SWM Report;
3. Restore the SWM facility to a condition where it meets all of the performance requirements set out within the Final SWM submission and the approved drawings in accordance with the Final SWM Report as reviewed and accepted by the Municipality; and
4. Undertake all maintenance to correct all deficiencies such as erosion, restoration of plantings or vegetation which has not been taken, has died or was removed as part of the sediment removal processes in accordance with the Final SWM Report as reviewed and accepted by the Municipality.

5.4.5 Assumption Inspection

The Municipality will undertake an assumption inspection of the SWM facility. The Municipality will provide a list of deficiencies that are required to be corrected by the Proponent. If the Proponent does not repair the deficiencies within 45 days of receipt of the list provided by the Municipality, at its discretion, may order the Proponent to resume the Monitoring program, update the Final SWM report and undertake the preparatory steps for assumption as detailed in Section 5.3.4.

5.4.6 Post Assumption Requirements

The Proponent will prepare, pay for and submit to the MOE on behalf of the Municipality the required C of A application and fee to have the SWM facility and all related infrastructure under the facility's C of A ownership transferred to the Municipality.

5.5 FACILITY WARRANTY PERIOD

On or about the one (1) year anniversary of the assumption of the SWM facility, the Municipality will undertake a warranty inspection of the SWM facility. The Municipality will provide a list of deficiencies that are required to be corrected by the Proponent. Any security being held by the Municipality for the warranty period of the SWM facility will not be released to the Proponent until the Municipality judges that the deficiencies have been satisfactorily repaired.

6.0 Facility Operation by Municipality

Operation of the SWM facility after the Municipality's assumption will be carried out by the Municipality and will include periodic dredging of silt deposits from the sediment forebay of the SWM pond. Removal of potentially contaminated sediments may require compliance with regulations under the Environmental Protection Act. Lawn mowing, litter removal, trail maintenance and vegetation inspection (especially where a SWM facility is part of an open space) will be subject to the Municipality's maintenance and operations budget. Specific procedures for operation may be further addressed in updates of this document.

7.0 Acknowledgements and References

7.1 ACKNOWLEDGEMENTS

In order to build on the current municipal knowledge with regard to SWM policy and to provide for efficiencies to Proponents and Consultants who work in and around Middlesex Centre, this policy document has utilized and modified portions of the City of London's *Design Specifications and Requirements Environmental and Engineering Services Department, October 2003 Updated December 2005 Chapter 6 Stormwater Management Pond Requirements*. Major areas of commonality include Sections 3.3 and 3.4 dealing with SWM submission requirements, Section 4.3 Design Guidelines and Section 4.4 Technical Review Criteria.

In order to frame the policy background with regard to SWM, this document has utilized the Ausable Bayfield Conservation Authority's *Stormwater Management Policies and Technical Guidelines*, prepared by Stantec Consulting Ltd. This document provided the basis for Section 2.1 Summary of Roles and Responsibility and Section 2.5 Conservation Authority.

7.2 REFERENCES

Ausable Bayfield Conservation Authority. *Stormwater Management Policies and Technical Guidelines, Approved by ABCA Board of Directors, June 18, 2009.*

City of Cambridge. City of Cambridge *Stormwater Management Policies and Guidelines, (Revised) May 1997.*

Environment Canada, 2009*. Canada Geese and Shorelines*.

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Government of Ontario*. Environmental Protection Act.* Latest amendment to February 1, 2010.

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Government of Ontario. *Ontario Planning Act.* Latest amendment to February 1, 2010.

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Ontario Regulation 157/06 Upper Thames River Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses;

Ontario Regulation 171/06 St. Clair Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses; and

Ontario Regulation 152/06 Lower Thames River Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

Government of Ontario. Regulations made under the *Environmental Protection Act*. Latest amendment to February 1, 2010:

Ontario Regulation 347 General — Waste Management; and

Regulation 153/04 Records of Site Condition — Part XV.1 of The Environmental Protection Act

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APPENDICES

APPENDIX 4.1

Environment Canada publication

Canada Geese and Shorelines

Environment Canada | Environnement Canada

Canada Geese and Shorelines

Seasonal techniques to deter geese

Canada

Eric Dresser

Canada Geese in Southern Ontario

Canada Geese are beautiful birds and, until recent years, the sight of a flock carving a V in the spring sky was a welcome one for everyone. But geese that breed in temperate regions, such as southern Ontario, have become unwelcome residents of some lakeside properties.

