In Association with BLACK & VEATCH Building a world of difference

Town of Innisfil

Lakeshore WPCP Expansion Environmental Study Report (Final)

Ainley Group
Consulting Engineers and Planners
280 Pretty River Parkway,
Collingwood, Ontario
L9Y 4J5

Telephone: 705-445-3451
Fax: 705-445-0968
www.ainleygroup.com

File: 108128
September 2011

Table of Contents

Tables

Figures

Appendices

Abbreviations and Acronyms

°C	degrees Celsius
ADF	Average Day Flow
B&V	Black & Veatch Canada
BAF	Biologically Aerated Filter
BBPRD	Big Bay Point Resort Development
bioP	biological phosphorus removal
BNR	Biological Nutrient Removal
BOD_5	Biological Oxygen Demand (in five days)
CAS	Conventional Activated Sludge
$CBOD_5$	Carbonaceous Biological Oxygen Demand (in five days)
Class EA	Municipal Class Environmental Assessment
cm	centimetre
cm/s	centimetre per second
CofA	Certificate of Approval
DAF	Dissolved Air Flotation
dB	decibel
DO	Dissolved Oxygen
Dwg.	Drawing
EA	Municipal Class Environmental Assessment
EBR	Ontario Environmental Bill of Rights Registry
E. coli	Escherichia coli
EPA	United States Environmental Protection Agency
ESR	Environmental Study Report
F/M ratio	food to microorganism ratio
GE	General Electric

HESL	Hutchinson Environmental Sciences Ltd.
HRT	Hydraulic Retention Time
Hwy	Highway
I/I	Inflow and Infiltration
ICI	Industrial, Commercial and Institutional
IFAS	Integrated fixed-film activated sludge
kg	kilogram
kg/day	kilogram per day
kg/year	kilogram per year
L	litre
L x W x H	Length times width times height
LAC	Liaison Advisory Committee
L/c/d	Litres per capita per day
lmh	Litres per square metre per hour
LOT	Limit of Technology
LSEMS	Lake Simcoe Environmental Management Strategy
LSPP	Lake Simcoe Protection Plan
LWPCP	Lakeshore Water Pollution Control Plant
m	metre
m/s	metres per second
m^2	square metre
m^3	cubic metre
m^3/day	cubic metre per day
Max.	Maximum
MEA	Municipal Engineer's Association
mg/L	milligram per litre

mL	millilitre
ML/d	Megalitres per day
MLD	Megalitres per day / Million litres per day
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed liquor volatile suspended solids
MOE	Ontario Ministry of the Environment
n/a	not applicable
NH_3	un-ionized Ammonia
$NH_3 + NH_4$	Ammonia
NHIC	Natural Heritage Information Centre
NMS	Nutrient Management Strategy
No.	Number
NPV	Net Present Value
O&M	Operations and Maintenance
OMB	Ontario Municipal Board
OP	Official Plan
OPA#1	Official Plan Amendment Number 1
O.Reg.	Ontario Regulation
o/s	out of service
P	phosphorus
PAO	Phosphorus Accumulating Organisms
PF	Peak Flow
PIC	Public Information Centre
ppu	persons per unit
PRS	Phosphorus Reduction Strategy
PWQO	Ontario Provincial Water Quality Objectives

Q	Flow
RAS	Return Activated Sludge
SBR	Sequencing Batch Reactor
SLR	Solids Loading Rate
SOR	Surface Overflow Rate
SPR	Shoreline Protection Regulation
SRT	Solids Retention Time
TAL	Technology Achievable Limit
TKN	Total Kjeldahl Nitrogen
Town	Town of Innisfil
TP	Total Phosphorus
TSS	Total Suspended Solids
UV	Ultraviolet
VFA	Volatile fatty acid
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WCES	Water Conservation and Efficiency Strategy
WEFTEC	Water Environment Federation Technical Exhibition and Conference
WERF	Water Environment Research Foundation
WPCP	Water Pollution Control Plant
WQT	Water Quality Trading feasibility study

EXECUTIVE SUMMARY

Background

To accommodate the full build out of the Town of Innisfil's 2008 Official Plan including Official Plan Amendment #1, additional wastewater treatment capacity will be required. Therefore in October 2008 the Town retained the team of Ainley & Associates Limited and Black & Veatch Canada (Ainley/B&V) to undertake a Municipal Class Environmental Assessment (EA) for the expansion to the LWPCP.

Class EA - Phase 1

The Town issued a Notice of Study Commencement on May 23, 2008. At that time, the Town also solicited members of the public or interest groups to participate in a Liaison Advisory Committee (LAC) to be involved throughout the EA process. A Steering Committee, comprising Town Councillors, Town Staff and the Consultants was also established.

Phase 1 included completion of background studies (Stage1 Archaeological and Geotechnical Investigations) to compliment the Environmental Site Assessment previously completed by the Town, as well as determination of the serviced population. Following completion of these studies, a Draft Phase 1 Report was submitted to the Town on February 6, 2009.

The Problem Statement was defined as part of the Phase 1 Class EA as follows:

In order to accommodate the full build out of the Town of Innisfil's currently approved (1996) Official Plan an expansion of the existing Lakeshore Wastewater Treatment Plant in Alcona was planned and soon will be necessary. In addition, the Ontario Municipal Board has now approved the Big Bay Point Recreational Resort development in Innisfil (Official Plan Amendment # 17).

The problem statement was revised in July 2009 with the inclusion of OPA#1 lands into the service area.

Class EA – Phase 2

Phase 2 consisted of identifying possible alternatives to address the problem statement. Following publication of a Notice dated March 19, 2010, the first Public Information Centre (PIC) was held on April 7, 2009. A total of 26 members of the public signed in and a total of five comment sheets were received during the two-week comment period following the PIC.

Allowing for the fact that the discharge of phosphorus into Lake Simcoe is a major factor to consider for many of the alternatives, four Pilot Studies were undertaken during the spring of 2009 to investigate phosphorus removal technologies that could be implemented at the LWPCP or other alternatives. The Pilot Study goals were:

- To identify technologies that would permit the expansion to 40 MLD ADF while staying within the Interim Phosphorus Regulation (O.Reg. 60/08) cap of 351 kg per annum.
- Based on the 351 kg/year cap, achieve an effluent phosphorus concentration of 0.024 mg/L at an average day flow of 40 MLD.
- Identify the preliminary construction & operating costs associated with the proposed technologies.
- To select preferred technology but not preferred manufacturer;
- To confirm process/facility sizing and chemical requirements;
- To stress test the pilots at a flow of 3Q (120MLD);
- To determine if an effluent phosphorus concentration of 0.01mg/L can be met;
- To determine if there is a measurable performance benefit to those processes that claim some adsorption of phosphorus?

It is noted that, although the pilot study of April /May 2009 was undertaken with a goal to meet the interim effluent phosphorus loading of 351 kg/year, the Lake Simcoe Phosphorus Reduction Strategy, dated June 2010 increased the maximum allowable loading from the LWPCP to 629 kg/year. The pilot study was undertaken based on testing the technologies to their maximum.

The Pilot Study conclusions were:

- Two of the four technologies (GE/Zenon and BlueWater) achieved the 0.024 mg/L TP target that would permit the expansion to 40 MLD while staying within the Interim Phosphorus Regulation cap of 351 kg per annum.
- Membranes (GE/Zenon) proved to the most robust and provided the best performance under stress conditions.
- All of these technologies would be extremely expensive to construct and operate versus conventional TP removal technologies.

Concurrent with determining the Preferred Phase 2 Solution, the Steering Committee decided to revise the Service Area to correspond with the Town's 2008 Official Plan, including OPA #1. This adjustment to the Service Area increased the required wastewater treatment capacity to 39,573m^3/day, versus the 29,517m^3/day that was presented at the Phase 2 PIC, held in April 7, 2009. However, this adjustment had no impact on any of the analyses within Phase 2 of the Class EA and in particular did not change any of the Options that were reviewed and considered in Phase 2.

The Notice of "Phase 2 Preferred Solution & Revised Service Area" was published in August 2009 and identified the Phase 2 Preferred Option as:

- Expand/Upgrade the Town's existing Water Pollution Control Plant to 40 Million Litres per day (MLD) on the Municipally owned lands to the west of the existing site.

Class EA - Phase 3

The Notice of PIC #2 was published on September 30, 2009 and PIC #2 was held on October 14, 2009. A total of 29 members of the public signed in and only one comment sheet was received during the two week comment period following the PIC.

At that time, the Recommended Design Solution was to revise the secondary treatment to a conventional activated sludge process instead of the current extended aeration process. It was also determined that tertiary treatment would be provided by membrane filtration as a result of the successful pilot study. This decision was based on the total phosphorus limit as defined by the Province's Interim Regulation (O.Reg. 60/08) cap of 351 kg/year.

Subsequent to the October 14, 2009 PIC, the Ministry of Environment (MOE) requested that the Town put the Class EA temporarily on hold, pending release of the "Phosphorus Reduction Strategy" (PRS) and "Water Quality Trading" (WQT) studies for the Lake Simcoe Protection Plant (LSPP) by the MOE. The MOE subsequently released the PRS and WQT studies in Draft on February 17, 2010.

After restarting the Class EA in March 2010, PIC #3 was held on May 25, 2010 to present updated information based on the MOE's Draft PRS and WQT studies which identified a new, initial, baseline phosphorus load of 629 kg/year for the LWPCP until 2015 or the next time the LWPCP is expanded. Under the Draft PRS, staged decreases in the allowable TP loading, of 20% every 10 years, would be required, to totals of 503, 377 and 292 kg/year in 2025, 2035 and 2045 respectively. After 2015, the Draft PRS presented two possible options for reducing the phosphorus loads and achieving the 2031 (as per Official Plan projections) target of 459 kg/year as follows:

Option 1	Rely upon Treatment Technology
Option 2	Combination of Treatment Technology & Water Quality Trading (if implemented by the Province)

It should be noted that the June 2010 PRS (discussed under Clause 19.0) qualified the requirement for future incremental TP loading reductions by stating that a re-evaluation will be completed in 2015. As such, the requirement for staged decreases in TP loading from the Innisfil LWPCP has not been addressed in this ESR. In addition, the feasibility of water quality trading is considered to be undetermined at this time and therefore, the option of water quality trading has not been recognized in this ESR.

In addition, at PIC #3 a list of 13 secondary (biological) treatment alternatives were presented along with the following "short-listed" alternative secondary treatment processes for more in depth evaluation for two proposed expansion phases:

Alternative 1 – Conventional Activated Sludge with full Biological Nutrient Removal (BNR)

Alternative 2 – Extended Aeration Activated Sludge (Existing Process)

Alternative 3 – Conventional Activated Sludge (No BNR)

Based on the new total phosphorus limits identified within the PRS and WQT studies, it was determined that an extended aeration secondary treatment process could be retained for the first expansion up to 25,000 m^3/day (25 MLD). It was also determined that a conversion of the secondary treatment process should be made for any flows greater than 25 MLD, to a conventional activated sludge process with biological nutrient removal (BNR).

Phase 3 Recommendations

The Steering Committee made the following recommendations regarding the treatment process proposed for the LWPCP expansions:

Secondary Treatment Process

For the first expansion (Stage III), up to an average day flow of 25 MLD, the Extended Aeration Process is the recommended secondary treatment option for the following reasons:

- Easier to implement
- Lowest capital cost

For the second expansion (Stage IV), from an average day flow of 25 MLD up to an average day flow of 40 MLD, the Conventional Activated Sludge with full BNR process is the recommended secondary treatment option for the following reasons:

- Highest degree of sustainable operating technology
- Highest degree of environmental stewardship
- Lower capital cost because of reduced digestion volume requirement
- Lowest operating and maintenance cost

Tertiary Treatment Process

Based on the results of the Pilot Studies, the use of Membranes is the preferred Tertiary Treatment process for both expansions, for the following reasons:

Membranes provided the best performance under stress conditions. It is expected that they will be able to handle and recover quicker from unforeseen upset conditions.

Membranes provide barrier type treatment that will aid in removal of other parameters in the effluent.

Recommended Solution

In addition to the proposed secondary and tertiary treatment upgrades/expansions, the Class EA planning process determined that the Town should encourage water conservation and reduce inflow and infiltration into the wastewater collection system. The overall Recommended Solution is described as follows:

<u>Prior to June 2, 2014</u>

- The Town of Innisfil commits to complete a Water Conservation and Efficiency Strategy (WCES), in conjunction with detailed design of the proposed Lakeshore WPCP Stage III Expansion, for the water and waste water flows within the Lakeshore Water and Wastewater Service Areas. Note that the Lake Simcoe Protection Plan (LSPP) requires that a WCES be completed with implementation beginning by June 2, 2014. It is expected that detailed design will be completed prior to the LSPP deadline (detailed design is expected to be completed in 2012). However, the Town should have the WCES completed prior to June 2, 2014 to comply with the LSPP. The WCES should span the full planning horizon (up to 2024 at the minimum). The WCES shall:
    - Provide targets for conservation, efficiency, inflow and infiltration reduction to the Lakeshore WPCP;
    - Provide timelines for achieving the targets, as well as the strategies, tactics, programs and initiatives to be used, including the cost to implement these;
    - Assess methods of achieving conservation measures such as improved management practices, the use of flow restricting devices and other hardware;
    - Encourage water conservation incentives, education and demand monitoring in an attempt to reduce water consumption;
    - Aggressively reduce wet weather peak inflow and infiltration rates into the collection system through enhanced system monitoring (flow measurement), system inspections and regular maintenance;
    - Develop a strict Sewer Use Bylaw along with regular monitoring program;
    - Assess the feasibility of non-potable effluent reuse/recycling and practices and technologies associated with water reuse/recycling;
    - Consider the potential impacts of climate change.
- The WCES shall include a program for the reduction of inflow and infiltration from the Lakeshore WPCP collection system. This program shall include reduction priorities, targets, timelines, tactics and initiatives, and the associated costs to implement these;
- The WCES shall include an implementation plan for the proposed initiatives. It shall also include a monitoring and reporting plan to assess the effectiveness of the initiatives as well as the achievement of water conservation and/or efficiency targets;
- The Town of Innisfil will consult with the public, relevant government agencies and the Ministry of the Environment's Central Regional Office on its proposed WCES;

The WCES shall include a review of best in class water conservation and efficiency programs, initiatives, strategies and tactics adopted by other jurisdictions. The review shall include an analysis of best in class tactics/strategies used by jurisdictions throughout the world. This review shall be made public and shall form part of the consultation process for the WCES, as required above.

Year 2015 (estimated)

- Expansion of the existing LWPCP on Town owned property to 25 MLD using the extended aeration secondary treatment process with membrane filtration for tertiary treatment, aerobic sludge digestion with land application of biosolids and existing outfall pipe configuration; and
- The Town should immediately undertake a program to investigate the sanitary sewer system in order to reduce the wet weather flows to the plant.

Year 2024

- Expansion of the LWPCP on Town owned property to 40 MLD by converting the secondary treatment process to conventional activated sludge with biological nutrient removal, expansion of the tertiary membrane filtration facility, conversion to anaerobic sludge digestion and the opening of all diffuser ports on the existing effluent outfall pipe; and
- Update the Water Conservation and Efficiency Strategy, in conjunction with detailed design of the proposed Lakeshore WPCP Stage IV Expansion, for the water and waste water flows within the Lakeshore Water and Wastewater Service Areas, based on the monitoring and reporting plan completed between 2014 and 2024.

Principal Environmental Impacts of the Project and Proposed Mitigating Measures

The preferred solution does not significantly impact the environment as outlined in Clause 21.12. There will be some short duration impacts during construction (truck traffic, noise, dust and mud), which will be mitigated. Construction traffic will be limited in accordance with local by-laws and construction times will be restricted. An established truck route will be determined. The need for a traffic impact study will be determined during final design.

Long term impacts have been identified as plant noise and odour. A Noise Assessment was completed as part of the Class EA process and a copy of the Report is included in Appendix S. Mitigation measures are outlined in the Noise Assessment and are summarized in Clause 21.12.3 of this ESR.

An Odour Assessment was also undertaken as part of the Class EA process and a copy of the Report is included in Appendix T. Recommendations to maintain the current odour magnitude are included in the Report and are summarized in Clause 21.12.4 of this ESR.

An Effluent Assessment was also completed with respect to the protection of Lake Simcoe. A copy of the Effluent Assessment is included in Appendix O and is summarized in Clause 19.0 of this ESR. The proposed Plant expansions (25MLD and 40MLD) will have negligible effects on aquatic life in Lake Simcoe. The discharge will meet all MOE requirements for a mixing zone and discharge to surface water. Only small volumes of receiving water exceed PWQO for un-ionized ammonia.

Public's Principal Concerns

Public comments and concerns were recorded throughout the Class EA planning process. A summary of the Phase 2 comments is included in Clause 14.0 of this ESR. Copies of the Phase 2 comments are included in Appendix F.

Two PICs were held during Phase 3. Copies of the comments received as a result of PIC # 2 (October 14, 2009) are included in Appendix P. Copies of the comments received as a result of PIC # 3 (May 25, 2010) are included in Appendix Q.

The public's principal concerns are briefly summarized as follows:

- Implementing water conservation programs is considerably less costly that constructing plant upgrades;
- Implementing I & I reduction programs to reduce the average daily flow to the LWPCP;
- Design per capita demand should be based on historical data;
- MOE requested an Air Quality Impact Assessment (letter dated August 11, 2009 provides suggested approach);
- Local Residents concerns about odour in the future;
- Local Residents wants noise reduced from sludge trucks;
- Residents concerned about charges that might be passed on to the residents;
- Metis First Nation representatives if an aerator could be added to the discharge pipe to provide oxygen to the effluent;
- Advisory committee members wondered why servicing to Barrie was not being considered and expressed concern about the cost of servicing lands in the Highway 400 corridor;
- Residents enquired what "controls" will be put in place to prevent exceedances of phosphorous loading to the Lake;
- Advisory committee members enquired about financing plans, and;
- Advisory committee members asked if a "septic inspection program" is included as part of the solution.

In addition, a letter dated July 28, 2010 was received from Ms. Claire Malcomson of Environmental Defence (See Appendix Q). Ms. Malcomson's concerns are summarized as follows:

- "…Environmental Defence believes that any increase in phosphorous loads, from any source, must only take place where it has been demonstrated that a greater load will be offset somewhere else. Innisfil has not demonstrated this." "The Innisfil STP project as presently constituted is, in our respectful submission, a missed opportunity for the Lake."
- "…the public consultation component, has been conducted under the "chill" of tens of millions of outstanding law-suits against residents of Innisfil opposed to the Big Bay Point mega-marina and resort. Completing this EA under these circumstances is unacceptable." "..please explain how the public consultation component of this EA met your Environmental Bill of Rights duty to conduct public consultation in "an open and consultative process when making decisions that might significantly affect the environment."
- "Water conservation is inadequately addressed in this EA."
- "Until each subwatershed and municipality affected by an STP expansion has a watershed plan it is premature to approve a Phosphorous load increase from any sector. Innisfil's plan is not complete…"
- "Reporting required for the financing ….is unclear."
- "piece-mealing…is not permitted by law" – referring to water supply to Big Bay Point.
- "A septic system inspection program must be in place and operating."
- "Other ideas: compliance reporting which covers progress on subwatershed plan implementation, and/or develop a Community Advisory Committee."

In response to the letter from Environmental Defence, a letter was received from Jeffery P. Shankman, Barrister & Solicitor, representing Kimvar Enterprises. Mr. Shankman provides a response to Ms. Malcomson's assertion that the public consultation was completed under the "chill" of law-suits and a "climate of fear". A copy of the letter is included in Appendix Q.

A formal response letter was sent to Environmental defence on November 26, 2010 and a copy of that letter is also included in Appendix Q.

A list of design considerations resulting from public and review agency consultation is included in Clause 22.0 of this ESR.

During the 30-day review, two separate requests for Part II Orders were received by the Ministry of the Environment. The requests were reviewed by the Ministry and the decision that an individual EA is not required was formalized in the Minister's letter dated July 12, 2011. The letter imposes conditions on the project related to the preparation of a Water Conservation and Efficiency Strategy.

Phase 4

The following tasks were undertaken in Phase 4 of the Class EA planning process:

- Received Council's endorsement to issue Draft Environmental Study Report (ESR) to MOE and subsequent to receiving MOE comments, published the Notice of Completion;
- Submitted DRAFT ESR to MOE September 2010;
- Received MOE comments on Draft ESR document – October 2010
- Published "Notice of Completion" and Started 30-day public review period – December 2010
- MOE responded to requests for Part II Order – July 2011
- Reviewed Public & Agency comments received and finalized ESR – September 2011.

1.0 Introduction

The Town of Innisfil is undertaking the completion of a Municipal Class Environmental Assessment (Class EA) planning process to determine future wastewater treatment requirements to meet planned growth. The consulting team of Ainley Group and Black & Veatch was retained in October 2008 to document the Class EA planning process in an Environmental Study Report (ESR) and to prepare a Preliminary Design Report.

The existing Lakeshore Water Pollution Control Plant (LWPCP) was constructed in 1987 (Stage I) and was doubled in capacity in 1996 (Stage II).

2.0 Class Environmental Assessment Process

Ontario Municipalities are subject to the requirements of the Environmental Assessment Act (EAA) for public works projects. The Municipal Engineer's Association's (MEA) "Municipal Class Environmental Assessment" document (October 2000, as amended in 2007) provides municipalities with a phased procedure, approved under the EAA, to plan most municipal works projects. These are usually limited in scale with a predictable set of environmental impacts and mitigation measures. As noted in the MEA Document, the "Key Principles of successful environmental assessment planning" are:

- Consultation
- Reasonable range of alternatives
- Consideration of effects on all aspects of environment
- Systematic evaluation
- Clear documentation
- Traceable decision making.

The MEA procedure for the Innisfil LWPCP Class EA is a Schedule C planning process, involving five Phases.

- Phase 1 – Problem or Opportunity
- Phase 2 – Alternative Solutions
- Phase 3 – Alternative Design Concepts for Preferred Solution
- Phase 4 – Environmental Study Report
- Phase 5 – Implementation

3.0 Background Information and Reports

3.1 Existing LWPCP

The Lakeshore Water Pollution Control Plant (LWPCP) was constructed in 1987 to alleviate pollution problems from septic tank malfunctions. The Stage I works included a sanitary collection system, four Pumping Stations, and the LWPCP with an outfall to Lake Simcoe. A Stage II expansion (doubling of the LWPCP) was completed in 1996 to increase the service area. The current rated capacity is 14,370 m^3/d with a design peak flow rate of 39,960 m^3/d.

The LWPCP currently comprises the following process units: headworks with mechanical screens and aerated grit tanks; four extended-aeration tanks (2,500 m^3 each); four secondary clarifiers (26 m diameter); RAS and WAS pumping; chemically-enhanced phosphorous removal (Alum dosed into aeration tanks and filter feed); four tertiary filters (60 m^2 each); UV disinfection; effluent outfall sized for a peak gravity flow rate of 51,322 m^3/d; aerobic digestion, first and second stage; and biosolids holding tanks.

The existing plant site was originally planned for a Stage III expansion to 21,555 m^3/d.

The effluent criteria, as per the existing Certificate of Approval (1938-73QJ7D), is summarized as follows in Tables 3-1 and 3-2 (a copy of the CofA is included in Appendix A):

Table 3-1 Effluent Objectives

Parameter	Concentration	Loading
$CBOD_5$	5 mg/L	72 kg/day
Total Suspended Solids	5 mg/L	72 kg/day
Total Phosphorus	0.1 mg/L	1.4 kg/day
Total Ammonia Nitrogen (Ammonia Nitrogen + Ammonium Nitrogen)	3 mg/L	43 kg/day
E. coli	<200 organisms per 100 mL	N/A

Table 3-2 Effluent Compliance Limits

Parameter	Concentration	Loading
$CBOD_5$	10 mg/L	144 kg/day
Total Suspended Solids	15 mg/L	216 kg/day
Total Phosphorus	0.3 mg/L	2.2 kg/day (803 kg/year)
Total Ammonia Nitrogen (Ammonia Nitrogen + Ammonium Nitrogen)	5 mg/L	72 kg/day
pH of the effluent	Maintain between 6.0 and 9.5, inclusive at all times	

However, the Province of Ontario implemented interim regulation O.Reg. 60/08 reducing the total phosphorus (TP) loading at the LWPCP from 803 kg/year to 351 kg/year for the period from April 1, 2008 to March 31, 2010. Subsequent to the interim regulation, the Province released the June 2010 Phosphorus Reduction Strategy, which provides a TP loading objective for the LWPCP of 629 kg/year. This objective, which will be used for this Class EA, will become a compliance requirement by 2015 or the next time the WPCP expands, whichever comes first. The TP loading compliance baseline of 629 kg/year will be the limit for the period from 2015 to 2025.