Conflicts between people and Canada Geese arise when landowners are unable to deter the birds from taking up residence each spring. Once geese have nested successfully, their numbers tend to increase in future years.

Groups of the large birds feeding on the property may be simply inconvenient, or people may be concerned about feeding damage and an abundance of bird droppings. If landowners object to the presence of the birds, the best approach is timely, seasonal deterrence to discourage geese from settling on the property.

Eric Dresser

Timing is everything

There is no one solution to discourage Canada Geese. However, timely and careful attention to deterrent techniques may be enough to encourage geese to nest and feed elsewhere. Take the time to identify potential nesting and rearing sites on the property, and prepare to discourage the birds as soon as they arrive – as early as February. Monitor potential sites for newly arriving birds and act immediately. The birds are extremely reluctant to move on once they have begun moulting their flight feathers, in early June.

In the long term, attractive nesting and rearing habitat will continue to draw geese each year. Habitat modification may be necessary, along with seasonal deterrence, to discourage the geese more effectively over time.

If geese successfully establish a nest, do not destroy it. It is illegal to do so, and the geese will very likely rebuild another nearby.

Ian Parsons, Canadian Wildlife Service

Arrival		*Rearing-Moulting*		*Fall Migration*
February / March	Mid March to early May	Early May to late July	Late July to mid November	Mid November to December
	Breeding-Nesting		*Foraging flights*	

Sub-arctic breeding Canada Geese breed and raise their young in remote northern locations, stopping in southern Ontario to rest and feed during spring and fall migrations. These geese migrate between summer breeding grounds in the muskeg and tundra regions of northern Canada and their wintering areas in the United States.

Temperate-breeding Canada Geese live and breed in southern Ontario. Some may move south to the eastern United States for the winter period if snow and ice cover their feeding and roosting areas. Many remain year-round in southern Ontario. The expanding population and range of temperate-breeding geese have led to increased conflicts with people, particularly near water bodies.

Canada Geese: Protected by law

The Canada Goose is a migratory bird, protected under Canadian law by the *Migratory Birds Convention Act.* The Canadian Wildlife Service, part of Environment Canada, manages wildlife matters that are the responsibility of the federal government, including protection and management of migratory birds.

It is illegal to disturb, damage or destroy the nest or eggs of Canada Geese. However, special permits may be obtained from the Canadian Wildlife Service to use acceptable deterrent techniques. To request a permit, contact the Permits Officer at (905) 336-4464.

Seasonal deterrent techniques

Reduce the attractiveness of the site for breeding Canada Geese. Grassy expanses near water provide ideal goose habitat. Canada Geese are grazers and eat mainly short grasses such as those found in lawns, parks and golf courses. Geese also prefer good visibility to detect predators. They feed in open areas with clear flight access to ponds, lakes or marshes. Adjacent docks, beaches and yards provide secure places for preening and loafing.

• Modify the grass

It's a fact: Canada Geese prefer manicured lawns. Let the grass adjacent to the water body grow a little longer or plant coarse, tall grasses that are less appealing to geese.

• Obstruct the shoreline

Maintain an unmowed shoreline buffer of grasses, shrubs and wildflowers. Obstruct bird access to the shoreline with low fences or rock walls. Natural barriers include trees, densely spaced brush, hedge or shrubbery near the shorelines of lakes, ponds, wetlands and streams.

• Discourage nesting with "scare" techniques

Disturb the birds as soon as they arrive to deter them from settling on the property. Short-term techniques include noisemakers, strobe lights, recorded distress calls, and the use of trained dogs. Combine techniques (e.g., noise and light) and vary the sequence continuously or the birds will quickly adapt to the disturbance. Landowners may wish to consult with a wildlife professional about new technologies.