3.2 Existing Wastewater Collection System

The existing lakeshore wastewater collection system services older and newer developments from the Killarney Beach Road area (Lefroy) in the south to north of the 10th Line (Sandy Cove Retirement Area). The existing sanitary collection system is shown on Drawing 108128-OP1 (copy included in Appendix B). The system includes five sewage pumping stations. The assessment of sewage pump stations and related forcemains is not part of this Class EA.

3.3 Headworks – Historical Flow Data

The historical flow data was provided by the Town for the years 1997 to 2008. It is assumed that wastewater flow rates for future growth of Industrial, Commercial, Institutional and Residential will remain proportionate to current flow levels. In order to determine the flow per capita for those years, it is necessary to know the number of service connections for each year. The Town provided that information as well, based on Annual Reports. It is noted that the number of service connections in the annual reports were based on an assumption of the number of new houses constructed each year. Actual counts were not undertaken. The number of service connections dropped significantly in 2006 due to a revised estimating method in the serviced units. The revised estimation method is not known but it lowered the number of service connections significantly, which in turn drastically changed the per capita flow rate. Due to the considerable impact this has on the determination of the future design flows, it was considered critical that a new lot count be completed. Ainley completed a lot count for 2007 service connections and the results are shown in Table 3-3 overleaf.

Table 3-3 Serviced Properties (2007)

Area or Subdivision Name	No. of lots on Ainley Dwg.	Estimated % Vacant Lots	Developed units per Alcona Subdivision/ Area	Estimated # Connected Homes
Lefroy	370	2		363
Bell Ewart	802	4		770
Big Cedar Shoreline	114	2		112
Tepco-Monarch (H. Creed)			75	
Previn Court Homes			290	
M. Konczewski (Orsi Development)			0	
Orsi Development				
Maple Lane Development (Wallace Mills)			525	
Innisbrook			130	
Green Acres			127	
756322 Ontario Limited			0	
Woodland Park (Libew Vecchiarelli)			100	
Alcona Downs			0	
Pratt South (Hynan Ackerman)			0	
Pratt South (Par Marcedon Realty)				
Pratt North (Rose Antanavicius)			5	
Antonio Alonzi			0	
1223174 Ontario Ltd.			0	
Letizia Homes			18	
A. Morris			0	
Brian Gregory			0	
Skivereen			128	
Remaining Alcona	3294	3	3195	
Subtotal – Alcona (Areas 4 – 22)				4593
Leonard's Beach	224	15		190
Sandy Cove Residential	245	1		243
Sandy Cove Retirement				1196
Total				**7467**

Table 3-4 below lists estimated annual average daily flows, using both the historical service connection numbers and the recent lot count.

Table 3-4 Historical Flow Data

Year	Service Connections	Population*	Average Daily Flow (ADF) m³/d	Peak Flow (PF) m³/d	Peak Factor	Actual Per Capita Flows (L/c/d)
1997	5,312	14,740	4,671	8,482	1.82	317
1998	5,750	16,054	4,915	8,053	1.64	306
1999	6,008	16,828	5,252	8,462	1.61	312
2000	6,386	17,962	6,128	11,282	1.84	341
2001	6,556	18,472	6,398	12,417	1.94	346
2002	7,054	19,966	6,940	15,634	2.25	348
2003	7,354	20,886	7,133	13,758	1.93	342
2004	7,654	21,766	7,413	16,403	2.21	341
2005	7,954	22,666	7,280	17,826	2.45	321
2006**	5,928**	15,588**	8,116	20,308	2.50	489**
2007	7,467 ***	21,205	7,648	16,823	2.20	361
2008	7908 ****	22,528	9,340	23,016	2.46	415

* Population calculated using 2 ppu for Sandy Cove Retirement Area (1196 connections) and 3 ppu for remaining development

** Revised estimation of number of service connections resulting in lower numbers along with increased per capita flows

*** Actual lot count (from Table 3-3)

**** Includes 441 additional connections in 2008 (information provided by Town of Innisfil Building Services Department

Table 3-4 suggests that the estimated number of service connections for the years 1997 to 2005 were high resulting in a lower than actual per capita flow. Likewise, the estimated number of service connections for 2006 (revised estimating method) is low resulting in a higher than actual per capita flow. Therefore, in considering the estimated number of service connections using the recently completed lot count for the years 2007 and 2008, the per capita flow rates were 361 and 415 L/c/d respectively. It should also be noted that 2008 was an unusually wet year. It is therefore proposed to use 400 L/c/d for the existing serviced population and 375 L/c/d for future serviced populations for the purposes of this Class EA. The reduction in the per capita rate from 400 to 375 reflects the Town's commitment to reduce existing water consumption. A document titled, "Town of Innisfil Lakeshore WPCP Flow Analysis" discussing the historical flows is included in Appendix C. This document is discussed in Section 3.5.

The LWPCP currently receives septage at the headworks. It is anticipated that the amount of septage volume will increase and therefore, a septage allowance will be made in the design of future plant expansions. For the purposes of this Class EA, it is assumed that septage will only be received from local (Town of Innisfil) sources.

3.4 Raw Water Concentrations and Effluent Quality Data

Raw Wastewater

The original plant design was based on the following raw wastewater concentrations.

Table 3-5 Original Raw Water Design Assumptions

Parameter	Units	Average Daily Flow Conditions
Total Flow	m^3/d	21,555
BOD_5	mg/L	137
	kg/d	2,953
TSS	mg/L	165
	kg/d	3557
TP	mg/L	7
	kg/d	151
TKN	mg/L	35
	kg/d	754

The historical raw wastewater concentrations, shown in Table 3-6 below, for 5-day Biochemical Oxygen Demand (BOD_5), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Kjeldahl Nitrogen (TKN) are based on the Town's Annual Reports.

Table 3-6 Historical Raw Wastewater Data

Year/Parameter	BOD_5 mg/L	TSS mg/L	TP mg/L	TKN mg/L
Previous Design Basis	137	165	7	35
2003	110	161	2.8	18
2004	103	127	2.6	17
2005	114	165	2.9	18
2006	109	151	2.8	18
2007	140	202	2.8	16
2008	126	211	2.2	17
Historical Average	117	170	2.7	17

Although the average BOD_5 is less than the original design concentration, it is noted that a spike did occur in 2007. It is suggested that the original design concentration of 137 mg/L be retained for Class EA purposes.

The concentration of TSS is higher than the original design basis and therefore, a figure of 175 mg/L will be used for Class EA purposes.

The historical concentrations of TP are well below the original design basis and therefore, a reduction in the design concentration is reasonable. A figure of 4 mg/L will be used for Class EA purposes.

Similarly, the historical TKN concentrations are about half of the original design basis. Therefore, a reduction in the design concentration is warranted. A figure of 25 mg/L will be used for Class EA purposes.

Effluent Quality

Historically, the existing LWPCP has performed well with respect to meeting effluent concentration criteria. A tabulation of effluent parameters for $CBOD_5$, BOD_5, TSS, TP, TKN, Total Ammonia Nitrogen and *E. coli* is shown below.

Table 3-7 Historical Effluent Data

	$CBOD_5$	BOD_5	TSS	TP	TKN	$NH_3 + NH_4$	*E. coli*
Effluent Objective	5 mg/l	5 mg/L	5 mg/l	0.1 mg/L		5 mg/L	< 200
Effluent Limit	10 mg/L	10 mg/L	15 mg/L	0.3 mg/L		5 mg/L	
YEAR/PARAMETER	CBOD	BOD_5	TSS	TP		$NH_3 + NH_4$	
2006 – Annual Average	2.8	4.5	2.24	0.115	3.147	4.89	18.2
2007 – Annual Average	2.46	3.92	2.46	0.078	3.008	2.17	32.7
2008 – Annual Average	2.88	4.16	2.62	0.0625	1.756	1.12	3.04

The pH is consistently between 6.0 and 9.5.

With respect to actual loadings, Table 3-8 shows a comparison of effluent criteria against recorded loadings.

Table 3-8 Historical Effluent Loadings

Parameter	2006 Average	2007 Average	2008 Average
ADF m^3/d	8,116 m^3/d	7,648 m^3/d	9,340 m^3/d
TP – 0.3 mg/L, 2.2 kg/d	0.93 kg/d	0.60 kg/d	0.58 kg/d
Total Ammonia Nitrogen – 5 mg/L, 72 kg/d	39.69 kg/d	16.60 kg/d	10.46 kg/d
CBOD – 10 mg/L, 144 kg/d	22.73 kg/d	18.81 kg/d	26.90 kg/d
TSS – 15 mg/L, 216kg/d	18.18 kg/d	18.81 kg/d	24.47 kg/d

Based on average daily flows and TP loadings, the historical annual total phosphorus loadings for 2006 to 2008 are as follows:

2006 = 0.93 x 365 = 340 kg

2007 = 0.60 x 365 = 219 kg

2008 = 0.58 x 365 = 212 kg

3.5 Historical Flow Assessment

An historical flow assessment was completed and is detailed in the document titled, “Town of Innisfil Lakeshore WPCP Flow Analysis” included in Appendix C. The flow assessment looks at the average dry weather flow, average day flow, maximum monthly flow, highest weekly flow and peak day flow for the years 1998 through 2009 to determine average flows and inflow/infiltration flows. It also provides design flows as per Table 3-9 below by considering population growth and per capita flows. It is considered that the plant expansion will be completed in two phases. The phased approach will be discussed further in Section 9.0.

Table 3-9 Design Flows

WPCP Expansion Phase	Current WPCP Capacity	Stage III Expansion	Stage IV Expansion
Population	36,818	65,165 *	101,809 *
Per Capita ADF	390 L/c/d	384 L/c/d	391 L/c/d
Design ADF	***14.37 ML/d***	***25.00 ML/d***	***40.00 ML/d***
Per Capita MMF	500 L/c/d	494 L/c/d	491 L/c/d
Design MMF	***18.41 ML/d***	***32.19 ML/d***	***49.94 ML/d***
Per Capita PDF	1094 L/c/d	1084 L/c/d	1081 L/c/d
Design PDF	***40.28 ML/d***	***70.63 ML/d***	***110.06 ML/d***
Per Capita PHF	1514 L/c/d	1427 L/c/d	1365 L/c/d
Design PHF	***55.72 ML/d***	***92.99 ML/d***	***138.96 ML/d***
Per Capita PIF	1968 L/c/d	1855 L/c/d	1775 L/c/d
Design PIF	***72.44 ML/d***	***120.86 ML/d***	***180.65 ML/d***

* The Stage III and IV populations include equivalencies for non-residential (employment) lands – see “Summary” Table following Clause 9.0.

The document also comments on extraneous flows in Innisfil. It notes that the flow records reflect generally increasing extraneous flows. However, average daily and maximum monthly extraneous flows appear to have generally stabilized. When comparing the extraneous flows with the MOE Guidelines, the extraneous flow is excessive based on the MOE Guidelines and further aggressive efforts should be taken by the Town to reduce these flows. Extraneous flows will be discussed further in Section 11.4.

4.0 Provincial Requirements

In 2009 the Province filed interim Regulation 60/08 (amended to O. Reg. 130/09), titled, “Lake Simcoe Protection” under the Ontario Water Resources Act. The Regulation contained measures to protect Lake Simcoe and to reduce phosphorus loadings to the lake in the short term until the Province could implement long term measures under the Lake Simcoe Protection Act and the associated Lake Simcoe Protection Plan. As a result of the recently enacted legislation and considering the substantial increase in wastewater flow that is proposed for the Town of Innisfil, any plant expansion will have to meet more stringent permit limits, in particular for total phosphorus (TP). Discussions with the Province prior to the filing of O. Reg. 130/09 suggested that the Province is concerned about the technical challenges of consistently meeting ultra low TP limits that are expected to be imposed in the future on the expanded plant.

Regulation 60/08 included two Sections of direct relevance to the Innisfil LWPCP Class EA. Section 6(1) prohibited the establishment of a new sewage treatment plant in the Lake Simcoe Basin. Section 2(1) assigned individual limits to the total amount of phosphorus that can be discharged from each of 15 wastewater treatment plants located in the Lake Simcoe Basin. With respect to the Innisfil LWPCP, the interim TP loading for the period from April 1, 2008 to March 31, 2010 was 351 kg/year (a copy of the Regulation is included in *Appendix D*). Subsequently, the Province published the “Lake Simcoe Protection Plan” (LSPP) containing additional measures to protect Lake Simcoe and to reduce phosphorus loadings to the lake, including the Phosphorus Reduction Strategy (PRS), Water Quality Trading Feasibility Study and the Shoreline Protection Regulation. These documents are discussed further in Section 19.1 but basically, the PRS has decreased the annual loading of TP from the Innisfil LWPCP from the 803kg/year as per the Certificate of Approval to 629 kg/year.

The Province’s intent is to reduce loadings of phosphorus to Lake Simcoe. Lake Simcoe is a sensitive water body that is currently suffering from nutrient enrichment. It was the subject of an intensive remedial program (the Lake Simcoe Environmental Management Strategy, “LSEMS”), which has now been superseded by the LSPP.

The nutrient of primary concern for Lake Simcoe is phosphorus. Phosphorus is required for the growth of all plant life, including plants and algae in Lake Simcoe. It is considered a “limiting nutrient” in surface waters because it is the nutrient that is in shortest supply for plant growth. As a result, even small additions of phosphorus can stimulate the growth of aquatic plants. While some plant growth is essential for the proper function of the aquatic system, too much phosphorus can result in:

- Unsightly scums or “blooms” of algae on the surface of the water
- Reduced water transparency (although zebra mussels in Lake Simcoe have also increased water clarity as nutrient loads have been reduced)

- Proliferation of rooted aquatic plants in nearshore waters (although much of the recent proliferation may be a result of increased water clarity in response to zebra mussels, and increased plant habitat)
- Loss of oxygen in the deep waters of Lake Simcoe when algae and plant growth decompose

The original LSEMS Program (now LSPP) had numerous objectives. Among them is the original target of reducing overall phosphorus loadings to all of Lake Simcoe to restore water quality and improve dissolved oxygen concentrations in the deep-water habitat for Lake Trout (Salvelinus namaycush) in Lake Simcoe. Both the Provincial and Federal governments recently committed substantial funds to the remediation of Lake Simcoe and a public consultation process was carried out to seek input to the Lake Simcoe Protection Act, which was posted in June of 2008. As a result, any alternative that involves construction of a new plant with discharge to Lake Simcoe or which increases phosphorus loadings to the lake beyond the limits imposed by the legislation would not be approved, even though existing Certificates of Approval provide higher loading limits.

The Lake Simcoe Protection Act was passed in December 2008. In January 2009, the DRAFT Lake Simcoe Protection Plan under the Lake Simcoe Protection Act was placed on the public record for comment. A review of the Protection Plan was undertaken for the purposes of this Class EA. The Protection Plan is focused on reducing P loading in order to maintain a dissolved oxygen concentration in the lake of 7.0 mg/L[1]. The basis of the plan is that excess P loading results in excessive algae and plant growth, thereby reducing dissolved oxygen (DO) levels in the Lake. The Plan sets a target loading of 44 tons per year of P to the lake. A lake DO greater than 7.0 mg/L should support a cold weather fishery and return the lake to a sustainable status.

The Plan addresses the multiple sources of P to the lake and the requirement that measures be implemented to reduce the P loading from each source. The Plan proposes to set mass limits for phosphorus discharge from sewage plants. As plants expand, the resultant concentration of phosphorus from sewage plants will continue to be driven down. Chapter 8, Implementation, does address the desire to implement a water quality trading program, to use economic forces to reduce P in a cost effective manner. This section references trading programs that have been implemented in Pennsylvania and Virginia as examples. The programs in PA and VA have not been fully implemented as yet and have experienced significant implementation issues. In order for a “trading” program to be successful, all contributors of the pollutant that are involved in the program must be under a regulatory framework to reduce the pollutant. In PA, the program was designed with the intention of point sources purchasing nutrient credits from non-point sources. The challenge in this system is that the non-point sources do not have a regulatory driver for nutrient reduction and are only enticed by the economic benefit of the sales of credits.

1 The Plan sets a target of 7 mg/L, expressed as the volume-weighted end of summer hypolimnetic dissolved oxygen content of the lake. This is a method of averaging the oxygen concentration in the stratified deep, cold water habitat of lake trout during the period of greatest combined habitat stress from warm water and low oxygen.

This has created a situation where the pricing of non-point credits has not been lower than the cost of WPCP upgrades and very few trades are occurring. Under the Plan, a Water Quality Trading Feasibility Study was completed. This study is discussed further in Section 19.1.

The Plan also addresses groundwater resources within the lake's watershed and acknowledges the stresses that are placed on the water supply. As part of this discussion water reuse and recycling was noted as a strategic action. The utilization of this approach may provide a lower cost alternative to the sewage plants by reducing the volume of water discharged to the receiving body, thereby allowing a higher P concentration in the effluent. Municipalities should follow this development closely in order to ensure that a water reuse/recycling plan is developed in a manner that promotes public acceptance, while not burdening sewage plants to the point that this option is not economically viable.

The Plan also addresses the potential impact to the lake from on site sewage treatment systems. It appears that the plan only considers direct impacts to the Lake from those systems that are within 100 meters of the lake or tributaries. This is consistent with P discharges from other watersheds that have eutrophication challenges, as the P tends to be bound to the soil but the N species migrate with the ground water. This approach will make it unlikely that a sewage plant will acquire nutrient credits from taking on site sewage treatment systems off line.

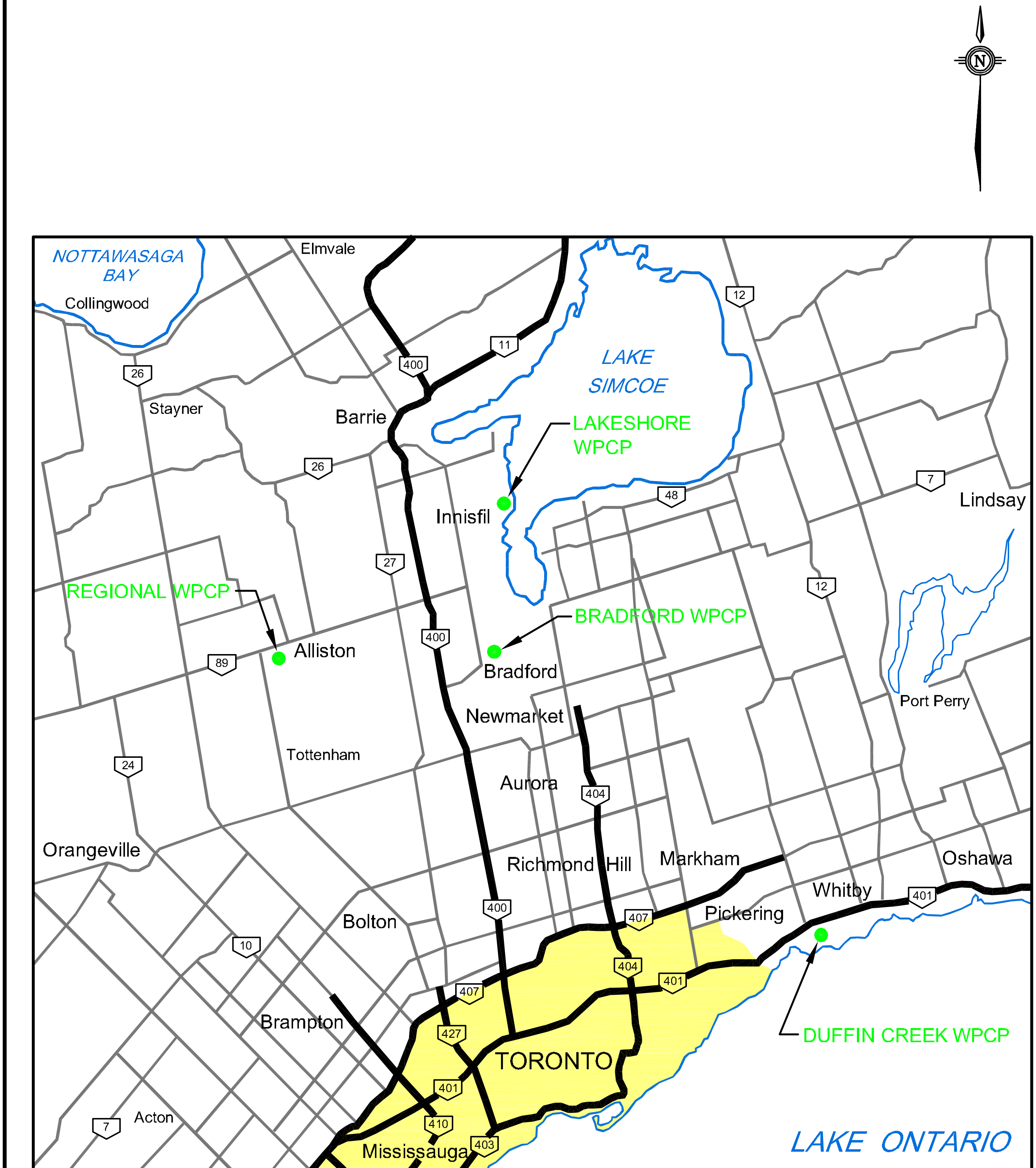
The plan addresses the threat to the Lake from climate change including lack of winter ice and potential changes in weather patterns. As recommendations/regulations are proposed for P reduction, the sewage plants should consider the additional greenhouse gas emissions that will occur from the enhanced process and utilize this as another factor in addressing the costs and impacts of relatively small reductions in the mass of P discharged to the Lake.

5.0 Study Area

The Study Area includes any location that may be considered for a new or expanded water pollution control plant. In establishing the Study Area, several considerations need to be recognized as follows:

- Servicing negotiations with the City of Barrie broke down in the spring of 2008.
- Other municipalities with plants within the Lake Simcoe basin that may be large enough to accept the Town of Innisfil's wastewater include Bradford and York Region.
- The closest existing municipal wastewater collection systems that are not located within the Lake Simcoe basin and may be large enough to accept wastewater from the Town of Innisfil are in the Township of New Tecumseth (Alliston Regional Plant) and the York-Durham system.
- The closest potential receiving stream for surface water effluent disposal is the Nottawasaga River near Baxter in Essa Township.

The Study Area is therefore considered to be a large section of south-central Ontario as outlined on Figure 1 overleaf.



Ainley CONSULTING ENGINEERS PLANNERS	TOWN OF INNISFIL LAKESHORE WPCP CLASS EA	SCALE: N.T.S. DATE: JUNE 2010
	STUDY AREA	DWG. 108128–Fig.1

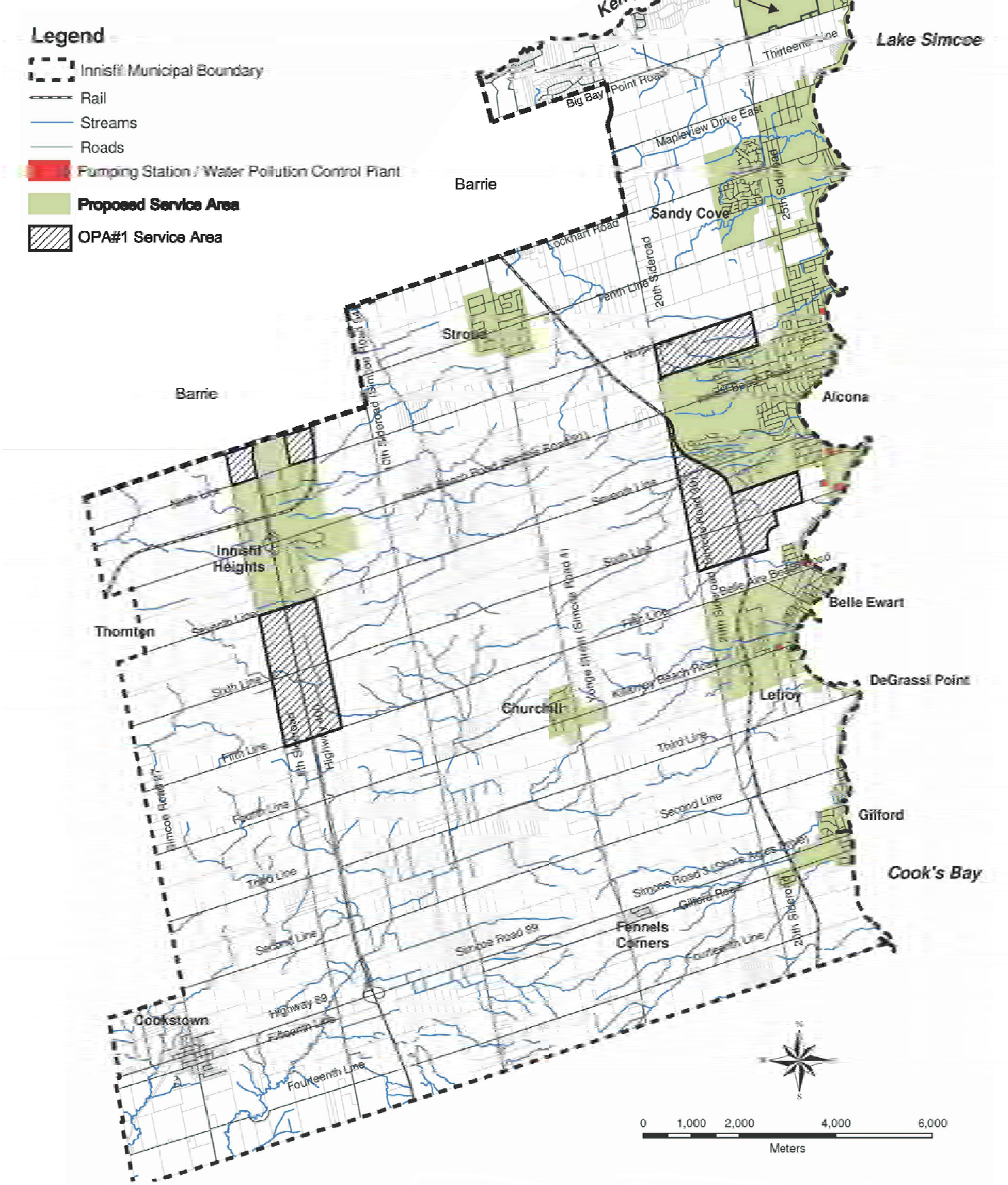
6.0 Service Area

The Service Area is shown on Figure 2 overleaf. This original service area was described in the "Notice of Study Commencement" which was issued on May 23, 2008 and published in the local newspapers. The original Service area is in accordance with the 1996 Official Plan along with an allowance for Stroud, Churchill and Innisfil Heights. A copy of the Notice and related Plan is included in Appendix E.

A revised service area was issued as part of the "Notice of Phase 2 Solution & Revised Service Area" on July 31, 2009. The revised service area included OPA 1 which had been passed subsequent to the May 23, 2008 Notice. It also showed a potential future Innisfil/Barrie boundary line since both Municipalities were in discussion with the Province about Barrie annexing land from Innisfil and the official boundary had not been decided at the time. A copy of this Notice is included in Appendix F.

Subsequent to the July 31, 2009 Notice, the annexation of land to Barrie from Innisfil was finalized and the final service area drawing reflected this boundary. The service area had not changed as a result, only the Innisfil/Barrie boundary line. This was presented at PIC #3 on May 25, 2010. It is noted that the 1996 Official Plan includes interior (non-shoreline) communities of the Town (Churchill, Stroud, Innisfil Heights and Cookstown) and therefore, the ultimate service area for this Class EA includes Churchill, Stroud, Innisfil Heights and Cookstown. Figure 2 shows the revised service limits including the OPA # 1 area.

Innisfil Lakeshore WPCP Class EA Revised Service Area



Ainley CONSULTING ENGINEERS PLANNERS	TOWN OF INNISFIL LAKESHORE WPCP CLASS EA	SCALE: N.T.S.
		DATE: JUNE 2010
	ORIGINAL SERVICE AREA	DWG. 108128-Fig.2

7.0 Capacity Assessment of Existing WPCP

Hydraulically, the existing Innisfil LWPCP is at about 65% capacity as follows: 9,340 m^3/d (2008 ADF)/ 14,350 m^3/d (Stage II rated capacity).

Considering the requirement of a maximum TP effluent loading of 629 kg/year (1.72 kg/d average) as per the Phosphorus Reduction Strategy, the plant was at about 35% Phosphorus capacity in 2008 with an annual phosphorus loading of 212 kg. Therefore, at this time, the hydraulic loading is the limiting factor and the plant is considered to be at 65% capacity.

8.0 Development of Problem Statement

The Town published a Notice of Study Commencement in May 2008 with the following Problem Statement:

In order to accommodate the full build out of the Town of Innisfil's 1996 approved Official Plan an expansion of the existing Lakeshore Wastewater Treatment Plant in Alcona was planned and soon will be necessary. In addition, the Ontario Municipal Board has now approved the Big Bay Point Recreational Resort development in Innisfil (Official Plan Amendment # 17).

The problem statement was revised in July 2009 with the inclusion of OPA#1 lands into the service area.

In August 2010, the Town clarified the description of the Service Area (see Figure 2) and revised the per capita wastewater flow for the future population component from 400 L/c/d to 375 L/c/d. This resulted in a slight change to the 2031 design average day wastewater flow (39,573 m^3/d revised to 39,790 m^3/d). Therefore, the required capacity of the Stage IV expansion remains as an average day flow of 40 MLD.

9.0 Design Capacity

The required design capacities to service various levels of growth are outlined in a Table entitled "Summary of Potential Future Wastewater Demands for Lakeshore Service Area Including OPA1" which was prepared for the Town by Ainley. A copy of the updated version of this Table is included overleaf.

Based on this Table and using a flow rate per capita for new development of 375 L/c/d, the projected Average Day Flow (ADF) for the Service Area is 39,790 m^3/d (approximately 40,000 m^3/d or 40 MLD). The existing rated hydraulic plant capacity is 14,370 m^3/d and therefore, the required increased capacity is 25,420 m^3/day, which is close to three times as large as the existing plant.

However, this comes from a 25-year projection and it is proposed that the plant capacity be increased in two stages (Stage III and Stage IV). It is proposed to expand the plant by 11,000 m^3/d to approximately 25,000 m^3/day (25MLD) and be operational in approximately 2015 for the Stage III expansion and then to expand the plant by an additional 14,500 m^3/day to approximately 40,000 m^3/day (40MLD) to be operational in approximately 2024 for the Stage IV expansion. The potential future wastewater flows are presented graphically in Figure 9.1 (page 20 showing the anticipated future wastewater flows along with the proposed plant capacity expansions.

Town of Innisfil
Lakeshore Water Pollution Control Plant
Summary of Potential Future Wastewater Flows for Service Area including OPA1
Updated to December 31, 2008

S:\108128\Engineering\108128\WorkingFile\108128\Innisfil WPCP EA Capacity Ledger (Mar 2009).xls

Dated: Sept 30, 2009

			Connections			Total Flow Allowances Per Capita (L/p/d)	Theoretical Average Day Flow (m^3/day)	Cumulative Average Day Flow (m^3/day)
			No of Units	Persons per Unit	Equivalent Population			
1	Existing Connected Development	Sandy Cove - Existing Residential	243	3.0	729	400	292	
		Sandy Cove - Existing Retirement	1,196	2.0	2,392	400	957	
		Leonards Beach Shoreline	190	3.0	570	400	228	
		Alcona	5,034	3.0	15,102	400	6,041	
		Big Cedar Shoreline	112	3.0	336	400	134	
		Bell Ewart	770	3.0	2,310	400	924	
		Lefroy	363	3.0	1,089	400	436	
		Totals	**7,908**		**22,528**		**9,011**	**9,011**
2a	Existing not Connected & Approved Development	Sandy Cove - Existing Unserviced	486	3.0	1,458	400	583	
		Loblaw's OPA 19 (Equivalent No.)	58	3.0	174		69	
		Alcona - Existing Unserviced	206	3.0	618	400	247	
		Big Cedar Shoreline - Existing Unserviced	192	3.0	576	400	230	
		Alcona - Secondary Plan	2,401	3.0	7,203	400	2,881	
		Sub-Totals (Includes Equivalent Pop)	**3,343**		**10,029**		**4,011**	
		Cumulative Totals (Includes Equivalent Population)	**11,251**		**32,557**			**13,023**
2b	Approved Development and Infill/Intensification Potential not Connected	Big Bay Point - Residential within Resort	1,600	3.0	4,800	400	1,920	
		Big Bay Point - Non Residential (Equivalent Population No.)			3,769	-	875	
		Lefroy Secondary Plan	1,600	3.0	4,800	400	1,920	
		Big Bay Point Shoreline - Existing Unserviced	1,035	3.0	3,105	400	1,242	
		Big Bay Point Shoreline - Future (Vacant plus Infill & Intensification)	141	3.0	423	400	169	
		Alcona Capital Properties - OPA 18 (assumed residential)	242	3.0	726	400	290	
		Alcona - Future	1,274	3.0	3,823	400	1,529	
		Leonards Beach Shoreline - Future	2	3.0	6	400	2	
		Big Cedar Shoreline - Future	5	3.0	15	400	6	
		Bell Ewart - Future	345	3.0	1,034	400	413	
		Sandy Cove - Future (Excludes Sandy Cove Expansion)	1,807	3.0	5,422	400	2,169	
		Gilford - Existing Unserviced	555	3.0	1,665	400	666	
		Gilford - Future	119	3.0	357	400	143	
		DeGrassi Point Shoreline - Existing Unserviced	134	3.0	402	400	161	
		Sub-Totals (Includes Equivalent Pop)	**10,859**		**30,345**		**11,506**	
		Cumulative Totals (Includes Equivalent Population)	**22,110**		**62,902**			**24,528**
Special Policy Areas	Sandy Cove	Potential Expansion to Sandy Cove Retirement Area (As per OMB Decision - Case No. PL080118	767	2.0	1,534	400	614	
	Innisfil Heights "Existing Designated Area"	Economic District (320 Ha) (Equivalent Pop No.)			7,700	400	3,080	
		Special Policy Area Totals (Includes Equivalent Population)	**767**		**9,234**		**3,694**	
		Cumulative Totals (Includes Equivalent Population)	**22,876**		**72,136**			**28,222**
Existing Non-Lakeshore Areas	Stroud	Potential Servicing for existing community	845	3.0	2,535	400	1,014	
	Churchill	Potential Servicing for existing community	234	3.0	702	400	281	
		Existing Non-Lakeshore Areas Totals (Includes Equivalent Population)	**1,079**		**3,237**		**1,295**	
		Cumulative Totals (Includes Equivalent Population)	**23,955**		**75,373**			**29,517**
Preferred Growth Management Areas (OPA 1)	Alcona North & South Expansion	Potential Residential Area	3,333	3.0	10,000	400	4,000	
		Employment Lands (Equivalent Pop No.)			500	400	200	
		Sub-Totals (Includes Equivalent Population)	**3,333**		**10,500**		**4,200**	
	Innisfil Heights	Expanded Economic District (180 Ha) (Equivalent Pop No.) (See Note 5)			5,400		2,452	
		Future Expanded Economic District (250 Ha) (Equivalent Pop No.) (See Note 5)			6,600		3,405	
		Sub-Totals (Includes Equivalent Population)	**0**		**12,000**		**5,857**	
		Preferred Growth Management Area Totals (Includes Equivalent Population)	**3,333**		**22,500**		**10,057**	
		Cumulative Totals (Includes Equivalent Population)	**26,210**		**97,873**			**39,573**

Notes:

1 The number of units within each area was provided by Sorensen Gravely Lowes and is contained within a table entitled "Innisfil 2007 Existing and Future Units and Population for Servicing" and dated Feb. 25, 2008.

2 All vacant lots identified within the table entitled "Innisfil 2007 Existing and Future Units and Population for Servicing" were added to the "Future" within the aforementioned table.

3 The existing lots for Big Bay Point are identified under existing occupied & vacant for "Shoreline" of the table entitled "Innisfil 2007 Existing and Future Units and Population for Servicing."

4 The demands associated with the Big Bay Point Resort Development are based upon the information within the Revised Table 1 Land Use Statistics dated January 15 2007, prepared on behalf of BBPRD.

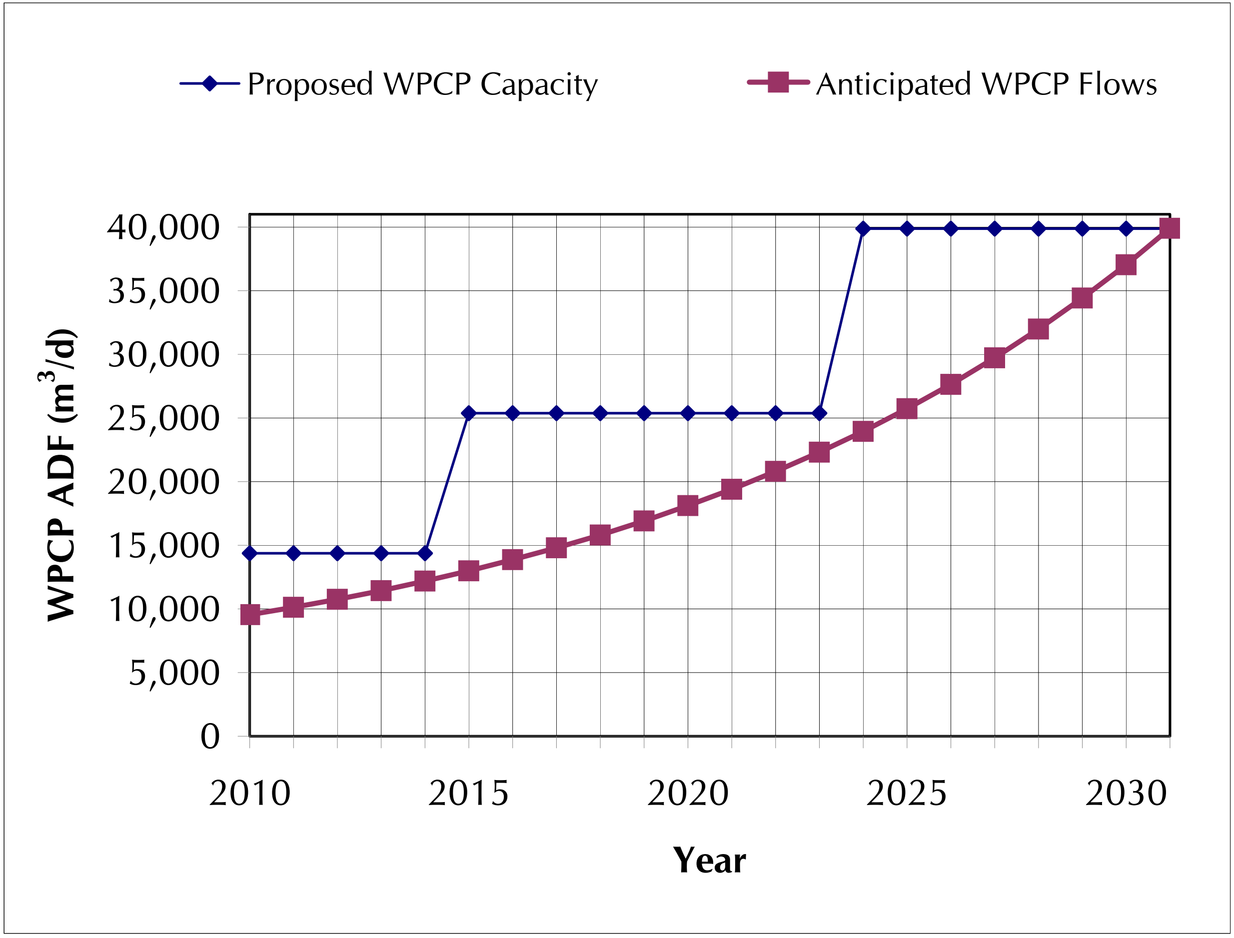
5 The average day Wastewater flows for the various Employment Lands throughout the area were calculated using an estimated value of 13.62 m^3/day/ha.

6 The total number of residential units around the Big Bay Point Resort and outside of Official Plan Service boundaries which are not connected to the Sewage System was obtained from Stantec's February 2004 Report for Big Bay Point Development. It should be noted that the no decision has been made by Council with regard to the connection associated with the existing residential unit external to the Big Bay Point development.

7 With the exception of Sandy Cove, the Populations associated with all Residential Development was obtained by multiplying the number of lots by a theoretical value of 3 persons per unit. In Sandy Cove a theoretical value of 2 persons per unit was used.

8 The sewage flows for the existing connected residential units are calculated utilizing 400 L/c/day (325 L/c/day + 75 L/c/day) and the sewage flows for the future residential units are calculated utilizing 400 L/c/day (325 L/c/day + 75 L/c/day).

Figure 9-1 Lakeshore WPCP – Anticipated Future Flows



As noted above, it is proposed to undertake a Stage III plant expansion of 11,000 m^3/d additional capacity (estimated to be needed in 2015) and a Stage IV plant expansion of 14,500 m^3/d additional capacity (estimated to be needed in 2024).

However, it must be stressed that the proposed plant capacity increases will not address the requirement to limit TP to 629 kg/year. Additional tertiary treatment is needed to meet that requirement as the hydraulic capacity in increased.

As noted in Section 3.3 (Headworks - Historical Flow Data), it is suggested that a figure of 375 L/c/d be used for future design flow requirements.

10.0 Phase 1 Public and Agency Consultation

A Notice of Study Commencement was issued on May 23, 2008 and published in local newspapers. A copy of the Notice and the distribution list are included in Appendix E.

Responses to the Notice of Study Commencement were received from Indian and Northern Affairs Canada (dated July 10, 2008) and Ministry of the Environment (dated June 13, 2008). Copies of these letters are also included in Appendix E.

The letter from Indian and Northern Affairs Canada outlines potential claims that may affect the study along with associated First Nation Communities.

The letter from the Ministry of the Environment identifies issues of concern and provides information to assist in addressing these issues. The identified issues are as follows:

- Ecosystem Protection and Restoration
- Surface Water and Groundwater
- Servicing and Facilities
- Air Quality
- Contaminated Soils
- Mitigation and Monitoring
- Planning and Policy
- Class EA Process
- First Nation Communities

These issues will be addressed in Phase 2, 3 & 4 of the Class EA process with the exception of First Nation Communities. Affected Aboriginal communities were contacted as part of establishing a Liaison Advisory Committee as outlined below.

Correspondence was also received requesting to be part of the planning process. This correspondence is included in Appendix E and is summarized as part of the establishment of the Liaison Advisory Committee.

Further to the Notice of Study Commencement, a Liaison Advisory Committee (LAC) was established comprised of members of the public, local developers, local environmental representatives, along with Town and Consulting staff. First Nation communities were also invited to provide representation. In Phase 1, three LAC Meetings were held on November 6, 2008, December 9, 2008 and January 13, 2009. The minutes of these meetings are attached in Appendix G along with a List of Invitees and Responses Received. The purpose of the LAC is to ensure that comments are solicited from a variety of stakeholders.

A Steering Committee was also established comprised of representatives of the Town and the Consulting Team. A Project Initiation Meeting was held October 15, 2008. Steering Committee Meetings were held on November 3, 2008, December 3, 2008 and January 14, 2009. The minutes of these meetings are attached in Appendix H.

Phase 2 Report

11.0 Identification and Description of Alternatives

11.1 General

Based on the considerations identified in Section 4, a total of 18 Phase 2 Solutions (generic LWPCP options) were considered in Phase 2 of the Class EA planning process. Descriptions of each solution are provided hereinafter.

11.2 Alternative 1 – Do Nothing

The historical flow records for the LWPCP show that the plant is operating at about 65% of the existing capacity. As such, there is limited capacity for new development.

Under the Do Nothing option, the Town would maintain the existing facility and continue to monitor flows. New development and/or infilling development would need to be closely monitored to ensure that there is sufficient residual capacity. Planning policies should require that all new development proposals be assessed with respect to municipal servicing implications. This assessment process ensures that existing infrastructure will not be overloaded. It also ensures that developers are financially responsible for any required upgrades to municipal infrastructure such as wastewater collection systems. The Town would also have to review existing approved development projects to ensure that there is sufficient residual capacity.

It is also noted that the total phosphorus (TP) limit established by the Phosphorus Reduction Strategy (under the Lake Simcoe Protection Plan) will be 629 kg/year in 2015. This may also impact the capacity of the LWPCP and therefore action may required to reduce TP loading to allow any growth to occur.

Limiting growth in this manner contradicts the Official Plan and may have legal implications if existing approved development projects are suspended due to insufficient capacity. No further assessment of this alternative is warranted as part of this Class EA.

11.3 Alternative 2 – Water Conservation/Sewer Use By-Law

Under the Water Conservation alternative, the Town would augment its existing Water Conservation Strategy in an attempt to further reduce water consumption. A reduction in water consumption would ultimately lead to lower wastewater flows. Lower water and wastewater flows would reduce Operating and Maintenance costs at both the Water and Wastewater Treatment Plants. Water conservation is also environmentally responsible.

The Town of Innisfil intends to complete a Water Conservation and Efficiency Strategy (WCES) for the Lakeshore Water & Wastewater Service Areas, which will include initiatives to promote water conservation within the Town and the preparation of a plan for implementation. The WCES is required to be completed by June 2, 2014 with implementation beginning at that time.

Some initiatives to consider as part of the strategy are a Public Awareness Campaign including booklets / brochures / posters / web pages with water conservation tips, school educational programs, an outdoor lawn water by-law, a toilet rebate programme, a revised water rate structure, water festivals and incentives for residents and businesses. However, water conservation alone will not completely address the wastewater capacity issue and will need to be used in conjunction with another solution(s). It should be noted that a reduction in wastewater flow does provide a corresponding reduction in TP loadings. Water conservation will be included as part of the overall Recommended Solution.

In conjunction with Water Conservation, as part of the water and wastewater study, the Town will commit to review its current Sewer Use By-law to ensure that both wastewater flows and parameters are restricted and controlled from commercial and industrial sources, including an on-going monitoring program.

11.4 Alternative 3 – Reduce Inflow and Infiltration

The Town of Innisfil's collection system is approximately 25 years old on average. As a result, there are areas that experience a significant amount of wet weather (rain/snow) inflow and/or groundwater infiltration. This significant amount of rain/snow inflow and/or groundwater infiltration is confirmed in the peak flow assessment (Section 3.5). The benefits of reduced inflow and infiltration will be seen during peak flow events, including rainstorms and spring snow melts. Reducing inflow and infiltration would result in spare capacity at the existing LWPCP through an overall reduction in the average daily flow (ADF). It could also reduce Operating and Maintenance costs associated with peak flow events. It is noted that any plant expansion will not allow for significantly high wet weather flows.

As noted in Section 11.3 above, the Town commits to undertake a Water Conservation and Efficiency Strategy, which will include investigating historical Inflow and Infiltration impacts, along with a reduction strategy. Some initiatives for reducing inflow/infiltration include regular system flow measurement, frequent system inspection and regular maintenance. The Town has already initiated a program to reduce inflow and infiltration, which will be reviewed and improved as part of the water and wastewater study. The study should include reduction priorities, timelines, reduction targets, proposed reduction methods and initiatives, along with the cost and feasibility of implementation.