• Obtain a permit to discharge a firearm

A permit from the Canadian Wildlife Service is required for this technique. Where bylaws allow, permits may be issued authorizing the use of a firearm as a noisemaker to disturb the geese. The applicant must demonstrate that other techniques were tried without success.

• Obtain a permit to sterilize eggs

A permit from the Canadian Wildlife Service is required for this technique. If the birds have nested, use this technique within 10 days after the last egg is laid. Sterilize the eggs by coating them with non-toxic vegetable or mineral oil. Or addle (shake) the eggs to destroy the developing embryo. The goose will continue to incubate her eggs beyond the normal hatching date and will not re-nest.

• Erect temporary barriers

Keep broods (adults with goslings) away from designated areas with temporary barriers. Low fences marked with "Birdscare-Flash-Tape", fluttering strands of shiny Mylar tape, or other highly visible material can repel geese. Place the barrier at goose and gosling height between the water and the area to be protected. Adults can fly over the barrier but goslings will not follow – and the adults will not leave their goslings behind.

Report Leg Bands 1-800-327-BAND

Please call to report bird band numbers. The Canadian Wildlife Service bands more than 3,000 geese each year in southern Ontario. Band reports support decisions in monitoring and managing bird populations.

Population management

The Canadian Wildlife Service estimates that there are more than 400,000 temperate-breeding Canada Geese in Ontario today, far more than would have occurred without human interference. In some areas, the expanding goose population can bring about conflicts, mess and damage for community parks, recreational or agricultural properties, and lakeside homes and cottages.

Eric Dresser

The Canadian Wildlife Service employs various measures to manage the population:

- *periodic surveys* to monitor the population size and range;
- *leg banding* to track individual survival, movements and number harvested;
- *advice and permits* to landowners to mitigate conflicts with Canada Geese;
- *hunting regulations* to provide harvest opportunities and limit population growth.

Walter B. Fechner

Understanding Canada Geese

A brief history

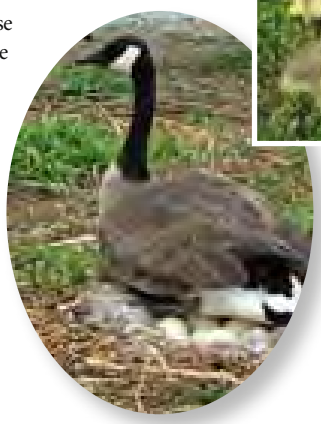
Accounts by seventeenth century explorers show that Canada Geese were part of the area's original fauna and were very abundant in the extreme southwest, where prairie and wetlands covered hundreds of square kilometres. Settlers in the late eighteenth century cleared most forests in southern Ontario – improving goose habitat – and local wildlife was hunted to support growing families. Unrestricted harvests drastically reduced goose populations and, by the turn of the twentieth century, Canada Geese had disappeared from nearly all of their former breeding range within southern Ontario.

In the late 1960s and early 1970s, the Ontario Ministry of Natural Resources and local conservationists reintroduced Canada Geese to southern Ontario. A combination of factors contributed to the success of this effort. Manicured parks, lawns, golf courses, and agricultural crops flanked by ponds or watercourses provided ideal breeding habitat. Few predators remained in the region. In addition, geese are remarkably adaptable. Geese have been reported nesting in trees, roadside ditches, adjacent to swimming pools, and even on flat rooftops.

Biology basics

Breeding: Most pairs of Canada Geese mate for life, but a new mate will be selected if one dies. Canada Geese usually breed for the first time in their third year. Many live longer than 10 years and some as long as 25 years. Pairs seek nesting sites during the first warm days of February. By mid to late March, most pairs have a well-established breeding territory and begin laying clutches of two to eight eggs.