Reducing inflow/infiltration will not completely address the wastewater capacity issues. Furthermore, reducing inflow/infiltration will not reduce phosphorus loading to Lake Simcoe. For the purpose of this Class EA, it is considered that this is not a complete solution and will need to be done in conjunction with other options. The commitment to reduce inflow and infiltration will be included as part of the overall Recommended Solution.

11.5 Alternative 4 – Effluent Reuse/Recycling

Effluent Reuse and Recycling involves using treated effluent from the LWPCP for a number of uses such as irrigation and industry. It is most common to use the treated effluent for non-potable applications. Non-potable uses include agricultural and landscape irrigation (including public parks, sports fields, sod farms and golf courses), industrial processes (cooling or process water), toilet flushing, dust control, construction activities, man-made lakes, etc. However, there are occurrences of using treated effluent for potential potable applications such as ground water aquifer recharge or supplementing surface water reservoirs. The Town of Innisfil does not have a significant amount of industry that requires cooling or process water. However, the use of treated and disinfected effluent could be investigated for irrigation purposes.

Ground water recharge can also be investigated to divert some of the effluent from Lake Simcoe. However, the MOE has in the past been reluctant to approve ground water recharge especially with a large body of water such as Lake Simcoe in the immediate vicinity. Furthermore, hydrogeological investigations would be required to prove that the effluent doesn't migrate to Lake Simcoe still causing an effect after it has been injected into the ground.

In Innisfil, the most likely uses for Effluent Reuse/Recycling would be for irrigation of parks, sports fields, sod farms and golf courses. This could be accomplished either by installing a grey water piping system, complete with a pumping station, to pump the disinfected effluent to nearby receivers or by utilizing tanker trunks to transport the effluent to the required location. The disinfected effluent could offer a marketable product.

Effluent Reuse/Recycling can reduce both water consumption and as a result wastewater flows. It will therefore reduce Operating and Maintenance costs at both the Water and Wastewater Treatment Plants. It could also help to reduce the phosphorus loading to Lake Simcoe, however, additional infrastructure may be required.

Effluent Reuse/Recycling is environmentally responsible. However, it will not completely address the wastewater capacity issue and will need to be used in conjunction with other options. It is recommended that the Town commit to assessing Effluent Reuse/Recycling initiatives in an effort to reduce the quantity of effluent that will be introduced into Lake Simcoe as a result of any future plant expansions. A Commitment to assess effluent reuse/recycling will be included as part of the overall Recommended Solution.

11.6 Alternative 5 – Wetlands

Using Constructed Wetlands for the treatment of wastewater has recently increased in popularity due to the fact that they create green space and natural environmental areas as well as habitat for flora and fauna. A number of communities in Canada have constructed wetlands within the last ten years. The main challenge with constructed wetlands is the amount of land required. For treatment of the volume of wastewater required for the Town of Innisfil, a considerable amount of land would be required. The added capacity required beyond the existing plant capacity is more than 25,000 m^3/day. Wetland wastewater treatment is generally used for small communities. According to the MOE guidelines, this would result in a required minimum wetland size of 25 ha (62 acres) up to as much as 250 ha (620 acres) depending on the soil conditions and design. Furthermore, for significant phosphorus removal, this could double (potentially even triple) the land required. It would be difficult to find the sufficient vacant land to construct a wetland to MOE approval requirements. No further consideration will be given to this option.

11.7 Alternative 6A and 6B – Wastewater to Barrie

This alternative would involve sending wastewater from Innisfil to the City of Barrie for treatment. Under Alternative 6a, all flows from Innisfil would be pumped to Barrie and the existing LWPCP would be decommissioned. A new dedicated pump station and forcemain would be required. Alternative 6b would involve retaining the existing LWPCP and pumping flows in excess of the existing rated capacity (approximately 25,000 m^3/day) to Barrie. No upgrades would be made to the existing LWPCP. Again a dedicated pump station and forcemain would be required.

Although the City of Barrie's WPCP (currently being expanded) may have some spare capacity, based on previous attempts by the Town of Innisfil to negotiate servicing agreements (wastewater and water) with the City, it is suggested that this Option is not politically viable. Furthermore, this will not reduce the overall phosphorus loading to Lake Simcoe because Barrie's WPCP also discharges to Lake Simcoe. No further consideration will be given to this Option.

11.8 Alternative 7A and 7B – Wastewater to Alliston

This alternative would involve sending wastewater from Innisfil to the Town of New Tecumseth's Regional WPCP in Alliston for treatment. Under Alternative 7a, all flows from Innisfil would be pumped to Alliston and the existing LWPCP would be decommissioned. A new dedicated pump station and forcemain would be required. Alternative 7b would involve retaining the existing LWPCP and pumping flows in excess of the existing rated capacity (approximately 25,000 m^3/day) to Alliston. No upgrades would be made to the existing LWPCP. Again a dedicated pump station and forcemain would be required.

The current rated capacity of the New Tecumseth Regional Wastewater Treatment Plant is 5,063 m^3/d. An expansion of that plant is currently under construction, which will increase the capacity to 11,400 m^3/d. However, the MOE has restricted the allowable effluent discharge rate of the expanded plant to 7,595 m^3/d to ensure that the plant expansion is capable of being operated such that the effluent criteria are met on a continuous basis. It is considered that the design and operation of a further expansion of the New Tecumseth Regional WPCP to service Innisfil would be onerous and costly due to the anticipated effluent requirements of the discharge to the Nottawasaga River. The Nottawasaga River has limited assimilative capacity. In addition, it would be costly to pump raw wastewater from Alcona to Alliston. Sending raw wastewater to New Tecumseth would also require negotiations and agreements with the Town of New Tecumseth, which may have political implications. It may also result in potentially high user fees in the future, as the Town of New Tecumseth will dictate increases in user fees. Furthermore, although sewage will be directed from the Lake Simcoe watershed, which will reduce phosphorus loading to the Lake, there is concern with the long-term effects of removing water from the Lake Simcoe watershed. No further consideration of this Option is warranted.

11.9 Alternative 8A and 8B – Wastewater to York/Durham

This alternative would involve sending wastewater from Innisfil to the York/Durham Sewage System's Duffin Creek WPCP in Pickering for treatment. Under Alternative 8a, all flows from Innisfil would be pumped to the York/Durham Sewage System (YDSS) and the existing LWPCP would be decommissioned. A new dedicated pump station and forcemain would be required. Alternative 8b would involve retaining the existing LWPCP and pumping flows in excess of the existing rated capacity (approximately 25,000 m^3/day) to the York Durham Sewage System. No upgrades would be made to the existing LWPCP. Again a dedicated pump station and forcemain would be required.

A majority of the wastewater collected in the Region of York is directed to the Duffin Creek Wastewater Treatment Plant in the Region of Durham. Although York Region does own and operate its own WPCPs in the North Part of the Region, they all discharge to Lake Simcoe and therefore, there would not be any benefit to servicing Innisfil at any of those plants. The Duffin Creek facility discharges effluent to Lake Ontario. The current rated capacity of the Duffin Creek plant is 420,000 m^3/d (420 ML/d) and the current ADF is 365 ML/d. Therefore, there may be spare capacity to service Innisfil's future needs. Durham Region has completed a Class EA to expand the plant (Stage 3 expansion) to 630 ML/d. That expansion is expected to be completed in 2010. It is considered that the pumping of raw wastewater from Alcona to the top end of the York/Durham sewage collection system would be cost prohibitive. In addition, if the Innisfil wastewater flow rate was to be in the order of 50 or even 95 ML, there would be significant pipe sizing impacts to the existing York/Durham collection system. It is likely that Innisfil would have to share in the cost to increase the size of the existing York/Durham trunk sewers. Again, although sewage will be directed from the Lake Simcoe watershed, which will reduce phosphorus loading to the Lake, there is concern with the long-term effects of removing water from the Lake Simcoe watershed. As a result, no further consideration of this option is warranted.

11.10 Alternative 9A and 9B – Wastewater to Bradford

This alternative would involve sending wastewater from Innisfil to the Bradford WPCP in Bradford West Gwillimbury for treatment. Under Alternative 9a, all flows from Innisfil would be pumped to Bradford and the existing LWPCP would be decommissioned. A new dedicated pump station and forcemain would be required. Alternative 9b would involve retaining the existing LWPCP and pumping flows in excess of the existing rated capacity (approximately 25,000 m^3/day) to Bradford. No upgrades would be made to the existing LWPCP. Again a dedicated pump station and forcemain would be required.

An expansion of the Bradford WPCP was completed in 2010 and the rated capacity is 17,400 m^3/day. In order for Bradford to accept wastewater from Innisfil, the Bradford WPCP would have to be expanded beyond the current upgrade. It is considered that the design and operation of a further expansion of the Bradford WPCP to service Innisfil would be onerous and costly due to the anticipated effluent requirements of the discharge to the Holland River (and ultimately Lake Simcoe). In addition, it would be costly to pump raw wastewater from Alcona to Bradford. Sending raw wastewater to Bradford would also require negotiations and agreements with the Town of Bradford West Gwillimbury, which may have political implications. It may also result in potentially high user fees in the future, as the Town of Bradford West Gwillimbury will dictate increases in user fees. Furthermore, this will not reduce the overall phosphorus loading to Lake Simcoe because the Bradford WPCP discharges to the Holland River, which flows to Lake Simcoe. No further consideration will be given to this Option.

11.11 Alternative 10A and 10B – Wastewater to Georgian Bay

This alternative would involve sending wastewater from Innisfil to Georgian Bay near the Collingwood/Wasaga Beach area. Under Alternative 10a, all flows from Innisfil would be pumped to a new WPCP near Georgian Bay and the existing LWPCP would be decommissioned. A new dedicated pump station and forcemain would be required. Alternative 10b would involve retaining the existing LWPCP and pumping flows in excess of the existing rated capacity (approximately 25,000 m^3/day) to a new WPCP near Georgian Bay. No upgrades would be made to the existing LWPCP. A dedicated pump station and forcemain would be required.

For this alternative, an appropriate site near Georgian Bay would need to be selected. The Town would need to acquire land. Acquiring land, constructing a new WPCP as well as the costs associated with pumping the raw wastewater to the Georgian Bay area would be cost prohibitive. Furthermore, although sewage will be directed from the Lake Simcoe watershed, which will reduce phosphorus loading to the Lake, there is concern with the long-term effects of removing water from the Lake Simcoe watershed. No further consideration of this Option is warranted.

11.12 New WPCP in Innisfil (Effluent to Lake Simcoe)

This alternative would involve constructing a new WPCP in Innisfil for flows in excess of the existing rated capacity (25,000 m^3/day) with the effluent being discharged to Lake Simcoe. The existing LWPCP would be retained.

The interim Regulation 60/08 prohibited the establishment of any new sewage treatment plant within the Lake Simcoe Basin. Subsequently, Lake Simcoe Protection Plan Policy 4.3-DP also prohibits the establishment of any new sewage treatment plants within the Lake Simcoe Basin unless the new plant is intended to replace the existing plant or one or more subsurface sewage works or on-site sewage systems that are failing. Therefore, based on the interpretation of the Lake Simcoe Protection Plan, if the Town were to construct a new plant, they would be required to decommission the existing LWPCP.

Furthermore, in order to construct a new WPCP in Innisfil, the Town would need to acquire land sufficient in size to accommodate the new facility. However, the Town already owns sufficient land at the existing LWPCP site for a new facility. Therefore, no further consideration of this Option is warranted.

11.13 Alternative 12 – New WPCP in Innisfil (Effluent to Nottawasaga River)

This alternative would involve constructing a new WPCP in Innisfil for flows in excess of the existing rated capacity (25,000 m^3/day) with the effluent being discharged to the Nottawasaga River. The existing LWPCP would be retained.

The environmental impacts associated with this option are similar to Alternatives 7a and 7b (Wastewater to Alliston) in that the effluent would be discharged to the Nottawasaga River, which has limited assimilative capacity. Additionally, although sewage will be directed from the Lake Simcoe watershed, which will reduce phosphorus loading to the Lake, there is concern with the long-term effects of removing water from the Lake Simcoe watershed. No further consideration of this Option is warranted.

11.14 Alternative 13 – Expand existing WPCP

This alternative would involve expanding the existing LWPCP for the future requirements with effluent discharge to Lake Simcoe. The existing Town owned property is of sufficient size to allow an expansion with capacity to meet the future needs of Innisfil. The Phosphorus Reduction Strategy under the Lake Simcoe Protection Plan establishes a phosphorus loading objective of 629 kg/year from the LWPCP to Lake Simcoe. This objective will become compliance in 2015 or if the plant capacity is expanded prior to 2015. Therefore, the expanded LWPCP would require advanced phosphorus removal technologies in order to meet the proposed loading to Lake Simcoe of 629 kg/year. This alternative should be assessed further.

12.0 Evaluation Matrix – Recommended Alternatives

In evaluating the Phase 2 treatment plant alternatives, the following four questions were posed for each alternative. The answers are summarized in the subsequent evaluation matrix.

SCREENING QUESTIONS

1) Will the Review Agencies permit discharge at the proposed receiving water body?

In determining the answer to this question, positions of Review Agencies including the MOE and conservation authorities, were considered. The assumption was made that local conservation authorities would not allow removing water from one watershed and relocating it to another. The assumption was also made that the MOE and conservation authorities would allow effluent discharge to Lake Simcoe as long as the phosphorus concentrations comply with interim Regulation 60/08 (in place at the time of the Phase 2 Evaluation) and the Certificates of Approval of the specific WPCPs. It was also assumed that the MOE would not allow the construction of a new WPCP discharging to Lake Simcoe as imposed by Regulation 60/08.

2) Will the alternative solve the Problem Definition?

3) Is the strategy appropriate for the volume of flow to be treated?

4) Will the associated Municipalities likely grant approval for the proposed alternative?

In determining the answer to this question, all associated Municipalities were considered (including the Town of Innisfil). The evaluation is summarized in Table 12-1.

Table 12-1 Evaluation Matrix

Alt	Description	Screening Question			
		No. 1	No. 2	No. 3	No. 4
1	Do Nothing	n/a	N	N	n/a
2	Water Conservation	n/a	N	N	n/a
3	Reduce Inflow and Infiltration	n/a	N	N	n/a
4	Effluent Reuse/Recycling	n/a	N	N	n/a
5	Wetlands	Y	Y	N	N
6a	Send all flows to Barrie WPCP	Y	Y	Y	N
6b	Send flows from additional service areas to Barrie WPCP and Maintain existing LWPCP in operation	Y	Y	Y	N
7a	Send all flows to Regional WPCP in Alliston	N	N	N	N
7b	Send flows from additional service area to Regional WPCP in Alliston AND Maintain existing LWPCP in operation	N	N	N	N
8a	Send all flows to Duffin Creek WPCP in York Region	N	Y	Y	N
8b	Send flows from additional service areas to Duffin Creek WPCP in York Region AND Maintain existing LWPCP in operation	N	Y	Y	N
9a	Send all flows to Bradford WPCP	Y	N	N	N
9b	Send flows from additional service areas to Bradford WPCP AND Maintain existing LWPCP in operation	Y	N	N	N
10a	Send all flows to a New WPCP near Georgian Bay	N	Y	Y	N
10b	Send flows from additional service areas to a New WPCP near Georgian Bay AND Maintain existing LWPCP in operation	N	Y	Y	N
11	New WPCP (effluent to Lake Simcoe) in Innisfil for additional service areas AND Maintain existing LWPCP (effluent to Lake Simcoe) in operation	N	Y	Y	Y
12	New WPCP (effluent to Nottawasaga River) in Innisfil for additional service areas AND Maintain existing LWPCP (effluent to Lake Simcoe) in operation	N	Y	Y	N
13	Expand LWPCP	Y	Y	Y	Y

As a result of the Evaluation Matrix, Alternative No. 13 is the only alternative that answered yes to all four screening questions. It was therefore considered to be the recommended Phase 2 solution in conjunction with Alternatives 2 and 3.

13.0 Phase 2 Public Information Centre (PIC)

A Public Information Centre (PIC) for Phase 2 of the Innisfil LWPCP Class EA was held at the Town offices on April 7, 2009. A Notice informing the public and review agencies was issued March 19, 2009. The Notice was sent to residents within a 1km radius of the LWPCP. A copy of the Notice and mailing lists are included in Appendix I. The Notice was also published in the Innisfil Examiner on March 20 and 27 and in the Innisfil Scope on March 25 and April 1, 2009. The Notice was added to the Town's web site along with all of the PIC material.

The following plates were presented at the PIC:

- Welcome
- Problem Statement
- Municipal Class Environmental Assessment Flowchart
- Site Plan – Existing Conditions
- Existing Sanitary Sewer System Layout
- Class EA Service Area
- Class EA Study Area
- Overview of Lake Simcoe Protection Act and Regulation 60/08
- Summary of Potential Future Wastewater Flows for Service Area
- Current and Projected Populations and Flows
- Long List of Alternatives
- Evaluation Matrix
- Next Steps – Anticipated Schedule
- What Can You Do?

The Evaluation Matrix presented Alternative No. 13 (Expand Lakeshore WPCP) as the recommended alternative. A copy of the PIC presentation material is included in Appendix I.

A total of 26 members of the public signed in. Copies of the Sign-in Sheets are included in Appendix I.

Many of the attendees were advised of the recent Council decision to approve OPA#1, which would add about 10,000 m^3 of future wastewater flow, increasing the Class EA design Average Daily Flow rate from about 30,000 to 40,000 m^3. The public was advised that this will necessitate a reduction in the annual average phosphorus concentration (TP) in order to meet the Lake Simcoe Protection Act requirement of a maximum annual dosage of 351 kg of TP (as per interim Regulation 60/08, which was applicable at the time).

14.0 Public and Review Agency Comments

Most of the comments received during Phase 2 were as a result of the Public Information Centre. A summary of the verbal comments noted during the PIC is provided as follows:

- Noise from the existing plant is noticed at night and it will likely increase as a result of the planned expansion
- Odours are not evident from the plant but rather from Pump Station # 3
- Is there enough room on the Town's site to expand the plant from 14,000 m^3/d to 40,000 m^3/d? (answer – yes)
- Will the soccer pitch be impacted? (answer – no, it could be retained in its current location) Subsequent to the April 7, 2009 PIC, it was determined that the proposed plant expansion will require the land that is currently used as a soccer pitch. Therefore, the soccer pitch will be removed. It is noted that the Town has number of new soccer fields at its Multi Use Facility.
- What technologies are being piloted? (answer – four different technologies which are described in Report to Council)
- How will the expansion be financed? (answer – likely through Development Charges since all of the expansion is for future development)
- How did the Big Cedar Point Area get eliminated from the original servicing programme? (answer – not really part of this Class EA but there was an OMB decision in 1983 based on concerns expressed by the property owners)
- Consider chemical phosphorus elimination with iron and aluminium (provided article) (answer – chemical adsorption of TP is being considered)

A total of four comments sheets were received at the PIC and one comment sheet was received following the PIC (copies included in Appendix I). Three of the comment sheets required a written response (copies included in Appendix I). A summary of the comment sheets is provided as follows:

Table 14-1 Phase 2 Comment Summary

Sheet #	Wants to receive further Notices	Preferred Option	Other Comments
1	Yes	Not provided	How are other new development areas to be serviced? Are they included in this Study? How will the expansion be paid? Will the expansion insure all septic systems close to the Lake are eliminated? **Written response provided**

In Association with BLACK & VEATCH Building a world of difference

Sheet #	Wants to receive further Notices	Preferred Option	Other Comments
2	Yes	Not provided	Concerned about cost to property owners and time frame to pay for the expansion Positive step to help Lake Simcoe Concerned about water quality
3	Yes	Not provided	Existing plant emits odours – How will odours be contained with the proposed plan? Cost estimates for hook-up are completely unreasonable at $45,000 per home (seems to be talking about Big Cedar Point Servicing which is not related to this Class EA) **Written response provided**
4	Yes	Not provided	Concerned about existing noise and increased noise levels from expanded plant and asks for measures to reduce noise
5	Yes	Not specifically mentioned	DRAFT capacity ledger sets population at 75,373 but County OP allots 65,000 to Innisfil Extent of expansion seems premature since Province has not approved growth anticipated by Town DRAFT capacity ledger uses 3 ppu rationalization for the area needed for settlement area uses 2.6 ppu – be consistent Educate people to use less water Does not make financial sense to service unserviced areas such as De Grassi Point and Gilford – inspect septics and enforce guidelines Is pipe from Big Bay Point a separate Class EA? – please provide timelines Encourages Town to accept MOE interim limit of 351 kg TP per year as the final limit **Written response provided**

15.0 Supporting Studies

15.1 Phase I Environmental Site Assessment

A Phase I Environmental Site Assessment (ESA) was completed by Terraprobe of the adjacent property to the LWPCP when the property was purchased by the Town. A report was issued June 22, 2005. The report notes that they were unable to determine the conditions within the existing buildings (Terraprobe could not gain access to the house). However they observed wrecked cars, debris, tanks, fill piles, and oil and diesel fuel spills on the property surrounding the residence. A historical review suggests similar structures were located on the site, dating back to at least 1954. The Report recommends a Phase II ESA be undertaken. A copy of the Report is included in Appendix J.

15.2 Phase II Environmental Site Assessment

A Phase II ESA of the adjacent property to the LWPCP was completed by Terraprobe in September 2009 (as recommended by the Phase I Assessment). The investigation included 14 Test Pits advanced to depths varying from approximately 0.75 to 5.3m, two boreholes advanced to depths of 6.6 and 8.1m and the installation of monitoring wells at both borehole locations. Chemical analysis was conducted on approximately 11 selected soil samples and two groundwater samples.

Because the site is within 30m of Cedar Creek #6, it is considered potentially sensitive under O.Reg. 153/04. It is therefore considered that Table 1 Standards apply. Areas that are more than 30m from the creek would have to be described as a separate land parcel in order to allow application of Table 2 standards. Some of the soil samples exceeded the Table 1 standards. However, the exceedances are localized to the fill above the native soils and were generally associated with petroleum found in isolated areas within the vicinity of above ground storage tanks and the nature of the debris/fill found above the native soil. Exceedances included antimony, lead, zinc and various petroleum hydrocarbons. There were no exceedances of the Table 1 and Table 2 Standards in the native underlying soil or groundwater samples.

Terraprobe considers impacts to be surficial, located primarily in the vicinity of the above ground storage tanks or along the perimeter of the driveway in fill/waste debris piles. Terraprobe recommends that all waste, debris, fill and topsoil should be stripped and removed from the site followed by an inspection and sampling of subgrade material to ensure contaminants have not been leached into the native soil. All removed material should be disposed of at a licensed landfill facility or recycling centre. Terraprobe also recommends that follow up inspection and testing is undertaken to confirm the site is adequately remediated to meet current standards. A copy of the Report is included in Appendix J.

15.3 Stage 1 Archaeological Report

A Stage 1 Archaeological Assessment was completed by Archeoworks Inc and a report was issued March 2009. Archaeological potential was identified by conducting background research along with a non-intrusive site visit. Areas of the existing LWPCP site and adjacent Town owned property (which were identified in the Report) were determined to have high potential for the recovery of Aboriginal remains but low potential for locating Euro-Canadian historical remains. The Report recommended that a Stage 2 Archaeological Assessment be undertaken on the areas indicated that have high Archaeological potential. The Report was filed with the Ministry of Culture. A copy of the Report is included in Appendix K.

15.4 Stage 2 Archaeological Report

A Stage 2 Archaeological Assessment was completed by Archeoworks Inc in the fall of 2009 and spring of 2010 with a report being issued in April 2010. Areas that were considered to be undisturbed (including an open agricultural and fallow fields, woodlands, lawn and an existing soccer pitch) were subjected to a pedestrian or shovel test-pit form of survey. The undisturbed area was tested at survey intervals of 5m. No archaeological remains were encountered within the limits of the property. Archeoworks recommends that the property be cleared for further archaeological concern. They also recommend that the Report be filed with the Ministry of Culture. It is noted in the Report that should previously unknown or unassessed deeply buried archaeological resources be uncovered during construction, the proponent cease alteration of the site immediately and engage a licensed archaeologist to carry out archaeological fieldwork (in compliance with Provincial legislation). Furthermore, should human remains be uncovered, the Heritage Operations Unit of the Ministry of Tourism and Culture, the police or coroner and the Registrar of Cemeteries must be notified immediately as outlined in the Report. A copy of the Report is included in Appendix K.

15.5 Preliminary Geotechnical Report

A preliminary geotechnical investigation was completed by Terraprobe and a report was issued December 3, 2008. The purpose of this investigation was to determine soil and groundwater conditions within the Town owned property to the west of the existing LWPCP. Eight (8) boreholes were drilled in November 2008. Terraprobe notes that the area appears to consist of perched water conditions above very dense silt till soils. While this is a preliminary study and further investigation will be required for any design, it is considered that the native soil conditions are suitable for the support of structures required for an expansion of the LWPCP.

With respect to construction, Terraprobe notes that the footings and base slabs could be founded entirely on the dense native soil (at least 1.0 m below grade), 1.2 m of soil cover is required for frost protection. Structures should be designed to resist hydrostatic uplift pressure during seasonally high groundwater periods (considering empty tanks) and that the majority of native soil on site will be suitable to be used for compacted fill, subject to water content.

Terraprobe does not believe that a Permit to Take Water will be required for construction on this site. This information will have to be reviewed during final design. A copy of the Report is included in Appendix L.

16.0 Preferred Alternative

Further to the receipt of comments as a result of the Phase 2 planning process (including the PIC), the preferred alternative is Alternative 13 (Expand Lakeshore WPCP) on the existing Town owned property coupled with Alternative 2 (Water Conservation/Sewer Use By-Law) and Alternative 3 (Reduce Inflow and Infiltration).

17.0 Inventory of the Natural, Social and Economic Environments of the Preferred Alternative

17.1 General

The Municipal Engineers Association's (MEA) *Municipal Class Environmental Assessment* document (MEA, 2007) states that a detailed inventory of the natural, social, and economic environments need only be carried out to the extent necessary to select a preferred design concept. As such, only those aspects of the environment in which further investigations were deemed necessary have been assessed.

17.2 Natural Environment

The Town of Innisfil is located along the western shoreline of Lake Simcoe, south of the City of Barrie and north of the City of Toronto. Lake Simcoe is a remnant of the former glacial Lake Algonquin. The general location of features designated as Natural Environment Areas are shown in Appendices 1 and 2 and Schedule B of the Town's Official Plan (see copies overleaf). Based on these plans, there are no significant natural areas within the proposed LWPCP site. However, the Town has designated a small forested area on the LWPCP site as a Natural Environmental area. The remainder of the site is designated Rural Area. The area designated as Natural Environmental Area will have to be reviewed by the Town, and a zoning change will likely be required. Furthermore, the trees removed during construction can be replaced by trees surrounding the site, which can provide a visual, noise and odour buffer for neighbouring properties.

17.3 Physiography and Soils

The LWPCP site is relatively flat, sloping from an elevation of approximately 226.25 in the northwest corner to an elevation of approximately 222.00 at the culvert inlet in the southeast corner at the intersection of the 6^{th} Line and the Road Allowance between Lots 25 and 26. This slope occurs over a distance of about 558 m resulting in a slope of about 0.76%. There are no significant physical features on the site. The soil conditions are described in Clause 15.5 of this ESR.

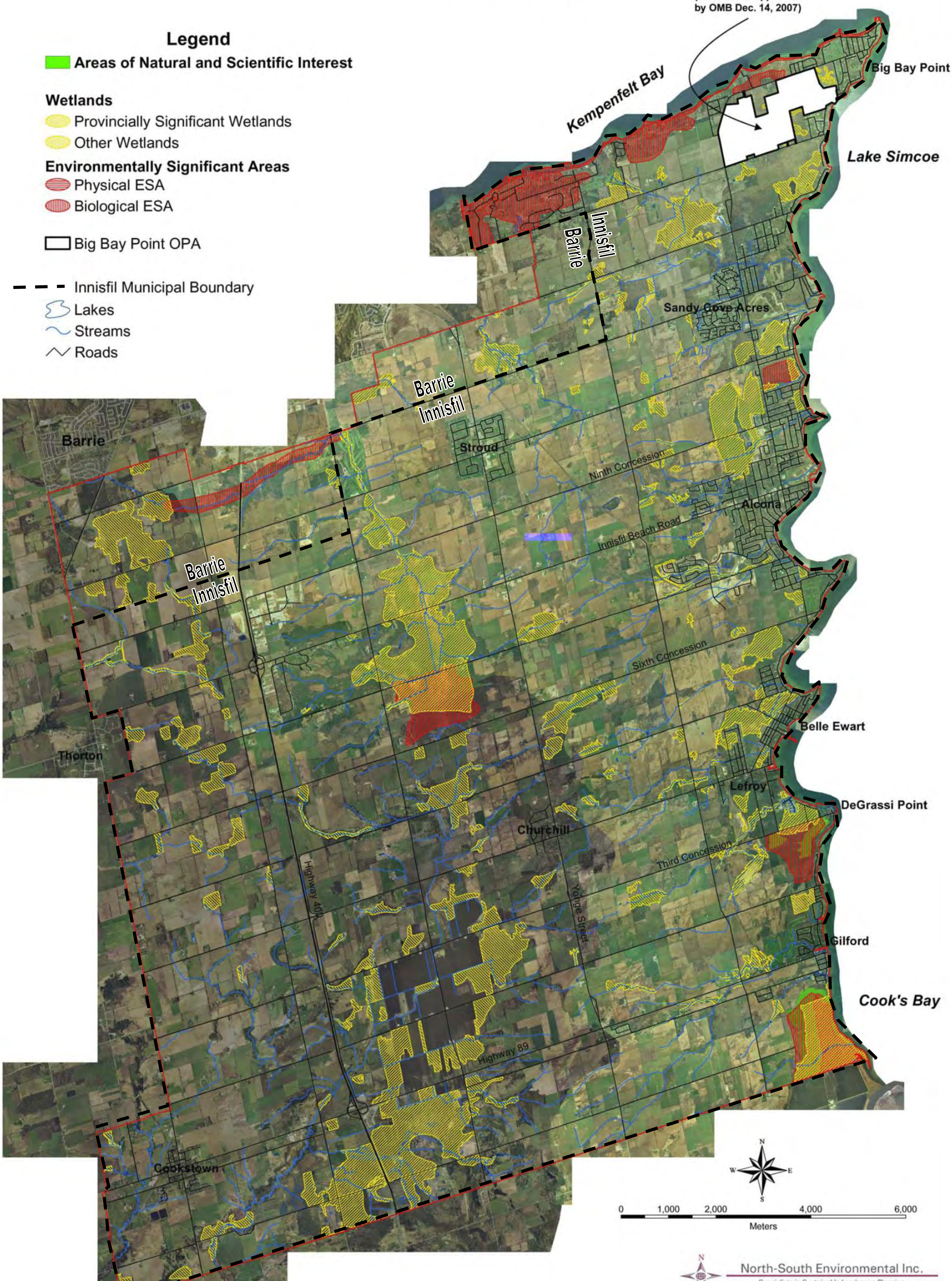
17.4 Natural Heritage Resources

Based on a review of the Town's Official Plan and the Ministry of Natural Resource's Natural Heritage Information Centre (NHIC) database, there are no identified natural heritage resources on the LWPCP site. The closest identified wetland is the Little Cedar Point Swamp – 129.7 ha in size- located in the Belle Ewart area to the south. This wetland is not listed as Provincially Significant.

The proposed LWPCP site was assessed for Archaeological resources (See Sections 15.3 and 15.4). No archaeological remains were encountered.

Appendix 1: Natural Areas

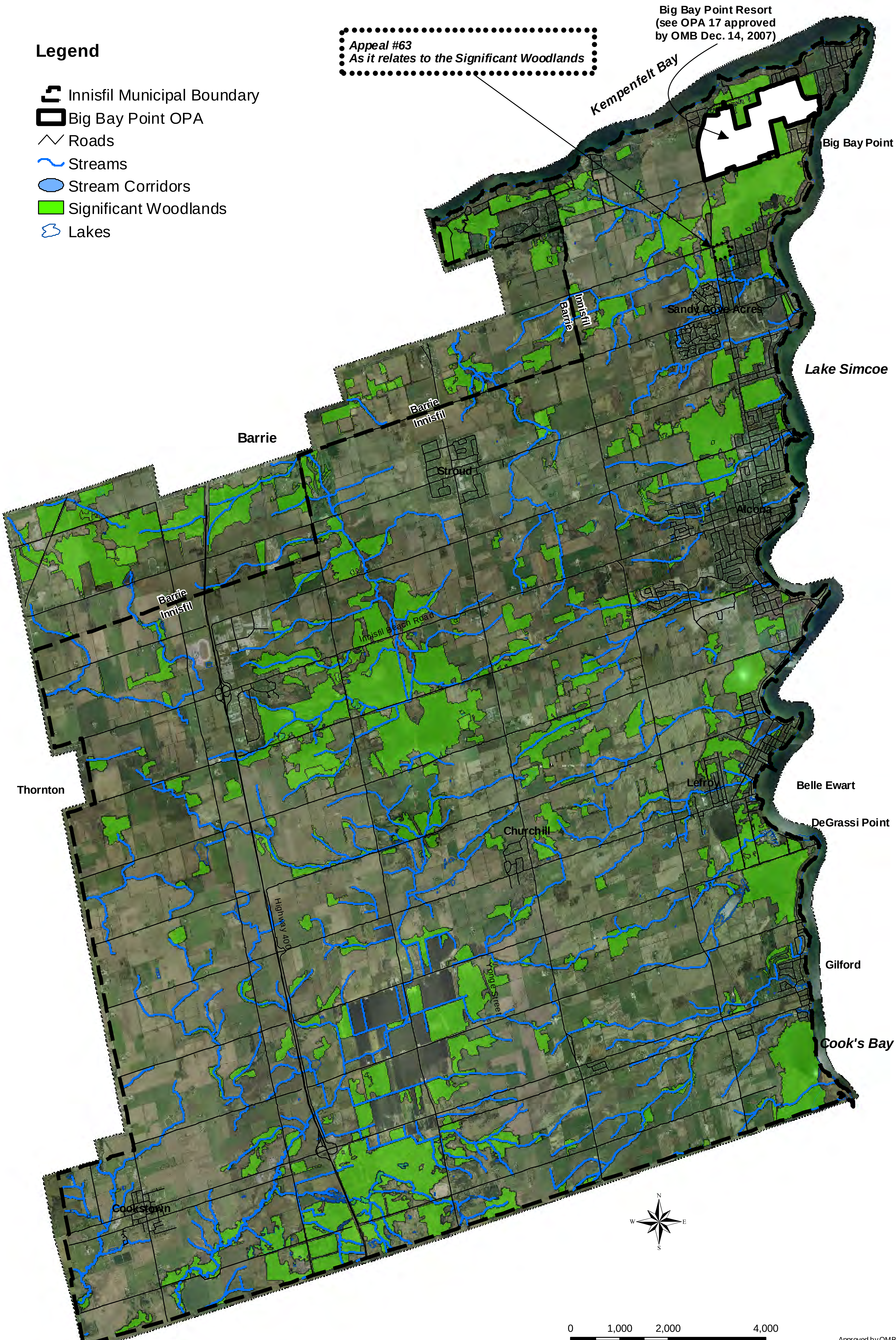
Innisfil Official Plan



Approved by OMB
May 13, 2009 and March 1, 2010

Appendix 2: Natural Areas

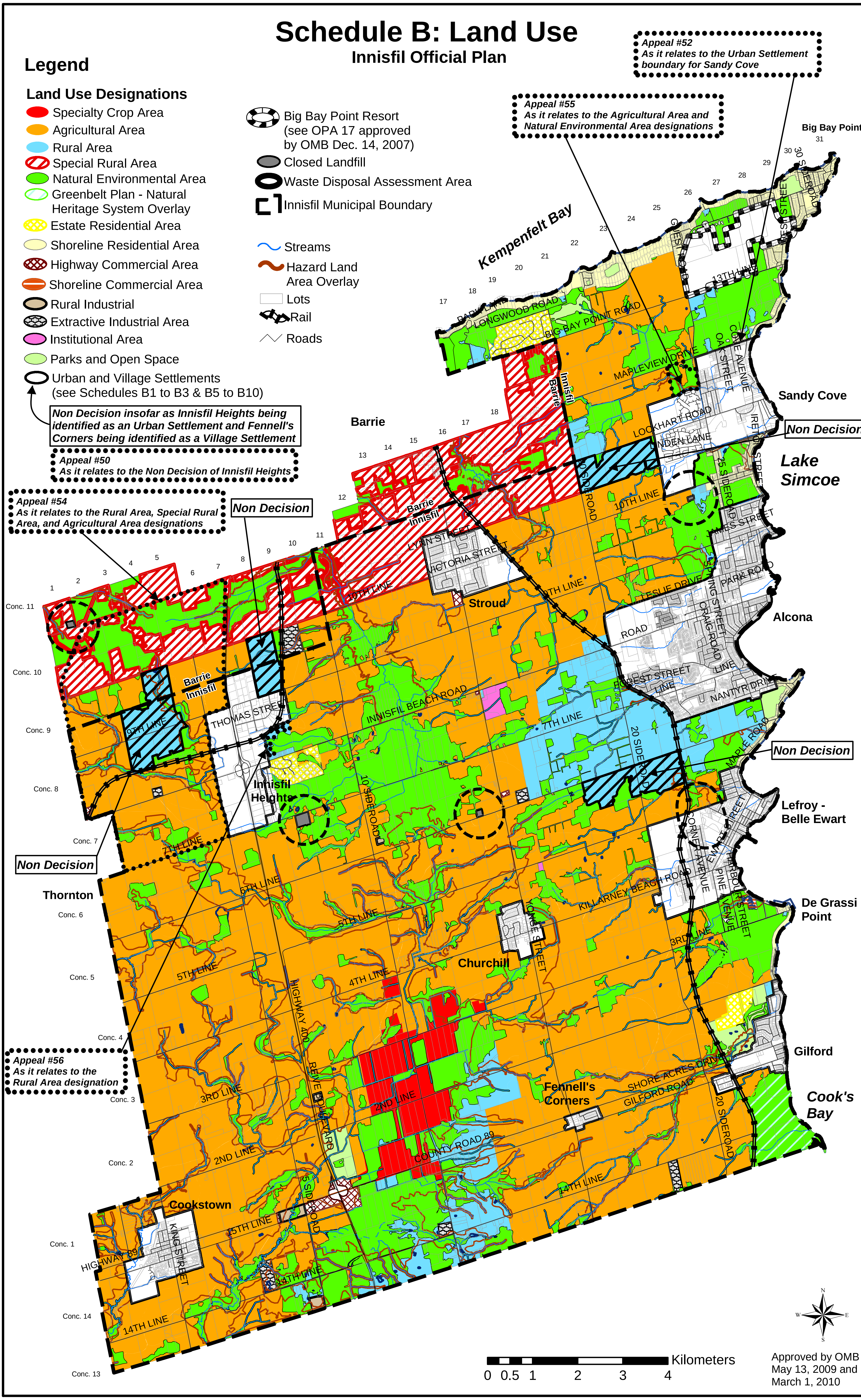
Innisfil Official Plan



Approved by OMB
May 13, 2009 and
March 1, 2010

Schedule B: Land Use

Innisfil Official Plan



Significant Wetlands

There are no provincially significant wetlands in the vicinity of the LWPCP.

Significant Portions of the Habitat of Endangered and Threatened Species

A review of the (NHIC) database revealed that one endangered species that was reported to have habitat in the general area is listed as occurring on the LWPCP site or directly adjacent to it.

Henslow's Sparrow (*Ammodramus henslowii*) is identified as occurring in an area of southern Ontario that includes the LWPCP. Information from Environment Canada and the Ontario Ministry of Natural Resources indicate that it prefers tall grasses of abandoned agricultural lands or active hay fields. The latest population estimates available in 2001 indicated counts of 2 to 3 pairs of Henslow's Sparrows in Canada. As of 2005, there are no confirmed breeding locations in Ontario. Information from Environment Canada and the Ontario Ministry of Natural Resources on Henslow's Sparrow is included in Appendix M.

Due to the rareness of this bird and a deficiency of confirmed breeding locations in Ontario, it is anticipated that expansion of the LWPCP will likely have no impacts on this species.

Significant Valleylands

There are no significant valleylands in or on lands adjacent to the LWPCP.

Areas of Natural and Scientific Interest

There are no ANSIs in or on lands adjacent to the LWPCP.

Significant Wildlife Habitat

No other species of conservation concern occur in the direct vicinity of the LWPCP, and no other designation of habitat significance has been applied to the LWPCP site by the planning authorities.

Information from the NHIC with respect to Natural Areas in Innisfil is included in Appendix M.

17.5 Socio-Economic Environment

The Town has maintained a recreational/tourist based economy, along the shoreline of Lake Simcoe and in particular in Gilford, Lefroy, Belle Ewart, Alcona and Sandy Cove Acres. Farther back form the shoreline area, agricultural endeavours are prevalent along with pockets of residential and commercial development in Stroud, Churchill, Fennels Corners and Cookstown. The Innisfil Heights area (8^{th} Line at Hwy 400) provides a more intense commercial development but also includes some low density, estate residential development. The Georgian Downs racetrack is located west of Innisfil Heights and provides economic stimulus for the entire Town and surrounding communities.

The Town intends to increase growth in both the residential and commercial/industrial sectors over the next 20 years.

With respect to the area immediately surrounding the LWPCP site, there is a golf course to the east with residential (both permanent and seasonal) development to the north (buffered by a woodlot) and east (Big Cedar Point). There are some existing developed residential lots to the south. It is also noted that the lands to the west are designed for future development.

The current LWPCP site has been used as a wastewater treatment facility for several decades. The adjacent Town owned property has been residential and agricultural in the past.

Both Stage 1 and Stage 2 Archaeological Assessments were carried out on the entire property and no archaeological remains were encountered, as discussed in Section 15.3 and 15.4 of this Report.

Phase 3 Report

18.0 Existing Wastewater Treatment Process Review

18.1 General

This section provides a description of the existing processes at the LWPCP.

18.2 Stages1 and 2 Design Capacity

The original design of the LWPCP had recommended construction in three similar phases, each with an average capacity of 7,185 m^3/d. Currently, two phases have been constructed so the plant has an average capacity of 14,370 m^3/d. Analyses of the major unit operations are provided in the sections below. A photo of the existing LWPCP is presented in Figure 18-1.

Figure 18-1 Existing Lakeshore WPCP Photo

18.3 Headworks

The headworks facility consists of two coarse mechanical bar screens with a screenings dewatering press. The dewatered screenings are stored in bins, which are periodically disposed of off-site at a landfill site. The screens are followed by two aerated grit tanks of dimensions 4.6 m wide by 4.6 m long by 4.0 m deep. The total volume for both grit tanks is 172m^3. The headworks facility was constructed with the original plant in 1987 and was designed to treat the Stage II design peak flow of 36,336 m^3/d. Using the MOE guideline of a five-minute hydraulic retention time at peak flow, the grit tanks are near capacity at Stage II flows with an HRT of about seven minutes. The headworks are designed to accommodate the peak instantaneous flow (as opposed to the peak daily flow) since there is no hydraulic buffering capacity in the system.

18.4 Aeration Tanks and Aeration System

The LWPCP has four aeration tanks each with 2,500 m^3 capacity. Process air is supplied to the tanks with three blowers (two operating, one standby) each with a capacity of 2,700 m^3/hr. The aeration tanks were designed to meet the MOE design guideline of 0.17 – 0.24 kg BOD/m^3 of tankage per day for extended aeration with nitrification[1]. At average conditions, the loading is about 0.2 kg BOD/m^3, within the guideline with some room for increased capacity.

18.5 Secondary Clarifiers

There are four 26 m diameter secondary clarifiers, representing a total clarification area of 2,124 m^2. The clarifiers were sized using the following MOE design guidelines:

- Surface overflow rate (SOR) of 0.41 L/m^2/s (35.4 m^3/m^2/d) at peak flow
- Solids loading rate (SLR) of 120 kg/m^2/d (at peak flow with 100% RAS flow)
- Weir loading rate of 2.9 L/m/sec (251 m^3/m/d) at peak flow

The actual parameters at Stage II design conditions are:

- SOR = (35,350 m^3/d)/(2,124 m^2) = 16.6 m^3/m^2/d at peak flow
- SLR = 108 kg/m^2/d (at MLSS = 4,500 mg/L)
- Weir loading rate = (35,350 m^3/d)/(π x 26 x 4) = 111 m^3/m/d

From this analysis, the solids loading is the more critical factor. The SOR and weir loading rates are well within MOE guidelines.

18.6 Tertiary Filtration

The Stage I and II sand filters have different media bed depths (Stage I is shallow, Stage II is deep) and therefore have different loading criteria. The MOE loading criteria are as follows:

- Shallow: 2.1 L/m^2/s (181 m^3/m^2/d) at peak flow
- Deep: 3.3 L/m^2/s (285 m^3/m^2/d) at peak flow

The above criteria include sand filter backwash, which was estimated by Ainley to be about 650 m^3/d per stage for a total of 1,300 m^3/d; this represents about 9% of the ADF.

The Stage I filters are continuous backwash travelling bridge filters while the Stage II filters are upflow, deep bed, continuously backwashing granular media filters. The Stage I filters consist

[1] From Table 10.1 of the MOE Guidelines for the Design of Sewage Treatment Works, July 1984

of two beds each measuring 3.8 m by 15.9 m, for a total filtration area of 121 m^2. The Stage II filters consists of 15 small modules of 4.65 m^2 each, for a total area of 70 m^2. This provides peak flow capacities of about 21,900 m^3/d and 19,950 m^3/d for Stage I and II respectively, for a total capacity of 41,850 m^3/d. Accounting for the backwash flow, the peak plant flow capacity is 40,550 m^3/d. This allows about 15% extra capacity than the predicted Stage II peak daily flow.

18.7 Ultraviolet Disinfection

The existing UV disinfection system has operated very well according to LWPCP annual reports. The *E. coli* counts have been consistently well below the C of A non-compliance limit of 200 organisms/100 mL, averaging <10 organisms/100 mL as an annual average according to plant records for the years 2002-2005.

18.8 Effluent Outfall

The final effluent outfall was constructed for the Stage III peak daily flow of 51,300 m^3/d. Flow regulation is provided by removing covers on some of the 18 diffuser ports on the outfall. Currently, ten diffuser ports are open on the outfall. Wastewater can flow by gravity via the existing outfall up to 51,300 m^3/d due to hydraulic limitations.

18.9 Aerobic Digestion

The MOE design guideline for conventional aerobic digestion is to provide 45 days of retention (including the solids retention time (SRT) of the aeration tanks). The current system consists of two primary aerobic digesters and two secondary digesters. The tanks are decanted to thicken the biosolids and increase the SRT. The primary digesters each have a volume of 540 m^3, and the secondary digesters each have a volume of 270 m^3. The existing digesters were sized assuming an SRT in the aeration system of 20 days, 15 days in the primary digester tanks, and 10 days in the secondary digester tanks, for a total of 45 days at Stage II loads.

18.10 Biosolids Storage

The LWPCP currently has a total of 10,800 m^3 of biosolids storage volume (2,700 m^3 from Stage I and 8,100 m^3 from Stage II), which is sufficient to give about 180 days of storage at Stage II loads. Additional capacity is required to meet the current MOE Guideline requirement of 240-days.