Nesting: By mid-April, most female geese are sitting on their nests. Preferred sites are near water, such as small islands, and the shorelines of ponds and wetlands. While nesting, geese may become aggressive toward people or their pets in defence of the nest. If the nest is destroyed, geese may attempt to re-nest nearby.



The Giant Canada Goose is the most common sub-species of Canada Geese breeding in rural southern Ontario.

Walter B. Fechner

Rearing: Conflicts between landowners and geese often occur in late spring and early summer when the geese are raising their young and feeding heavily. Peak hatching occurs in May. Rearing a brood requires more security and accessible food so adult pairs often move goslings some distance. High quality sites may attract several family groups.

Moulting: A few weeks after the goslings hatch, adult geese moult their wing feathers, leaving them flightless for up to six weeks. During this period, the adults are vulnerable and highly reluctant to leave the rearing-moulting area. By mid-July, many goslings and adults can fly. By the end of July, most geese move to roosting areas on larger bodies of water, from which they fly daily to feed. If the rearing-moulting area provides food, water and security, some family groups may remain until early September.

Fall migration: Temperate-breeding geese are joined in fall by sub-arctic breeding geese as they migrate. The length of stay for northern migrants depends on weather, food availability, and local hunting pressure. Peak numbers usually occur in mid to late October. By early December, the majority of sub-arctic breeding geese have flown south. If winter conditions occur in early to mid December, many temperate breeding geese also move south to the United States, some as far as Tennessee.

Glenn Barrett, Canadian Wildlife Service

Contact the **Canadian Wildlife Service**

By telephone:
London: (519) 472-1406 Nepean: (613) 952-2405

By fax:
London: (519) 472-3062 Nepean: (613) 952-9027

By e-mail:
Wildlife.Ontario@ec.gc.ca

To request a permit, contact the Permits Officer at (905) 336-4464.

www.on.ec.gc.ca/wildlife

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APPENDIX 5.1

Sample
SWM Maintenance
and Operations Manual

COVER PAGE
Name of Facility
Registered Plan Number
Report Prepared for: Development Proponent
Report Prepared by: Consultant
Date:_____

Table of Contents

List of Attached Forms

1.0 GENERAL DESCRIPTION

Provide description, example:

The XYZ stormwater management facility is comprised of an extended detention pond/wet pond/wetland type SWM facility with wetland plantings and is equipped with an outlet control system. The facility also has a turfstone access road for the purposes of maintenance including the removal of accumulated silt from the sediment forebay, which is located at the facility inlet.

2.0 RESPONSIBILITY OF OPERATION AND MAINTENANCE

The operation and maintenance of the facility is the responsibility of Development Proponent until the facility is assumed by the Municipality of Middlesex Centre who will undertake ownership. Following the expiration of the warranty period following assumption Middlesex Centre will take over the maintenance of the facility.

3.0 PURPOSE

3.1 Introduction

The SWM facility was constructed to treat the stormwater from the XX.X ha Development Proponent property to the levels presented as required by the Conservation Authority/Watershed Study/Subwatershed Study/Other Agency Mandated/ MOE 2003 BMMP. There are/aren't external drainage areas that contribute runoff to the facility. The facility is designed to meet the stormwater management criteria detailed in the following section.

3.2 Quality Control

Provide description, example:

The permanent pool volume is constructed to provide MOE 2003 BMMP Enhanced/Normal protection level water quality treatment.

3.3 Quantity Control

Provide description, example:

The facility is constructed to attenuate the 100-year peak discharge from the Development site to XX.X Litres per second (L/s).

3.4 Erosion Control and Baseflow Augmentation

Provide description, example:

The facility is constructed to detain 90% of the runoff from the 25mm rainfall event for a period of 72-hours. The remaining 10% is released at a rate of XX.XL/s to augment baseflow in Receiving Water Body.