19.0 Effluent Discharge Criteria to Lake Simcoe

19.1 MOE Documents relating to Lake Simcoe

The Lake Simcoe Protection Act became law in December 2008. The act required the Province to establish a protection plan for Lake Simcoe and surrounding area. The Lake Simcoe Protection Plan (LSPP) took effect on June 2, 2009. The purpose of the plan is to provide direction that will help protect and restore the ecological health of the Lake Simcoe watershed as important decisions are made, including decisions about new development. The LSPP also outlines a number of proposed actions to be undertaken by both the public and private sectors. In the near-term, the plan focuses on the issues most critical to the health of the lake, including improving water quality through reducing the amount of nutrients, primarily phosphorus, entering the lake. Recommendations included in the LSPP were to develop a phosphorus reduction strategy, study the feasibility of water quality trading to help reduce phosphorus loading to the Lake, and to develop a regulation to protect the shorelines of Lake Simcoe.

In conjunction with the release of the LSPP, the Ministry of Environment (MOE) enacted Ontario Regulation 60/08 under the Ontario Water Resources Act, as discussed in Section 4.0. Ontario Regulation 60/08 was an interim regulation put in place to limit phosphorus loading to Lake Simcoe during the time required for the Province to implement some of the recommendations of the LSPP. This regulation superseded existing Certificates of Approval (C. of A.) of all 15 WPCPs currently discharging into Lake Simcoe and capped their phosphorus limits until March 31, 2010 at a reduced level. In the Town of Innisfil's case, the total permissible phosphorus discharge limit was lowered from 803 kg/yr (total mass loading) to 351 kg/yr as an interim measure.

In accordance with the requirements of the LSPP, the Province posted the following three Draft documents on the Environmental Registry for public review and comment from February 17, 2010 to April 3, 2010.

- Phosphorus Reduction Strategy, June 2010 (PRS): (EBR # 010-8986) released July 7, 2010
- Water Quality Trading Feasibility Study (WQT): (EBR# 010-8989) February 2010
- Shoreline Regulation Discussion Paper: (EBR# 010-9107)

19.1.1 Phosphorus Reduction Strategy

The purpose of the PRS is to determine how to reduce phosphorus loadings to the Lake from various sources such as wastewater treatment plants, stormwater runoff, and atmospheric deposition. The ultimate goal of the PRS is to reduce phosphorus loadings to achieve a target for dissolved oxygen of 7 mg/L (long-term goal estimated at 44 tonne per year). The PRS is based on a vision of shared responsibility. The draft Phosphorus Reduction Strategy initially planned to achieve proportional reductions from each major contributing source, so that the proportional contribution each source makes to the 72 tonne/year total load today, will be the same proportional contribution it makes to the 44 tonnes/year goal in the future (2045). All 15 WPCPs currently discharge approximately 5,000 kg/year (approximately 7%), which should be reduced to 3,200 kg/year by 2045(i.e. approximately 40% reduction similar to the overall reduction for the lake). The draft PRS proposed to achieve the proportional reduction by incrementally reducing the phosphorus loading limit at each of the wastewater treatment plants over a period from 2015 to 2045. However, the final Phosphorus Reduction Strategy (June 2010) notes that currently available technology would not allow the WPCPs to meet their targeted load for 2045 and that it is currently not practical to require WPCPs to reduce their loads beyond the baseline limits (2015 limits as discussed below). The PRS does note that any further incremental reductions beyond the baseline limits will be re-evaluated in 2015 during the first review of the strategy.

The PRS identifies new Baseline Phosphorus Loads for all 15 WPCPs connected to Lake Simcoe. These baseline phosphorus loads have been adopted as objectives after the Interim O. Reg. 60/08 expired on March 31, 2010. The loads will become compliance limits for each WPCP Certificate of Approval (issued by the MOE) by 2015 or the next time the WPCP expands, whichever occurs first.

These baseline phosphorus loads were developed by taking the current rated capacity of each of the 15 WPCPs (as identified in their existing Certificate of Approval) and applying minimum standard of treatment technology. The new baseline phosphorus load for LWPCP is 629 kg/year and is based on the LWPCP achieving an effluent phosphorus concentration of 0.12mg/L at the current plant rating of 14,370 m^3/d. The total baseline phosphorus load for all 15 WPCPs is 6,979 kg/year, which is less than the total that was associated with the Interim Regulation (O. Reg. 60/08) of 7,161 kg/year. However, the proposed baseline load for the LWPCP is greater than the total associated with the Interim Regulation (351 kg/year).

In 2015, the aforementioned baseline phosphorus loads will become compliance limits for all WPCPs; therefore, for the purposes of this ESR, a Compliance loading limit of 629 kg/year of TP will be used for both the 25 and 40 MLD plant expansions.

The MOE has also completed a WQT Feasibility Study and has shown that WQT may be feasible in the future. However, the MOE has not yet determined if the implementation of such a program will proceed. This is discussed further in Section 19.1.2 below. For the purposes of this ESR, water quality trading has not been included as an option. A copy of the June 2010 Phosphorus Reduction Strategy is included in Appendix N.

With respect to the Innisfil LWPCP, the future TP requirement is 629 kg/year with concentrations presented in Table 19-1 as follows for various plant capacity ratings:

Table 19-1 Lakeshore WPCP Projected Wastewater Demands and Phosphorus Loads

Year	Proposed Expansions at the WPCP (m^3/day)	Total Capacity After Expansion (m^3/day)	Allowable Annual (kg)	TP Concentration Loading (mg/L)
2010		14,370	629	0.120
2015	11,000	25,370	629	0.068
2020		25,370	629	0.068
2025	14,500	39,870	629	0.043
2030		39,870	629	0.043

19.1.2 Water Quality Trading Program

The WQT feasibility study looked at different means to implement a WQT program to determine if it is feasible for the Lake Simcoe Watershed. Water Quality Trading is a market based way to control pollutants by trading them as commodities, with a net overall reduction as the goal. In the Lake Simcoe Watershed, the main pollutant that was investigated for trading is phosphorus. As part of the feasibility study, a number of items were considered including; if a there is a market for trading (demand is greater than supply); other successful programs and past studies of the watershed to determine if the phosphorus could be quantified.

The WQT feasibility study concludes that WQT is feasible for the Lake Simcoe Watershed. However, based on the comments received during the February 17, 2010 to April 3, 2010 public review period, the MOE will determine whether to proceed with implementing a WQT Program. If they decide to implement a program, the specifics of how it will operate will be determined at that time. The feasibility study did make recommendations for the MOE to consider. One of these recommendations includes establishing a central “clearinghouse” where all credits are sold and all credits are purchased. This would make the process more transparent and accountable and would prevent private deals between two parties. However, the specifics about how the clearinghouse would be created and managed as well as any specifics on how credits will be sold and subsequently purchased will be determined as part of the program implementation. The MOE has indicated that, if water quality trading is a future option, the details of such a program will be provided prior to 2015.

The ESR is based on the assumption that water quality trading will not be in place for either plant expansion.

19.1.3 Shoreline Protection Regulation

The Shoreline Protection Regulation (SPR) generally prohibits the removal of natural vegetation in existing naturally vegetated areas within shoreline buffer areas and shoreline natural areas, which may be areas within 15m of the lake or 30m of a stream. The intent is to leave these areas undisturbed, i.e. no removal, pruning, cutting or grubbing. Some exceptions are proposed but, in these cases, compensation will be required elsewhere to achieve "no net loss" of natural vegetation.

The regulation requires establishment of a vegetated riparian area at the time other works or activities are undertaken along the shore of a lake or a stream and applies within 15m to works such as erosion control, boathouse or dock construction or new landscaping. It would require that works within 15m revegetate to a distance of 5m from shoreline (15m is the "trigger", 5m is the "requirement") to mitigate past activities, and it would appear to be triggered by a building permit application.

The regulation prohibits significant shoreline alteration such new or expanded dredging into shoreline, new or expanded lagoons, and new or expanded channels between pond/lagoon and lake (i.e. this would prevent future Big Bay Point developments). The regulation says that developments transitioned by O. Reg. 219/09 "may be exempt"; however, we believe the proper wording should be "are exempt".

The regulation prohibits fertilizer use but appears to focus on "residential/aesthetic" uses as it exempts agriculture and allows municipal sports applications if need is demonstrated via soil testing. There is a total prohibition of fertilizer use within 5m of shoreline, and fertilizer must be phosphorus free within 30m. The prohibition could include compost, manure etc.

The regulation would prohibit new septic system or subsurface sewage works within 100m of shoreline or any permanent stream. Some exemptions would apply (agriculture, replacement of old system) but there does not appear to be an exemption for new cases even where advanced sewage treatment precedes disposal to a tile field that is used for disposal only, not treatment. This part of the regulation would be regulated under the Ontario Building Code.

The regulation would prohibit wetland interference, including:

- Activities that would change wetland boundary or wetland hydrology
- Removal of vegetation from wetland, or natural vegetation within 30m of wetland (vegetation removal would not change wetland classification)

There are some exceptions and exemptions; however the regulation even defines wetland drainage as a form of site alteration.

Implementation by and large would be through adding regulations to existing permits (Building Permits, Dock Permits) or the Public Lands Act. Voluntary compliance is encouraged; alternatively municipalities may be required to put in place bylaws consistent with regulation.

19.2 Effluent Criteria

Proposed effluent criteria have been determined based on the current CofA and on the TP limits established by the PRS. Furthermore, the effect of plant effluent on Lake Simcoe receiving waters after expansion was investigated using the proposed effluent criteria by conservative mixing modelling. The results of the modelling showed that the LWPCP discharge after expansion to 25 ML/d or 40 ML/d would have negligible effects on aquatic life in Lake Simcoe. The WPCP effluent is non-lethal. Under all modelled conditions and diffuser configurations, the discharge meets all MOE requirements for a mixing zone and discharge to surface water. A summary of the effluent mixing modelling is provided in section 19.4 below and details of the modeling methods and results are presented in Appendix O.

The proposed effluent criteria for the expansion to a 25 MLD plant are shown in Table 19-2 below.

Table 19-2 Effluent Criteria for 25MLD Plant Expansion

Parameter	Objective Limit	Compliance Limit
Total Phosphorus (TP) mass loading		629kg/year
Total Phosphorus (TP)	0.06mg/L	0.069mg/L
$CBOD_5$	5mg/L	10mg/L
Total Suspended Solids (TSS)	5mg/L	15mg/L
Ammonia	3mg/L	5mg/L
E. coli		200 counts/100mL

The effluent criteria for the expansion to a 40 MLD plant are shown in Table 19-3 below.

Table 19-3 Effluent Criteria for 40MLD Plant Expansion

Parameter	Objective Limit	Compliance Limit
Total Phosphorus (TP) mass loading		629kg/year
Total Phosphorus (TP)	0.035mg/L	0.043mg/L
$CBOD_5$	5mg/L	10mg/L
Total Suspended Solids (TSS)	5mg/L	15mg/L
Ammonia	3mg/L	5mg/L
E. coli		200 counts/100mL

19.3 Effluent Toxicity

The Ontario Ministry of the Environment (MOE) requires that all effluents discharging to surface waters be non-acutely lethal at the end of the pipe. The effluent of the LWPCP will be treated by ultraviolet sterilization to treat bacteria and so there will be no residual chlorine. There is potential, however, for effluent toxicity from the un-ionized fraction of ammonia (NH_3) in the effluent. The fraction of ammonia that is un-ionized increases with temperature and pH of the water.

Generally, an effluent concentration of 0.2 mg/L or less of un-ionized ammonia is required as a conservative estimate of the lethal threshold. The proposed compliance limit for the Innisfil LWPCP effluent is 5 mg/L of total ammonia, which corresponds to the current compliance limit of 5 mg/L for total ammonia as stated by the Certificate of Approval Number 1938-73QJ7D for the LWPCP. During 2008 and 2009, the 75th percentile of effluent pH was 8 and the 75th percentile of temperature at the Innisfil plant was 19.8°C in summer and 13.7°C in winter (see effluent quality below for details). Under these conditions, a total ammonia concentration of 5 mg/L results in un-ionized ammonia concentrations in the effluent of 0.19 mg/L in summer and 0.12 mg/L in winter, which are not acutely lethal.

Near-field mixing modelling of the effluent under the proposed expansion showed that quick effluent assimilation for the proposed expansions can be achieved through effective diffuser design. Under all modeled seasonal conditions, including dominant and onshore currents and stagnant conditions during maximum summer temperatures as well as under ice in winter, the effluent is quickly diluted at the diffuser within a distance of 10 m. Only small volumes of receiving water exceed the PWQO for un-ionized ammonia and the PWQO for TP of 0.02 mg/L was met within a few meters of the diffuser. Therefore the discharge meets MOE requirements for a mixing zone and no PWQO exceedences in the far-field due to the effluent are expected. Therefore far-field modelling of effluent effects on receiving waters was not deemed to be necessary.

19.4 Dispersion Analysis

19.4.1 Regulatory Context for Mixing Zones

Beyond the requirement for non-lethal effluent, the MOE manages surface water quality through Ontario Provincial Water Quality Objectives (PWQO, MOE 1994). These are a set of narrative and numeric criteria, which the MOE use to ensure that surface waters are of a quality that is suitable for aquatic life and recreation. The pollutant of concern in the effluent discharge is un-ionized ammonia for which the PWQO is 0.02 mg/L. Waters that are below the PWQO are considered safe for the indefinite survival of the most sensitive life stage of the most sensitive aquatic species expected in Ontario waters. The PWQO of 0.02 mg/L for un-ionized ammonia will be exceeded in Innisfil LWPCP effluent.

Although the PWQO represents a desirable water quality standard, MOE also recognize the concept of mixing zones for assimilation of wastewater discharges. A mixing zone is “an area of water contiguous to a point source … where the water quality does not comply with one or more of the Provincial Water Quality Objectives” (MOE 1994). The mixing zone recognizes that the cost of treating all effluent streams to PWQO level may not be justified and that residual waste may be diluted and assimilated in the aquatic environment with no adverse effect. Mixing zones are allowed, however, subject to several conditions:

- Mixing zones are not an allowable substitute for reasonable or practical effluent treatment. For Innisfil this requirement will be met through the use of technology that permits treatment to high quality effluent.

- Water quality must not be acutely lethal at any point in a mixing zone. This is assured by an effluent that meets the lethal threshold of 0.2 mg/L for un-ionized ammonia.
- Mixing zones should be as small as possible. This condition is met at the LWPCP through a highly treated effluent and quick dilution at the diffuser as shown by the modelling exercise summarized below.
- The mixing zone must not form a barrier to the passage of aquatic life. In practice, this means that it should not permanently occupy the entire width or depth of the receiving water. This condition is met for Innisfil, as shown by the modelling.
- The mixing zone should not prevent any beneficial uses of the water. In practice this is generally interpreted as a requirement that the mixing zone not interact with a swimming area. This is the case for the Innisfil outfall.

19.4.2 Summary of Dispersion Modelling

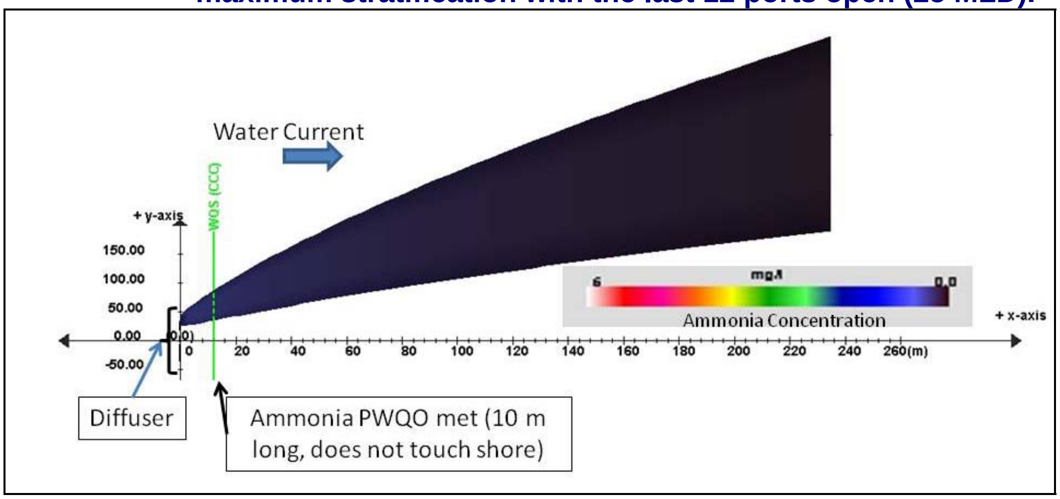
Hutchinson Environmental Sciences Ltd. was retained to investigate the anticipated impacts of the proposed effluent discharge on Lake Simcoe water quality near the LWPCP outfall. In this section, the approach and results of the hydrodynamic modelling of the effluent plume behaviour are summarized and implications for Lake Simcoe water quality within the current regulatory context are discussed. The detailed methodology, results and interpretation of the modelling exercise are presented in a comprehensive report prepared by Hutchinson Environmental Sciences Ltd. (HESL, 2010), which can be found in Appendix O of the ESR.

The main objective of the modelling exercise was to estimate the size of the effluent plume where the PWQO for un-ionized ammonia (NH_3) would be exceeded for both stages of expansion (25 and 40 MLD) and thus assess if the above listed requirements for mixing zones will be met by the effluent of the proposed expanded LWPCP. Total phosphorus (TP) was also modelled in the effluent plume as an example for a parameter whose behaviour will only be determined by dilution in the near field and because total phosphorus, although it is not toxic, is a critical water quality parameter for Lake Simcoe. The modelled effluent quality corresponds to the proposed compliance limits, e.g. 5 mg/L total ammonia for the 40 MLD and 25 MLD expansions, 0.043 mg/L total phosphorus for the 40 MLD expansion and 0.069 mg/L total phosphorus for the 25 MLD expansion (Tables 19-2 and 19-3).

A conservative approach to modelling the effect of the LWPCP effluent on Lake Simcoe was adopted. Four possible scenarios for both the 25 MLD and 40 MLD expansions were modelled, including three “worst case” assumptions, and input parameters for the model were chosen to represent conditions favouring the occurrence of un-ionized ammonia. Three summer scenarios were chosen, with maximum temperatures where un-ionized ammonia would be highest in both effluent and receiving waters and one winter scenario where un-ionized ammonia has a very low decay rate and ice cover would limit wind-induced currents. For the 25 MLD expansion, the number and location of open ports was varied in order to assess which configuration of the presently installed diffuser would be most beneficial for near-field mixing of the effluent.

Conservative modelling of the proposed effluent discharge from the expanded LWPCP to Lake Simcoe showed no significant effects of effluent ammonia on the lake under a variety of scenarios. Quick effluent assimilation for the proposed expansions can be achieved through effective diffuser design and low ambient concentrations. Under all modelled seasonal conditions, using 18 open ports for the 40 MLD expansion and using 12 open ports of the diffuser for the 25 MLD expansion, the effluent was quickly diluted at the diffuser within a distance of 10 m (Figure 19-1). Under these scenarios, the plume did not touch the shore. The proposed 25 MLD and 40 MLD expansions with an ammonia effluent compliance limit of 5 mg/L will therefore have a negligible effect on aquatic life in Lake Simcoe.

Figure 19-1 Plane view of effluent plume under near-stagnant conditions (0.8 cm/s) and maximum stratification with the last 12 ports open (25 MLD).



For the 25 MLD expansion under stagnant summer conditions with both 15 and 18-port configurations and the presently used widely-spaced 10-port configuration, the plume covered a larger horizontal area and extended to the lake edge. It remained thin (< 0.6 m), however, and was restricted to a 10 m depth, therefore not affecting shoreline recreation or aquatic life. Stagnant summer conditions have a probability of recurrence of 5%, thus will only occur very rarely and for short periods of time. They would also have to coincide with low effluent quality and high water temperatures for the plume to attain the modelled dimensions, which further reduces the probability of this scenario to occur.

The different results for different diffuser configurations for the 25 MLD expansion are reflective of the fact that the number and location of open ports significantly affects the discharge velocity and momentum and thereby the initial mixing at the diffuser. Fewer open ports increase the discharge velocity, improving initial mixing. Higher discharge velocity, however, requires larger pumping efforts, thus the cost and environmental impact of increased energy usage for pumping have to be weighed against the environmental benefits obtained through improved mixing at the diffuser. The best compromise between the best achievable mixing through a low number of open ports and a higher number of open ports required to minimize pumping efforts is the configuration with the last 12 ports open (Table 19-4). This is, therefore, the preferred diffuser configuration for the 25 MLD expansion.

Table 19-4 Comparison of approximate effluent plume volumes exceeding the un-ionized ammonia PWQO for different port configurations under the dominant winds and stagnant conditions scenarios.

Effluent Volume (MLD)	Scenario	Open ports			
		9	12	15	18
25	Dominant Winds	145 m^3 (1.7 m/s)	77 m^3 (1.3 m/s)	8250 m^3 (1 m/s)	7000 m^3 (0.9 m/s)
25	Stagnant	420 m^3 (1.7 m/s)	689 m^3 (1.3 m/s)	96,000 m^3 (1 m/s)	86,000 m^3 (0.9 m/s)
40	Dominant Winds	Not modelled	Not modelled	Not modelled	184 m^3 (1.4 m/s)
40	Stagnant	Not modelled	Not modelled	Not modelled	1070 m^3 (1.4 m/s)

Notes: Discharge velocities are given in parentheses.
For simplicity, the modelled concentrations for the centreline were assumed to be constant across the horizontal and vertical dimensions of the plume. In reality, ammonia concentrations decline towards the edges of the plume and therefore volumes are overestimated. This effect would be stronger in the larger plumes, therefore comparisons are not to scale, but the "larger than" statements are still valid.

The modelled total phosphorus concentrations in the effluent are low and thus require little dilution to meet the PWQO. Under all scenarios, the PWQO for TP of 0.02 mg/L was met within a few metres of the diffuser, when the plume is still dominated by the flow from the diffuser. Thus there will be no increase in algal growth or decrease in dissolved oxygen related to TP enrichment at the diffuser. The only exception to this was the stagnant summer scenario when 18 open ports were modeled, which resulted in a thin but large zone exceeding the TP PWQO. Therefore the discharge configuration with the last 12 ports open is also the preferred option for avoiding impacts of phosphorus enrichment near the diffuser.

It is believed that the approach of using phosphorus concentrations measured at the MOE Station C9 in order to characterize receiving water concentrations was the best possible approach, based on the following reasons:

1) Station C9 is located at 1 km distance from the Innisfil diffuser. For a large lake like Lake Simcoe, where waters are mixed frequently by wind-induced currents, this station represents a very close approximation of ambient water quality at the diffuser.
2) Station C9 is a long-term monitoring station visited by MOE. The data were measured at a high frequency (bi-weekly May through October) and are therefore highly representative for a variety of open-water conditions. In addition, they are of high quality regarding sampling, analytical and data processing procedures.
3) Near-shore data for Lake Simcoe are sparse and only the water treatment plants consistently monitor intake water at this point. There is no water treatment plant within 1

km of the Innisfil WWTP outfall and therefore no long-term dataset is available that would provide reliable, representative data closer to the outfall than what is available from Station C9. In order to fill this gap, the LSRCA just received a Lake Simcoe Cleanup-Fund grant from Environment Canada (July 2010) for implementation of a near-shore ecology and monitoring program.

4) The closest near-shore location in the vicinity of Innisfil with reliable, long-term monitoring data would be the Keswick Water Treatment Plant (located ca. 4 km southeast from Innisfil outfall) that has been monitoring intake water on a regular basis. Average phosphorus concentrations from 2004-2008 at this station were 13.1 ug/L compared to an average of 14.8 ug/L at Station C9 (Ministry of the Environment 2010[2]). Given that the Keswick intake is closer to shore (365 m) than Station C9, these data do not suggest that there is a pattern of higher near-shore compared to open-water phosphorus concentrations in that part of Lake Simcoe. On the contrary, they did seem to be in the same range and the Station C9 data appeared to represent a slightly more conservative estimate than the Keswick near-shore values.