4.0 DESCRIPTION OF SWM FACILITY OPERATION

4.1 Introduction

Provide description, example:

The facility is designed to be relatively maintenance free. The facility inlet is located on the eastern end of the pond and consists of a single inlet which discharges to a rip rap pad that mitigates the possibility of slope erosion. This inlet is designed for minor flow conveyance. Major system flows enter the facility by flowing down the northern and eastern side slopes. The outlet structure is located at the western end of the facility and consists of a clear stone exfiltration jacket/perforated CSP riser/orifice outlet assembly. The sediment forebay, located at the pond inlet, and is accessed by a turfstone maintenance path for the purpose of sediment removal. A summary of the pond dimensions, volumes, and elevations is provided in Table 1.

Table 1 – SWM Facility Summary

Pond Bottom Elevation (main pond/forebay)	___m / ___ m
Permanent Pool Volume Provided	_____ m^3
Permanent Pool Depth (main pond/forebay)	___m / ___ m
Permanent Pool Elevation	_____ m
Extended Detention Volume Provided	____ m^3
Extended Detention Depth	_____ m
Extended Detention Elevation	_____ m
Extended Detention Drawdown Time (25 mm storm)	>XX hrs
Extended Detention Outlet Orifice Size	___ mm
Extended Detention Outlet Orifice Invert Elevation	_____ m
Quantity Control Outlet Orifice Size	___ mm
Quantity Control Outlet Orifice Elevation	_____ m
Overflow Weir Crest Length	___ m
Overflow Weir Crest Elevation	_____ m

4.2 Volumes

Provide description, example:

As summarized in Section 4.1, storage volumes of XXXX m^3 and XXXX m^3 have been provided to meet and/or exceed the permanent pool and extended detention requirements for water quality control treatment. The permanent pool depth is X.X m in the main pond, and X.X m in the sediment forebay.

4.3 Flow Rate Control Systems

Provide description, example:

4.3.1 Extended Detention Orifice

The storage volume provided during low flow events (i.e. 25 mm design storm), from elevation XXX.X m to XXX.X m, is controlled and slowly released through the perforated CSP/orifice assembly. This assembly consists of an aluminized CSP manhole riser with perforations starting at elevation XXX.X m. This riser is fitted with a clear stone jacket and is designed to protect the outlet orifices. The XXX mm diameter orifice ultimately controls the extended detention volume outflow from the SWM facility. As the water level in the facility rises, the differential head increases through the orifice, thereby increasing the flow. Based on the operational characteristics of the pond, the flow rate may require adjustment in order to modify the detention time. This may be accomplished by installing a modified orifice plate.

4.3.2 Quantity Control Orifice

The storage volume provided during large flow events (i.e. >25 mm design storm), from elevation XXX.X m to XXX.XXX m, is controlled and slowly released through the perforated CSP/orifice assembly. The XXX mm diameter orifice ultimately controls the quantity control volume outflow from the SWM facility. As the water level in the facility rises, the differential head increases through the orifice, thereby increasing the flow. Based on the operational characteristics of the pond, the flow rate may require adjustment in order to modify the peak outlet discharge. This may be accomplished by installing a modified orifice plate.

4.3.3 Emergency Overflow Weir

If the storage capacity of the facility is exceeded, any additional flow is conveyed by the overflow weir located on the western side of the pond, which discharges to the Green Valley Storm Outfall.

5.0 CLEANING

The sediment forebay is designed to collect sediment from the storm runoff so that cleaning activities are restricted to the forebay and the remainder of the facility remains undisturbed. Therefore the forebay will require periodic removal of the accumulated sediment.

To ensure that the pond provides sufficient erosion and sediment control, the forebay may require cleaning during the site subdivision construction stage. Development Proponent, through their authorized representative, will remove accumulated silt based on the results of the erosion and sediment control monitoring, as detailed in the Functional SWM report. They will also provide qualified personnel to supervise, review and approve the cleaning operation.

After construction, it is estimated that cleaning may be required every seven years. However, this estimate should be used only as a guideline and pond cleaning should be performed as required. Cleaning, supervision of work, inspections and approvals will be performed by personnel authorized by Development Proponent. These qualified individuals will be able to estimate sediment accumulation and cleanout frequency based on the maintenance log for the facility. They will also be able to schedule the cleaning work during the dry season, which is considered highly desirable for cleaning operations.

Forebay cleaning may require the use of a small rubber-tired backhoe or similar vehicle or vacuum equipment and a dump truck. The accumulated sediment must be removed down to the original elevation, and the pond graded and restored appropriately

Any damage to existing vegetation should be repaired or restored. Exposed soils should be re-seeded to re-establish ground cover as quickly as possible to minimize erosion of the slopes. In addition, efforts should be made not to disturb the rip-rap and turfstone placed about the pond inlet, outlet and forebay areas as the sediment trapped in these surfaces will promote natural regeneration of plant species providing good stabilization for the slope and prevent further bank erosion.

Sediment accumulation within the clear stone jacket surrounding the CSP should also be inspected and flushed with a high pressure hose if required.

6.0 DISPOSAL

The settled material collected in the pond forebay is usually similar in composition to street sweepings. The same site used for the disposal of street sweepings should be used for the disposal of the settled silt material. In case of uncertainty with respect to the designated disposal site, a representative sample of the sediment and the Sediment Removal Form 3, as later detailed in this manual, must be analyzed and completed by a qualified laboratory to justify the method and disposal location.

7.0 GENERAL MAINTENANCE

General maintenance items should be reviewed annually by qualified engineering personnel, who should assess any damage and recommend proper repairs. Items to be reviewed/inspected include:

- All steel, plastic and concrete structures
- Access routes
- Condition of ground cover and other vegetation
- Berms and overflow weirs
- Conditions downstream of the outlet
- Removal of any accumulated litter or trash
- Sediment accumulation in the forebay

7.1 Vegetation Management in the Pond Block

The design of the SWM facility includes native plantings within the pond limits. Maintenance of the SWM block must protect the ability of the vegetation to develop naturally over time, and minimal disturbance should be the goal.

7.2 Initial Planting Inspection and Warranty Period

Planting, inspection and the two year plant survival warranty period are all covered by the landscaping tender and construction process. After the warranty period has expired, it will be up to the facility manager to maintain vegetation as recommended below.

7.3 Wetland Vegetation Maintenance

The planting plan for the pond includes establishment of emergent vegetation on the aquatic safety bench and floating vegetation throughout the extended detention pond/wet pond/wetland area, not including the sediment forebay. Regular cleaning activities to remove sediment will generally be restricted to the sediment forebay and will also result in the removal of most vegetation. Natural regeneration will be sufficient to re-establish

wetland vegetation in this area. If cleaning, or other disturbance is required in the remainder of the pond, emergent vegetation should be avoided, if possible. In the event that it is necessary to remove emergent or floating pond vegetation in the extended detention pond/wet pond/wetland a minimum of 20% of the existing plants of each species should be retained to provide a source for vegetation reestablishment.

The pond should be monitored annually for invasive, non-native species, particularly purple loosestrife. If large amounts of purple loosestrife become established in the pond, and is judged to be a potential negative impact to the native pond vegetation, or adjacent floodplain communities, a manual control program should be implemented. Early in the season, when the species is flowering for easy identification but has not yet gone to seed, individual plants should be removed by hand and burned to prevent seeds and vegetative pieces from entering the downstream ESA, to the extent possible. Plans for control of other invasive, non-native species should be implemented as necessary.

No regular maintenance will be required for the native wetland vegetation.

7.4 Terrestrial Vegetation Maintenance

The planting plan for the area surrounding the pond has been designed so that it does not require any mowing. Woody vegetation is encouraged and mowing is discouraged to eliminate open areas that provide potential nesting and loafing habitat for geese and other waterfowl. These species can have a detrimental effect on water quality, particularly through nutrient enrichment.

Corrective pruning, using best standard arboricultural or horticultural practices, may be implemented to enhance the vigour of planted specimens or remove any hazardous limbs or trunks that could pose a danger to pedestrians using the trail facilities. Aside from trimming to reduce human safety concerns, occasional replacement of dead or vandalized specimens, or the control of invasive species, the terrestrial portion of the SWM block should require no regular maintenance.