In conclusion, the Innisfil LWPCP discharge after expansion to 25 MLD or 40 MLD will have negligible effects on aquatic life in Lake Simcoe. The LWPCP effluent is non-lethal. Under all modelled conditions and diffuser configurations, the discharge meets all MOE requirements for a mixing zone and discharge to surface water and only small volumes of receiving water exceed PWQO for un-ionized ammonia. The discharge configuration of the last 12 ports open at the end of the diffuser represents the best combination of good effluent mixing and low pumping requirements.

[2] *Ministry of the Environment. 2010 Lake Simcoe Water Quality Update. May 2010, Queen's Printer for Ontario*

20.0 Summary of Design Basis for Expansion

20.1 General

The influent wastewater characteristics from the existing LWPCP were reviewed and, in combination with the flow projections developed in Section 3, this information was used to develop loading projections. These influent characteristics, flow and loading projections were used to develop conceptual designs for the expanded LWPCP.

20.2 Wastewater Treatment Plant Loading Rates

The primary constituents of concern for the LWPCP are: BOD_5, TSS, TP and total Kjeldahl nitrogen (TKN). Table 20-1 lists the influent concentrations and loadings of these parameters at the LWPCP, averaged over the years 2005-2008.

Table 20-1 Influent Characteristics (2005-2008 Average)

Constituent	Concentration (mg/L)	Flow (m^3/d)		Average Loading (kg/d)
		Average	Peak Daily	
BOD_5	119	8,358	23,016 (recorded in 2008)	2,186
TSS	190			3,487
TP	2.4			44
TKN	14.5			267

Projected loading rates were developed for both a potential Stage III interim expansion to 25 MLD average daily flow, and a Stage IV expansion to 40 MLD average daily flow. The influent criteria for these future expansions are summarized in Tables 20-2 and 20-3. It is noted that the plant designs for secondary treatment is based on maximum month loading conditions. Other processes in the plant are generally sized based on peak hydraulic conditions.

It is recognized that at the present time, that the serviced area of the Town is predominately residential with some light commercial. Therefore, the historical raw wastewater concentrations for both TKN and TP may be on the low side as compared to the original design of the plant. Actual operating plant data has been used for this ESR given that the original design was based on assumed design parameters as the residents were connected to septic tanks at the time. It is proposed, therefore, to increase the concentrations slightly for preliminary design purposes to allow for some future flexibility with respect to industrial and commercial wastewater servicing. It is proposed to use a TKN concentration of 25 mg/L and a TP concentration of 4 mg/L. These TKN and TP concentrations represent a more conservative accounting on a per capita unit loading basis for the expanded plant but still fall within typical ranges seen elsewhere compared to the observed BOD concentration (which is also relatively dilute).

Table 20-2 Influent Flow and Loading Criteria for LWPCP Expansion to 25 MLD

Parameter	Peaking Factor	MLD	mg/L	kg/day
Annual Average				
Flow	----	25	----	----
BOD_5	----	----	120	3,000
TSS	----	----	200	5,000
TKN	----	----	25	625
TP	----	----	4	100
Maximum Month(1)				
Flow	1.3	32.5	----	----
BOD_5	1.6	----	148	4,800
TSS	1.5	----	230	7,500
TKN	1.4	----	26.9	875
TP	1.4	----	4.3	140
Peak Day				
Flow(2)	2.75	68.75	----	----
BOD_5(2)	1.5	----	----	7,200
TKN(2)	1.5	----	----	1313

Notes:
(1) Evaluation of historical data shows that the maximum month load and flow could occur simultaneously.
(2) Peak day flow factor represents PD/AA. Peak day load factor represents PD/MM and applies to the full max month load used under winter design conditions.

Table 20-3 Influent Flow and Loading Criteria for LWPCP Expansion to 40 MLD

Parameter	Peaking Factor	MLD	mg/L	kg/day
Annual Average				
Flow	----	40	----	----
BOD_5	----	----	120	4,800
TSS	----	----	200	8,000
TKN	----	----	25	1000
TP	----	----	4	160
Maximum Month(1)				
Flow	1.3	51	----	----
BOD_5	1.6	----	148	7,680
TSS	1.5	----	230	12,000
TKN	1.4	----	26.9	1400
TP	1.4	----	4.3	224
Peak Day				
Flow(2)	2.75	110	----	----
BOD_5(2)	1.5	----	----	11,520
TKN(2)	1.5	----	----	2100

Notes:
(1) Evaluation of historical data shows that the maximum month load and flow could occur simultaneously.
(2) Peak day flow factor represents PD/AA. Peak day load factor represents PD/MM and applies to the full max month load used under winter design conditions.

21.0 Alternate Wastewater Secondary Treatment Concepts

21.1 General

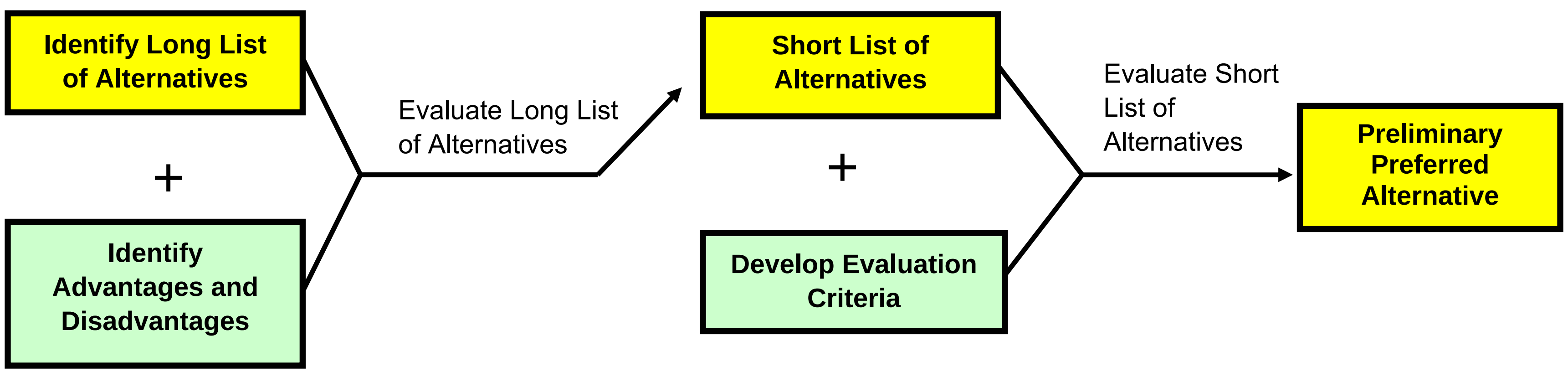
This section includes a description of the alternative wastewater treatment concepts, an evaluation of the alternatives to determine the preferred wastewater treatment concepts, an evaluation of the alternatives to determine the preferred effluent disinfection alternative, and a discussion of biosolids management, and the mitigating measures for potential impacts of the preferred solution on the environment.

21.2 Evaluation Approach for Wastewater Treatment Processes

A wide range of wastewater treatment processes were considered for expanding the LWPCP. These alternatives are differentiated in terms of the predominant treatment characteristics. The process undertaken to select the preferred wastewater treatment alternatives was based on the following approach as outlined in Figure 21-1.

- Identify feasible treatment alternatives (long list) that could possibly be constructed at the existing site
- Summarize the advantages and disadvantages of each alternative
- Develop a short list of alternatives based on analysis of the long list
- Develop evaluation criteria to evaluate the short list of alternatives
- Apply the evaluation criteria to each short-listed alternative
- Select the preferred alternative

Figure 21-1 Planning Process to Select Preferred Biological Treatment Alternative



21.3 Long List Evaluation

21.3.1 General

The major categories of treatment processes that were considered included:

- Suspended growth systems
- Fixed growth processes with chemical precipitation

Suspended Growth Systems

- Conventional Activated Sludge
- Extended Aeration Activated Sludge
- Oxidation Ditches
- Sequencing Batch Reactors
- Conventional Lagoons
- Facultative Lagoons
- Aerated Lagoons

Fixed Growth Processes with Chemical Precipitation

- Trickling Filters/Solids Contact
- Biological Aerated Filters
- Rotating Biological Contactors

The following sections describe the treatment processes that were considered for the expansion of the LWPCP.

21.3.2 Suspended Growth Systems

21.3.2.1 Conventional Activated Sludge

In the activated sludge process, an environment is created where microorganisms can oxidize organic matter in the wastewater under controlled aerobic conditions. The process normally occurs in tanks in which air is introduced to mix the contents and provide a source of oxygen for the microorganisms. The microorganisms consume the organic matter in the wastewater, and in so doing produce new cell mass. The microorganisms and the wastewater are mixed for a period of time, after which the mixture of new and old cells flow to a secondary settling tank where the micro-organisms are settled and separated from the treated wastewater. A portion of the settled activated sludge is recycled back to the aeration tank to maintain a desired concentration of microorganisms (return activated sludge, or RAS) and a portion of the settled sludge is waste for disposal (waste activated sludge, or WAS).

Influent wastewater is typically pretreated at a headworks facility consisting of screens and grit removal, followed by primary clarification. The influent proceeds, with or without chemical addition for phosphorus removal, to the activated sludge aeration tank. Primary treatment facilities reduce the organic and suspended solids loading in the activated sludge process, thereby reducing the aeration requirements.

The advantage of primary treatment and the savings in aeration generally apply to treatment plants with design capacities greater than 3,785 m^3/d. For smaller plants, the savings in aeration tankage and operating costs are generally less than the cost for primary sludge treatment and disposal.

21.3.2.2 Extended Aeration Activated Sludge

The extended aeration activated sludge process is a modification of the conventional activated sludge process in which primary settling tanks are omitted. Following screening and grit removal, raw sewage is introduced directly to the aeration tank. Long aeration times of 18 to 24 hours and low organic loadings are normally required to obtain acceptable effluent quality.

As with the conventional process, effluent from the aeration tank is discharged to a settling tank where the suspended microorganisms are removed from the treated wastewater. A high concentration of microorganisms is maintained in the extended process by re-circulating the majority of the solids from the settling tank back to the aeration tank.

The extended aeration process normally provides good nitrification and is well suited to communities with primarily domestic sewage. The process is capable of accommodating variations in hydraulic loadings that are typical for small communities, and produces less sludge than a conventional activated process. The extended aeration process is often considered to be too expensive for large treatment plants both in terms of capital cost for aeration and operating costs for supplying air to the system.

21.3.2.3 Oxidation Ditches

The oxidation ditch is a closed loop variation of the extended aeration-activated sludge process. As with the extended aeration process, it is characterized by hydraulic retention times of 18 to 30 hrs and solids retention of 10 to 33 days. The process is highly stable, reliable, and is suitable for the relatively small wastewater flows of small communities.

21.3.2.4 Sequencing Batch Reactor

The sequencing batch reactor (SBR) is a variation of the extended aeration system in which the primary settling tanks are typically omitted. Raw sewage flows through the preliminary treatment process (i.e., screening and grit removal) and is discharged to the aeration tank. While in the aeration tank, the sewage is aerated over a number of air-on/air-off cycles. The solid-liquid separations (clarification) occur during the air-off part of the cycle. During the latter part of the air-off cycle, treated effluent is decanted or withdrawn from the liquid surface.

The SBR process maintains a continuous sewage inflow to a series of tanks allowing flow equalization, biological oxidation, nitrification, biological phosphorus removal, final clarification, and aerobic sludge stabilization in the same tank. This amount of flexibility and capability in a single tank provides for reduced capital and operating cost compared to the other activated sludge processes.

21.3.2.5 Conventional Lagoons

Typically, a lagoon is a large, shallow, earthen basin that is open to the atmosphere and uses natural biological, chemical, and physical processes to stabilize the wastewater. Wastewater is introduced to the lagoon that contains algae and bacteria in suspension with aerobic conditions prevailing through its depth.

In a conventional lagoon, oxygen is introduced into the lagoons via algae photosynthesis and atmospheric diffusion. Through cell metabolism, the microorganisms consume the organic matter in the wastewater and the oxygen from the air stream. Settleable solids and dead biomass settle to the bottom of the lagoon and create an anaerobic zone in which further decomposition and sludge volume reduction occurs.

A properly operated, conventional lagoon can remove up to 95% of the BOD; however, high algae and bacteria concentrations in the effluent necessitate further processing. Conventional lagoons are susceptible to changes in temperature and operate best between 20^{o}C and 25^{o}C. At temperatures below 14^{o}C, anaerobic digestion slows considerably and there is little reduction in the sludge volumes. At temperatures below 1^{o}C, there is little microbiological activity and once an ice cover is formed, there is minimal oxygen available and treatment is reduced to sedimentation only.

21.3.2.6 Facultative Lagoons

A facultative lagoon is a modification of a conventional lagoon in that the earthen basin is deeper, creating three zones. The top zone is similar to the conventional lagoon, where aerobic decomposition of the waste occurs. The bottom zone is anaerobic, in which anaerobic bacteria actively decompose settled solids. An intermediate zone is present that is partially aerobic and anaerobic, in which facultative bacteria decompose organic matter.

Oxygen is sometimes added to the aerobic zone of a facultative lagoon by surface aeration. Surface aerators provide better transfer to the aerobic zone in winter months and prevent a complete cover from forming.

21.3.2.7 Aerated Lagoons

An aerated lagoon is a completely mixed basin in which mechanical aeration via surface aerators or mechanical diffusers provides oxygen for aerobic decomposition of organic matter. Generally, all solids are kept suspended in an aerated lagoon, similar to an activated sludge process without solid recycle.

Aerated lagoons have a higher load rating and can produce a more consistent effluent through the winter and spring seasons than facultative or conventional lagoons. However, since the lagoon is completely mixed, additional effluent settling facilities are required.

Lagoon effluent discharge can be either continuous or seasonal. Seasonal discharge is frequently required when a treatment facility is discharging to a receiving river or stream that has a limited assimilative capacity during the summer, or low flow conditions. Seasonal discharge facilities require sufficient storage capacity to store effluent until the receiving stream has sufficient flow to provide the required dilution of the effluent.

Due to the cost and the potential environmental nuisance of the effluent storage, continuous discharge is preferred where possible.

21.3.3 Fixed Growth Processes

21.3.3.1 Trickling Filters/Solids Contact

The tricking filter/solids contact process makes use of both attached and suspended growth types of treatment systems. The trickling filter is an attached growth type of biological wastewater treatment system. In this process, wastewater passes over a media to which microorganisms are attached. Through aerobic cell metabolism, the organic matter in the wastewater is consumed. The filter consists of a bed of porous media, and wastewater is introduced at the top and allowed to cascade or trickle through its depth. A bacteriological slime attaches itself to the media and absorbs the organic matter in the wastewater. The media support system is designed in a manner that allows natural air circulation up through the filter to maintain aerobic conditions.

Effluent from the filter flows to a solids contact unit. The solids contact unit consists of an aeration tank facility similar to a small activated sludge system, but with only 15 to 30 minutes residence time. The solids contact unit conditions the sludge to enhance settling characteristics and provide some additional nitrification and BOD removal. Effluent from the solids contact unit flows to the settling tanks where solids are separated from the treated wastewater. A portion of the settled solids returns to the solids contact unit, and the remainder is transferred to an aerobic digester for sludge processing.

The amount of sludge provided from a filter solids contact system is reported to be less than a conventional system, with improved settling and dewatering.

Primary treatment facilities are required in advance of the filter to prevent the nozzles of the *distribution system from clogging.*

21.3.3.2 Biological Aerated Filters

The biologically aerated filter (BAF) is another form of the attached growth process for wastewater treatment. It is similar to the trickling filter but the media is much smaller, similar in size to a grain of sand in a sand filter. The BAF can be a downward or upward-type, with the upward-flow units seeming to gain favour in recent years. Wastewater pre-treatment by primary sedimentation and fine screening is required before the BAF treatment unit. The pre-treated wastewater is added to the bottom of the filter unit along with compressed air to maintain aerobic conditions throughout the column. Both streams flow through the media column where the attached bacteria consume the organic carbon in the lower and middle areas of the columns. Nitrifying bacteria convert ammonia to nitrate in the upper sections of the column.

In contrast to the trickling filter, excess biomass is not sloughed off but is maintained in the filter bed. Effluent from the BAF unit is low in suspended solids and is acceptable for discharge without the need for final clarification. Excess biomass that accumulates within the filter must be removed by periodic backwashing of the filter units. Backwash water is re-circulated to the *headworks to co-settle with the influent.*

21.3.3.3 Rotating Biological Contactors

The rotating biological contactor (RBC) is another form of the attached biological wastewater treatment system, in which aerobic microorganisms are attached to the surface of rotating discs that are partially submerged in wastewater. Each RBC consists of a series of circular discs mounted on a horizontal shaft with approximately 40% of the disc diameter submerged in the contoured channel. As the disc rotates, a thin film of wastewater coats each disc and a bacteriological slime is formed. During rotation, the film is exposed to the atmosphere, thereby maintaining aerobic conditions. Similar to a trickling filter, excess bacteriological growth sloughs off and is carried with the effluent from the RBC treatment unit to the final settling tank where solids are separated from the treated wastewater.

Nitrification can be obtained by installing RBCs in serial arrangement. The organic matter is consumed in the first set of RBCs and nitrifying bacteria formed on the latter RBCs convert ammonia to nitrate.

Primary clarification is required prior to the RBC process to provide the needed reduction in solids and organic loading together with removal of larger solids and grease. Fine screening was used in place of primary sedimentation in some RBC installations, but the success of this arrangement was limited due to difficulties in handling and disposal of the fine screenings. RBCs are normally installed outside with insulated covers and have proven to perform successfully in northern climates.

21.4 Screening of Alternatives

Table 21-1 provides a summary of the advantages and disadvantages of the wastewater treatment alternatives.

Table 21-1 Advantages and Disadvantages of Wastewater Treatment Processes

Process	Advantages	Disadvantages
Extended Aeration Activated Sludge (Status quo)	• Same process reliability as conventional activated sludge • Consistent with existing facilities and current operation • No primary sludge to process and dispose of • Minimized odour potential • Can handle moderate hydraulic shock loads	• More energy intensive than conventional activated sludge • Typically not cost effective beyond the 20 to 40 MLD range • Aerobically digested WAS is typically less dewaterable than anaerobically digested sludge from conventional plant • Slightly larger net site requirement

Process	Advantages	Disadvantages
		(including liquid and solids streams)
Conventional Activated Sludge	• Can consistently meet treatment objectives • Slightly reduced land area requirements • Reduced aeration energy requirements • Appropriate for 40 MLD proposed capacity • Inclusion of primary clarifiers helps mitigate impacts of peak loads on downstream activated sludge process • Conventional 40 MLD plant provides better baseline for future expansion to 95 MLD • May be better suited to handle certain industrial effluents • Anaerobically digested sludge typically has better dewaterability than aerobically digested WAS • More amenable to potential operation for biological phosphorus removal and phosphorus recovery	• Requires both primary and waste activated sludge treatment and disposal • Higher level of odour control/treatment needed (primary clarifiers, anaerobic digesters) • New / additional processes compared to existing plant (requires additional training, more types of equipment to maintain)
Sequencing Batch Reactor	• Does not require secondary clarifiers • No return activated sludge pumping • Smaller liquid stream footprint • Can be designed with or without primary clarifiers (i.e. in conventional or extended aeration mode)	• Heavily reliant on instrumentation and control system • Inconsistent with current operation • Doesn't make good use of existing secondary clarifiers • Less flexible in terms of potential operation for biological phosphorus removal • Generally vendor specific equipment packages • Most SBR installations are smaller facilities
Membrane bioreactor	• Eliminates need for secondary clarifiers and filters • Smaller liquid stream footprint • Can be designed with or without primary clarifiers (i.e. in conventional or extended aeration mode) • Can be operated for biological phosphorus removal • Can produce the highest quality effluent of the alternatives being considered.	• Heavily reliant on instrumentation and control system • Generally vendor specific equipment packages • If designed without primary clarifiers, and no additional tertiary step (i.e. one set of membranes) there is only a single step for phosphorus removal • High O&M costs (membrane scour air)
Trickling Filter/ Solid Contact	• Relatively simple to operate • Reduced aeration energy costs • Possibly smaller secondary clarifiers than the activated sludge process	• Less reliable for meeting proposed permit limits than activated sludge processes • Not compatible with existing facilities • Freezing concerns • Potential for filter flies and other

Process	Advantages	Disadvantages
		environmental nuisances • Effluent needs further processing downstream (e.g., solids contact) • Chemical P removal only (no potential operation for bioP) • Requires primary clarifiers and primary and waste activated sludge treatment and disposal • Higher level of odour control/treatment needed (primary clarifiers, anaerobic digesters)
Rotating Biological Contactor	• Relatively simple to operate • Possibly smaller secondary clarifiers than suspended growth systems • Potentially lower operating cost compared to activated sludge process	• Less reliable for meeting proposed permit limits than activated sludge processes • Not compatible with existing facilities • High equipment maintenance costs (shaft and gear replacements) • Concerns with equipment reliability • Chemical P removal only (no potential operation for bioP) • Very little opportunity for process adjustment in the event of loss of process control (need other processes downstream) • Requires primary clarifiers and primary and waste activated sludge treatment and disposal • Higher level of odour control/treatment needed (primary clarifiers, anaerobic digesters)
Biological Aerated Filter	• No secondary clarifiers • Process reliability similar to activated sludge options • Smaller footprint for secondary treatment compared to suspended growth options • Good cold-climate technology	• Not compatible with existing facilities • Heavily reliant on instrumentation and control system • Requires finer screening • Chemical P removal only (little potential for operation for bioP) • New / additional processes compared to existing plant (requires additional training, more types of equipment to maintain) • Generally vendor specific media and equipment packages • Generally requires primary clarifiers and primary and waste activated sludge treatment and disposal
Moving Bed Biofilm Reactors	• Process reliability and effluent quality similar to activated sludge options • Option to use an alternative solids	• Reliable technology in Europe and US but less experience in Canada • Requires finer screening

Process	Advantages	Disadvantages
	separation technology to secondary clarifiers (such as smaller footprint DAF) • Smaller footprint for secondary treatment compared to suspended growth options • Good cold-climate technology • More compatible with existing facilities than other biofilm options • Can be more easily combined with activated sludge than other options (IFAS)	• Chemical P removal only (little potential for operation for bioP) • Generally vendor specific media and equipment packages • Primary clarifiers recommended • Primary and waste activated sludge treatment and disposal • Requires media retention sieves in aeration basins
Integrated fixed-film activated sludge (IFAS)	• Combines the advantages of activated sludge and fixed growth systems • Smaller footprint for secondary treatment compared to suspended growth options • Good cold-climate technology • Able to operate for biological phosphorus removal if desired	• Reliable technology in US but less experience in Canada • Requires finer screening • Generally vendor specific media and equipment packages • Requires media retention sieves in aeration basins
Natural or Conventional Lagoons	• Simple to operate • Lower operating and maintenance cost • Infrequent sludge disposal	• Effluent will not meet objectives • Incompatible with existing facilities and current operation • Requires very large land area • Freezing concerns • Potential for odours and other environmental nuisances • Capacity expansion difficult because of large area of land required • Dredging of sludge from lagoon can be a major effort, significant cost when done, and can interfere with treatment process
Facultative Lagoons	• Simple to operate • Lower operating and maintenance cost • Infrequent sludge disposal • Aerated facultative lagoons provide secondary treatment quality effluent	• Cannot provide effluent consistently meeting discharge criteria (lack of nitrification in winter months and high suspended solids in spring) • Require large land area • Freezing concerns • Increased potential for odours and other environmental nuisances • Capacity expansion difficult because of large area of land required • Dredging of sludge from lagoon can be a major effort, significant cost when done, and can interfere with treatment process

Process	Advantages	Disadvantages
Aerated Lagoons	• Most consistent lagoon effluent • Typically high aeration energy costs compared to other technologies	• Most energy intensive of the lagoon systems • No sludge reduction or sedimentation in the aerated cell • Requires large land area • Freezing concerns • Cannot consistently meet effluent criteria without further downstream processing • Increased potential for odour and other environmental nuisances • Capacity expansion difficult due to the large land area required • Dredging of sludge from lagoon can be a major effort, significant cost when done, and can interfere with treatment process

21.5 Short List Evaluation

21.5.1 Description

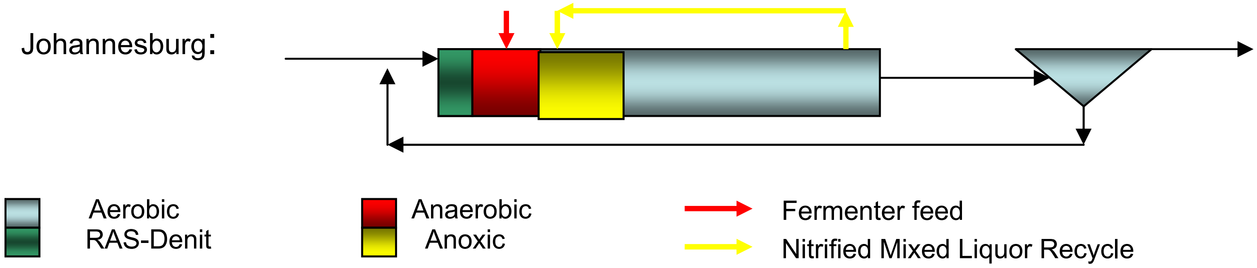
Based on an evaluation of the advantages and disadvantages of each secondary treatment alternative the following alternative treatment processes were short-listed for more in depth evaluation for the expansion of the Innisfil LWPCP to 25 MLD and then from 25 MLD to 40 MLD:

- Alternative 1 - Conventional Activated Sludge with Full Biological Nutrient Removal (BNR)
- Alternative 2 - Extended Aeration Activated Sludge (Existing Process)
- Alternative 3 - Conventional Activated Sludge (no BNR)

Alternative 1 - Conventional Activated Sludge with Full Biological Nutrient Removal

Biological Nutrient Removal (BNR), as shown in the figure below, enables the simultaneous elimination of carbon, phosphorus, nitrogen, and ammonia from the wastewater through a microbiological process. Biological zones called anaerobic, anoxic, and aerobic, remove organics, nitrogen, and phosphorus. Each of these zones favours different bacteria, allowing for the removal of the target pollutants. A schematic of a common BNR configuration, the Johannesburg process, is shown in Figure 21-2, overleaf.