8.0 COMPLIANCE WITH REGULATIONS

8.1 Introduction

The current owner of the facility shall periodically review to ensure that the operations practices for the facility meet the requirements of the issued Certificate of Approval, as well as any applicable MOE Orders, or Ontario statues and regulations.

8.2 Monitoring Frequency

A semi-annual monitoring frequency is required to be undertaken by the Development Proponent until the assumption by Middlesex Centre. Once Municipality of Middlesex Centre assumes operation and control of the facility, the facility will be monitored on a bi-annual basis or at a frequency required to meet issued Certificate of Approval, MOE Orders, or Ontario statues and regulations.

8.3 Pond Monitoring and Condition Review – Prior to Assumption

The facilities' performance will have to be monitored during maintenance and operation by the Development Proponent and after assumption by Middlesex Centre. The following program should be undertaken on a semi-annual (spring, autumn) basis to assess the facilities' condition:

- Complete the enclosed Pond Review Form 1 on each occasion. The form should be completed by a qualified technician and will provide the basis for any required pond maintenance.

- Undertake all required repairs to the pond and complete the enclosed Maintenance Log Form 2.

- During all inspection activities, litter or trash that may have accumulated in the facility should be collected and disposed of in an appropriate location.

The following program should be undertaken at least twice during the summer to monitor the extended detention performance of the pond;

- After a summer thunderstorm the depth of the ponded water should be monitored at regular intervals and the appropriate outflow rate be established by completing the enclosed Pond Performance Form 3.

8.4 Pond Monitoring and Condition Review – Post Assumption

The following program should be on a bi-annual basis or at a frequency required to meet issued Certificate of Approval, MOE Orders, or Ontario statues and regulations to assess the facilities' condition:

- Complete the enclosed Pond Review Form 1 on each occasion. The form should be completed by a qualified technician and will provide the basis for any required pond maintenance.

- Undertake all required repairs to the pond and complete the enclosed Maintenance Log Form 2.

- During all inspection activities, litter or trash that may have accumulated in the facility should be collected and disposed of in an appropriate location.

The following program should be undertaken at least twice during the summer to monitor the extended detention performance of the pond;

- After a summer thunderstorm the depth of the ponded water should be monitored at regular intervals and the appropriate outflow rate be established by completing the enclosed Pond Performance Form 3.

8.5 Sampling of Sediment

To ensure the sediment sampling is representative, samples will be taken from at least two areas of the pond to form a composite sample for each test.

However, if the physical characteristics of the sediment, such as colour, sheen, or texture of one area appear to be different from the other areas, this area should be analyzed separately.

The enclosed Sediment Removal Form 4 should be completed after each sediment sample. Based upon the quality of the sediment, the sediment may have to be analyzed prior to the removal to assess the proper disposal location.

All sampling procedures and locations should be performed and selected by qualified technicians based upon on-site conditions. In addition, the analysis of these samples must be conducted by a qualified and accredited laboratory.

Analysis of the sediment must be done in accordance with MOE Regulation 347 (formerly 309) and include leachate extraction, Schedule 4 metals and Schedule 4 anions, in order to determine dumping locations.

8.6 Reporting

Two copies of Pond Review Form 1 and Sediment Removal Form 3 must be sent to the following:

- Ministry of Environment
  Southwestern Regional Office
  659 Exeter Road, 2nd Floor
  London, ON N6E 1L3

- Municipality of Middlesex Centre
  10227 Ilderton Rd, R.R. # 2
  Ilderton, Ontario NOM 2AO
  Attention: Director, Public Works and Engineering

- Development Proponent

Pond Review Form 1

POND REVIEW FORM 1

Review Date: _____ By: _____
(name)

of: _____

Reason for Review: Regular Semi-Annual: _____ Other: _____

If other, provide brief description reason for review: _____

_____

ITEMS OF REVIEW

.1 Pond bottom: Description of pond bottom condition. Take photographs.

_____

_____

Number of photographs taken: _____

.2 Ground Cover: Condition of vegetation. Take Photographs

Mostly grass: _____

Weeds: _____ Bullrushes: _____ Shrubs: _____

Other: _____

Vegetation appears healthy: Yes _____ No _____ If no:

Lack of irrigation: _____ No _____ Other: _____

Number of photographs taken: _____

.3 Access roads. Description of access road conditions. Take photographs.

_____

_____

Number of photographs taken: _____

.4 Outlet Structure: Description of condition. Describe any faults with outlet structures. Take photographs.

_____

_____

Number of photographs taken: _____

.5 Berm and Overflow Weirs. Description of conditions. Describe any evidence of erosion. Take photographs.

_____

_____

Number of photographs taken: _____

.6 Depth of sediment. Describe each area where depth taken.

Inlet Sediment Forebay: _____ Depth: _____ cm

.7 Exfiltration Berm/Inlet structure. Description of condition. Take photographs.

_____

_____

Number of photographs taken: _____

.8 Downstream erosion. Description of condition. Take photographs.

_____

_____

Number of photographs taken: _____

Maintenance Log Form 2

MAINTENANCE LOG FORM 2

FROM _____ TO _____

	Litter Removed	Channel Cleaning	Concrete Repairs	Grate/Rails Repairs	Inspection Report *	Sediment Removed **
Date:						
Initial:						
Date:						
Initial:						
Date:						
Initial:						
Date:						
Initial:						
Date:						
Initial:						
Date:						
Initial:						
Date:						
Initial:						
Date:						
Initial:						

* Complete Pond Report Form 1

** Complete Sediment Removal Form 3

NOTES: _____

Pond Performance Form 3

POND PERFORMANCE FORM 3

Date: _____

Name: _____

Time	Water Level (m)	Surface Area (m^2)	Volume Exfiltrated (m^3)	Exfiltration Rate (m^3 / s)

COMMENTS: _____

Sediment Removal Form 4

SEDIMENT REMOVAL FORM 4

Date: _____ Removed by: _____

Description of precautions taken to prevent effluent fouling during removal of sedimentation:

_____

_____

_____

_____

Volume of sediment removed: _____ m^3

Samples Taken: _____ yes; _____ no

Analyzed by: _____

Results: _____

Sediment disposed at: _____

_____

_____

REVISIONS
(SUPERCEDED PAGES)

10. Proponent correction of deficiencies identified in warranty inspection.

5.4.2 Monitoring Program

The Proponent is required to ensure that any other monitoring required by the specific requirements of the Subdivision or Site Plan Agreement and/or other approval agencies is carried out.

5.4.2.1 Minimum Monitoring Program

The process of assumption commences with a minimum two (2) year monitoring program to be undertaken by the Proponent prior to confirm that the SWM facility is functioning as designed. The Proponent shall ensure that competent staff is employed by their engineering consultant to undertake the required sampling program. Inlet and outlet grab samples are required to confirm that quality objectives are being met based on sampling for the following parameters:

1. Total suspended solids;
2. Nitrate;
3. Phosphorus; and
4. F1-F4 Petroleum Hydrocarbons.

Annual sampling to include:

1. One (1) spring sample (April 1 to May 15);
2. Five (5) summer samples (May 15 to September 30);
3. One (1) fall sample (October 1 to November 3); and
4. One (1) winter sample (December 1 to March 31).

Grab samples are to be taken within 90 minutes of the onset of a rainfall event and only when there is sufficient inlet and outlet flow to recover samples. Samples are to be submitted for analysis to an Accredited Laboratory. Sample recovery and handling (including use of required bottles provided by the laboratory and sampling techniques) are to be in accordance with the procedures of the Accredited Laboratory. A formal chain of custody form from the Accredited Laboratory is to be maintained.

During each sampling event accurate measurements of the pond water elevations and the discharge rate will be taken. Reporting for each sampling event will include rainfall data from the closest available Environment Canada or Conservation Authority rain gauge to corroborate the run off event with a rainfall event.