Figure 21-2 Johannesburg Biological Nutrient Removal Process



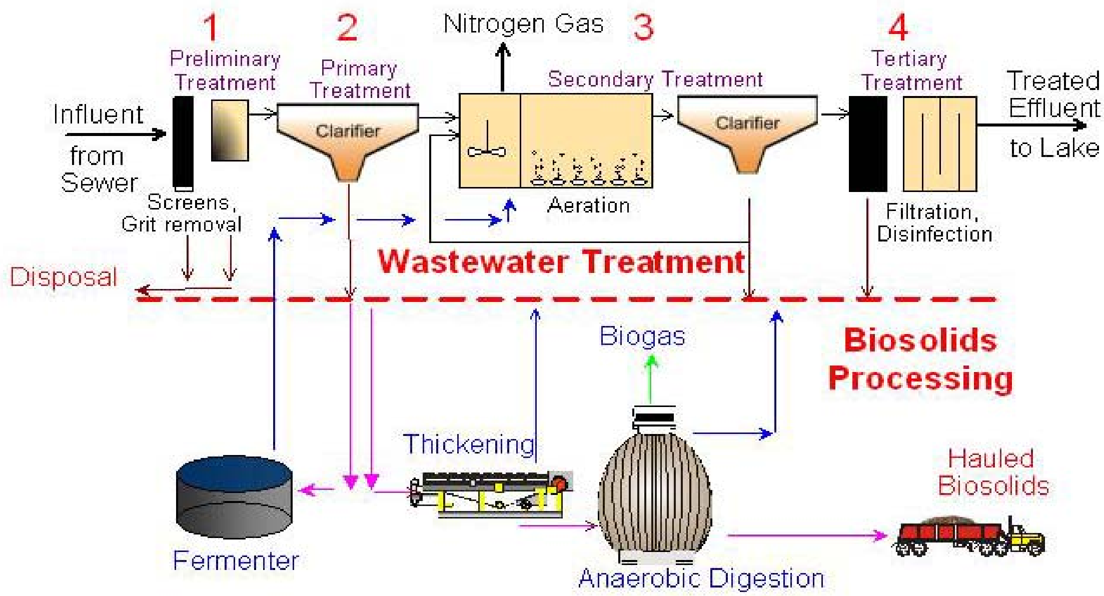
An aerobic zone contains oxygen. Aerobic zones allow a set of bacteria called *heterotrophs* to utilize oxygen in converting biodegradable organics into additional cell mass. This conversion requires that oxygen be present in excess of their biological demand. In addition to BOD removal, ammonia is oxidized to nitrite and nitrate in the aerobic zone. This nitrification is performed by a slow growing group of bacteria called nitrifiers. Specifically, *nitrosomonas* converts ammonia to nitrite, and *nitrobacter* converts nitrite to nitrate.

An anaerobic zone contains no oxygen and no nitrates. This zone provides an environment conducive to the growth of *phosphorus accumulating organisms*, or PAOs. These PAOs have a competitive advantage when alternated between anaerobic and aerobic environments. In the anaerobic zone, the PAOs take up soluble organic substrate (in the form of volatile fatty acids, or VFAs), then they use this stored energy to absorb excess soluble phosphorus in the downstream aerobic zones. The excess phosphorus is removed from the system in the waste activated sludge.

An anoxic zone contains nitrates and is void of oxygen. In the absence of oxygen heterotrophic bacteria utilize nitrate rather than oxygen to metabolize soluble BOD in the influent wastewater. This results in the reduction of nitrate to nitrogen gas, which removes the nitrogen from the wastewater. The anoxic zone is located upstream from the main aeration zone so that BOD in the influent wastewater is available as substrate for denitrification. Nitrate is added to the anoxic zone by internally recycling a large portion of the flow from the downstream aerobic zones back to the anoxic zone.

Alternative 1 consists of conventional activated sludge (with primary clarifiers and anaerobic digesters as further described in Alternative 3) combined with the “full” BNR process described above. For primary sludge thickening, and to generate volatile fatty acids to provide the necessary food source for the PAOs, static fermenters would be provided. The static fermenters are large gravity thickeners (sized for fermentation) with covers and odour control facilities. The overflow (or fermentate) is sent to the BNR process anaerobic zones. The thickened fermented sludge is sent to the anaerobic digesters with thickened WAS. Figure 21-3 on the following page is a schematic of Alternative 1.

Figure 21-3 Conventional Activated Sludge with Full BNR



Alternative 2 - Extended Aeration Activated Sludge (Existing Process)

The extended aeration activated sludge process is a modification of the conventional activated sludge process in which primary settling tanks are omitted. Following screening and grit removal, raw sewage is introduced directly to the aeration tank. Long hydraulic retention times of 18 to 24 hours are normally required. The solids retention time (SRT) is normally greater than 15 days such that the activated sludge system is in the endogenous or decline phases (operating at a very low food to microorganism ratios).

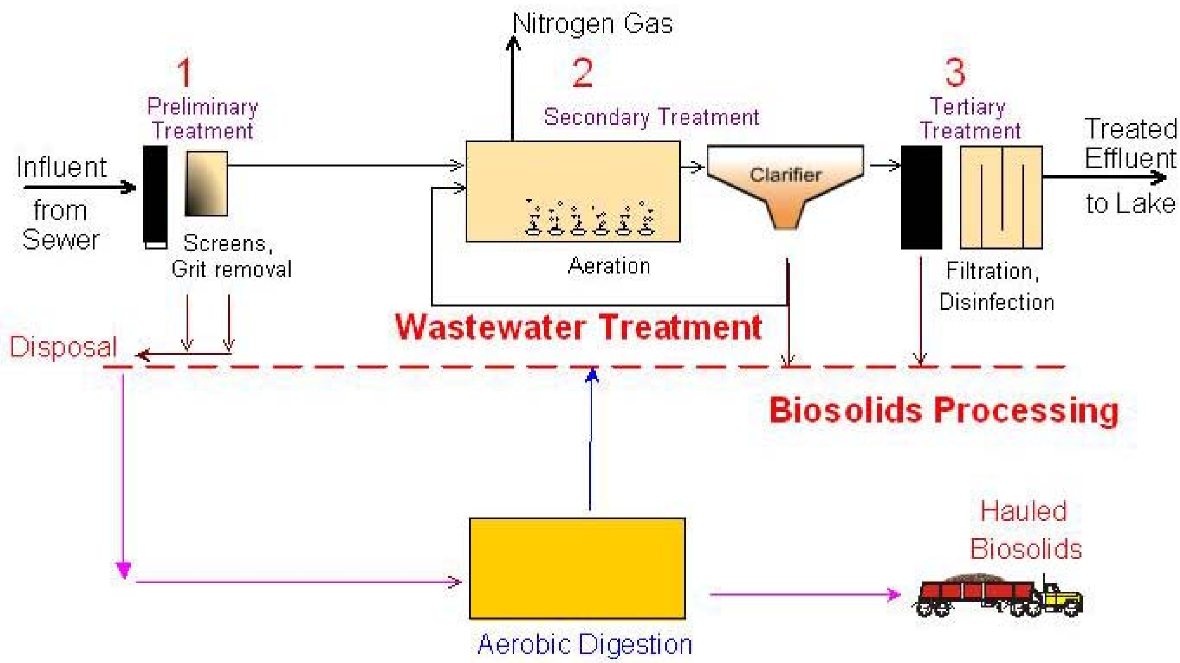
As with the conventional process, effluent from the aeration tank is discharged to a settling tank where the suspended microorganisms are removed from the treated wastewater. A high concentration of microorganisms is maintained in the extended process by re-circulating the majority of the solids from the settling tank back to the aeration tank.

The extended aeration process normally provides good nitrification and is well suited to communities with primarily domestic sewage. The process is capable of accommodating variations in hydraulic loadings that are typical for small communities, and produces less sludge than a conventional activated process. The extended aeration process is often considered to be too expensive for larger treatment plants both in terms of capital cost for aeration and operating costs for supplying air to the system.

Alternative 2 includes expanding the extended aeration process facilities and aerobic digesters, similar to the existing plant facilities. To maximize the capacity of the aerobic digesters and sludge storage basins, mechanical thickening would be provided for partial thickening of waste activated sludge or aerobically digested sludge to replace the existing digester decanting operation. Tertiary phosphorus removal facilities and UV disinfection also will be provided.

It is noted the extended aeration process can be designed to allow operation for BNR, similar to Alternative 1. The longer SRT used for extended aeration processes can work well for denitrification, but generally is less favourable for good biological phosphorus removal performance. Figure 21-4 below is a schematic of the Alternative 2.

Figure 21-4 Extended Aeration Activated Sludge



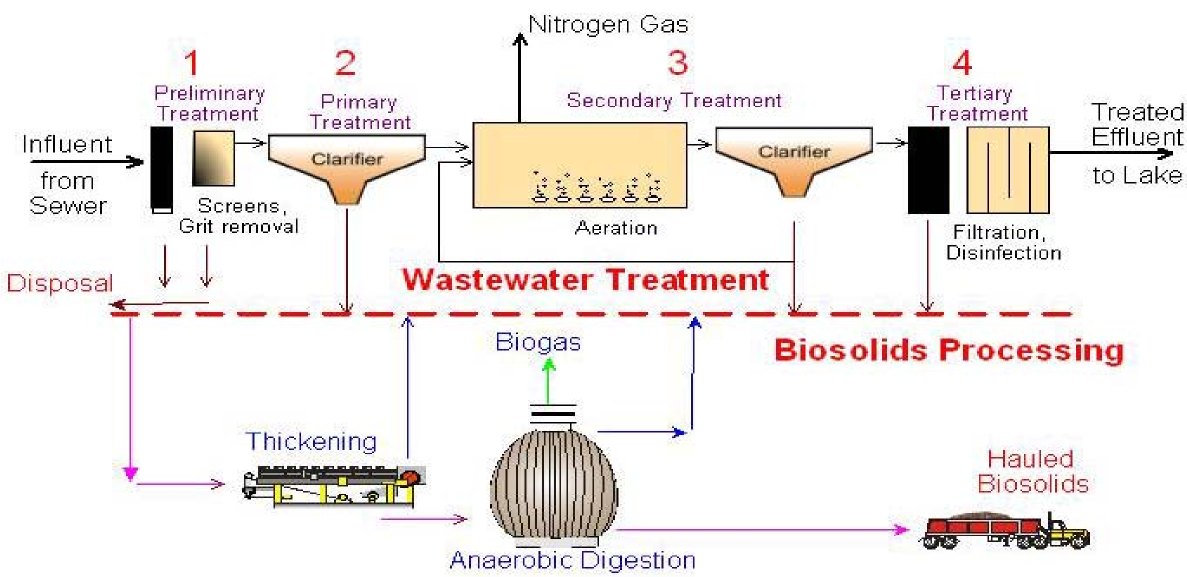
Alternative 3 - Conventional Activated Sludge (no BNR)

In conventional activated sludge processes, influent wastewater typically undergoes settling in primary clarifiers prior to entering the aeration basins. At plants that operate for chemical phosphorus removal, chemical is often added to the primary clarifiers to precipitate phosphorus. The primary-treated wastewater and acclimated microorganisms (activated sludge or biomass) are aerated in a tank. After a sufficient aeration period, the flocculent activated sludge solids are separated from the wastewater in a secondary clarifier. The clarified wastewater flows forward for further treatment or discharge. A portion of the clarifier underflow sludge is returned to the aeration basin for mixing with the primary- treated influent to the basin and the remaining sludge is wasted to the sludge handling portion of the treatment plant. The portion recirculated is determined on the basis of the ratio of mixed liquor volatile suspended solids (MLVSS) to influent wastewater biochemical oxygen demand, which will produce the maximum removal of organic material from the wastewater.

Conventional activated sludge processes are typically designed at shorter hydraulic retention times and lower SRTs than extended aeration processes. This is partly because the removal of much of the influent solids in the primary clarifiers reduces the overall solids inventory in the aeration basins and the aeration volume required. For the LWPCP, nitrification is required, so the design SRT must be long enough to allow nitrifying bacteria to grow. It is noted that conventional activated sludge processes also can be designed to allow operation for BNR, similar to Alternative 1.

Alternative 3 includes primary sludge thickening in gravity thickeners and conversion of the existing aerobic digestion process to anaerobic digestion. Waste activated sludge thickening would be provided using a mechanical thickening process such as rotary drum thickeners or gravity belt thickeners. Tertiary phosphorus removal facilities and UV disinfection also will be provided. Figure 21-5 below is a schematic of the Alternative 3.

Figure 21-5 Conventional Activated Sludge (no BNR)



21.5.2 Evaluation Criteria

The evaluation used is not based on a numerical ranking system. To ensure statistical validity, such an approach would have to strictly adhere to statistical methods that are often difficult to apply in a multi-faceted issue such as a Municipal Class EA. Instead, a descriptive or qualitative evaluation is used to consider the suitability of alternative solutions and design concepts. In this respect, the trade-offs that have been made between alternatives are described in the text of the report and these trade-offs form the rationale for:

1) the identification of the preferred alternative,
2) an advantage or
3) accepting a disadvantage to address a higher priority consideration.

Evaluation criteria were developed to evaluate the short listed alternatives. The purpose of the evaluation was to select the alternative that offers the greatest potential to solve the identified wastewater servicing problem.

The evaluation criteria address a wide range of technical, environmental, social, and financial concerns. An increasing level of detail was used to evaluate the short listed alternatives, and a qualitative rating scale was established for each criterion (i.e., high, medium and low). A "High" rating is most preferred and a "Low" rating is the least preferred as shown in Table 21-2. Table 21-3 lists the evaluation criteria used in the Short List Evaluation and the descriptions along with the definition for each rating.

Table 21-2 Criterion Table

○	Minimal impact
◉	Moderate impact
●	High impact

Table 21-3 Evaluation Criteria for Short List of Alternatives

Criterion	Criterion Description		Criterion Measure Guidelines
Natural Environment			
Water Quality	Potential to impact the receiving water quality	○	Minimal impact
		◉	Moderate impact
		●	High impact
Aquatic Systems	Potential to impact aquatic systems	○	Minimal impact
		◉	Moderate impact
		●	High impact
Land Requirement	Land area requirement for biological process	○	Minimal land required
		◉	Moderate land required
		●	Large land required
Groundwater Resources	Potential to impact groundwater resources	○	Minimal or no impact
		◉	Moderate impact
		●	High impact

Criterion	Criterion Description		Criterion Measure Guidelines
Technical			
Reliability	Reliable operation with minimal maintenance requirements and ability to meet effluent quality objectives	○	Very reliable
		◉	Moderately reliable
		●	Not reliable
Ease of Implementation	Can be easily implemented on a technical, regulatory and practical basis	○	Very easy
		◉	Moderately easy
		●	Not easy
Sustainable Operating Technology	Energy recovery and use and nutrient recovery.	○	High sustainability
		◉	Moderately sustainable
		●	Low sustainability
Ease of Operation	Process is easily operated	○	Very easy
		◉	Moderately easy
		●	Not easy
Social Environment			
Noise	Potential to produce noise during construction and/or operation	○	Minimal potential
		◉	Moderate potential
		●	High potential
Air Quality	Potential to produce air quality impacts during construction and/or operation	○	Minimal potential
		◉	Moderate potential
		●	High potential
Environmental Leadership	Being an leader in environmental stewardship	○	High environmental leadership
		◉	Moderate environmental leadership
		●	Low environmental leadership
Visual/Aesthetic	Potential for visual impact to the area	○	Minimal or no impact
		◉	Moderate impact

Criterion	Criterion Description		Criterion Measure Guidelines
		●	High impact
Community Health and Safety	Potential impacts to community health and safety	○	Little or no risk
		◉	Moderate risk
		●	High risk
Economic			
Capital Cost	Opinion of probable capital cost[1]	○	Low cost
		◉	Moderate cost
		●	High cost
Operating/ Maintenance Cost	Opinion of probable operating and maintenance cost[1]	○	Low cost
		◉	Moderate cost
		●	High cost

[1] Estimating accuracy of ±50%. Estimate does not include facilities and processes that are required for both processes such as the Total P Removal, Disinfection, Administration Building, Headworks, etc.

21.5.3 Short List Evaluation

The short-listed secondary treatment alternatives were evaluated based on the criteria in Table 21-2. Summaries of the evaluations are provided in Tables 21-4 and 21-5.

Table 21-4 Evaluation of Short-Listed Biological Treatment Processes for Expansion of the Innisfil LWPCP to 25 MLD

Criterion	Conventional Activated Sludge with Full BNR	Extended Aeration	Conventional Activated Sludge (no BNR)
Natural Environment			
Water Quality	○	○	○
Aquatic Systems	○	○	○
Land Requirement	◉	◉	◉
Groundwater Resources	○	○	○
Technical			
Reliability	○	○	○
Ease of Implementation	◉	○	◉
Sustainable Operating Technology	○	◉	◉
Ease of operation	○	○	○
Social and Environmental Impacts			
Noise	○	○	○
Air Quality	○	○	○
Environmental leadership	○	◉	◉
Visual/Aesthetic	○	○	○
Community Health and Safety	○	○	○
Economic			
Capital Cost	◉	○	◉
Operating/Maintenance Cost	◉	◉	◉

Table 21-5 Evaluation of Short-Listed Biological Treatment Processes for Expansion of the Innisfil LWPCP from 25 to 40 MLD

Criterion	Conventional Activated Sludge with Full BNR	Extended Aeration	Conventional Activated Sludge (no BNR)
Natural Environment			
Water Quality	○	○	○
Aquatic Systems	○	○	○
Land Requirement	◎	◎	◎
Groundwater Resources	○	○	○
Technical			
Reliability	○	○	○
Ease of Implementation	◎	◎	◎
Sustainable Operating Technology	○	●	◎
Ease of operation	○	○	○
Social and Environmental Impacts			
Noise	○	○	○
Air Quality	○	○	○
Environmental leadership	○	●	◎
Visual/Aesthetic	○	○	○
Community Health and Safety	○	○	○
Economic			
Capital Cost	◎	●	◎
Operating/Maintenance Cost	◎	●	◎

21.6 Selection of the Recommended Alternative

A PIC was held in the Town on October 14th, 2009 to present the recommended wastewater treatment concepts to the public, municipalities and review agencies. The recommended treatment concept that was presented was a Biological Nutrient Removal (BNR) process for secondary treatment. The PIC material from PIC #2 is included in Appendix P. However, subsequent to that PIC, the MOE requested that the Class EA be put on hold pending documents with respect to Lake Simcoe. In February 2010, three documents (Phosphorus

Reduction Strategy, Water Quality Trading Feasibility Study and a proposed Shoreline Regulation) were placed on the EBR for public review and comment. Subsequent the public review period for these three documents, the Town re-started this Class EA. It was determined at that time that the recommended alternative should be reinvestigated in light of the MOE documents and a revised Phase 3 PIC should be held. The primary reason for holding the Phase 3 PIC again was to advise the public and review agencies of the implication of the PRS and to explain the proposed new staging of the plant expansions.

The revised PIC (PIC #3) was held on May 25, 2010. The following is a description of the revised recommended secondary (biological) treatment alternatives for both the proposed Stage III (25MLD) and Stage IV (40MLD) expansions:

For the expansion to 25 MLD, the extended aeration alternative is the recommended option for the following reasons:

- Consistent with operation of the existing plant
- Easier implementation
- Lower capital cost

To enhance the extended aeration process, it is proposed that the design incorporate several mixed, unaerated zones at the beginning of the process. This will allow operation for denitrification, which will reduce overall aeration energy requirements and also will minimize the need for supplemental alkalinity (alkalinity is consumed in nitrification and when metal salts are added for chemical phosphorus removal). In addition, the plant would have some flexibility to operate for biological phosphorus removal, which would help reduce alum requirements even if the bio-P performance is not optimal.

It is noted that a tertiary phosphorus removal facility is needed downstream from the extended aeration process to enable the LWPCP to meet the effluent TP limits.

For the expansion from 25 MLD to 40 MLD, the conventional activated sludge system designed for full BNR is the recommended option for the following reasons:

- Highest degree of sustainable operating technology
- Highest degree of environmental stewardship
- Lower capital cost because of reduced digestion volume requirement
- Lowest operating and maintenance cost

The PIC material from PIC #3 is included in Appendix Q.

21.7 Selection of the Preferred Alternative

The second Phase 3 PIC was held on May 25, 2010. A copy of the PIC Material and related correspondence is included in Appendix Q. A summary of the verbal and written comments (one comment sheet received) is as follows:

- Do not eliminate the soccer field (this gentleman advised that he will be submitting his comments by email so that he can be assured that they get to the right people).
- Will property owners north of Big Bay Point Road be forced to connect the new infrastructure? Grant Shellswell responded that once services are provided in the area, the Town may do an assessment of the need for existing residents to connect but he advised that no decision would be made without public consultation.
- One person wanted to know what had changed since the previous PIC. It was explained that the changes were a result of the latest Provincial Documents including the PRS, which revised the Town's effluent TP limits.
- A representative of the "Ladies of the Lake" also wanted to know what had changed. She also inquired about how enforcement works if plant is out of compliance. She was advised of the changes as a result of the PRS and was told that the MOE would handle "out of compliance" instances based on annual reports that will be prepared by the Town operating staff.

No objections were raised to the recommended alternatives. As such, the preferred alternative was selected and is described in general terms as follows:

Prior to June 2, 2014

- Commitment to the completion of a Water Conservation and Efficiency Strategy (WCES), to assess historical water/wastewater conditions and implement a strategy for water efficiency. The Water Conservation and Efficiency Strategy should be completed in conjunction with detailed design, prior to the proposed plant expansion. It is noted that the Lake Simcoe Protection Plan (LSPP) requires that a WCES be completed with implementation beginning by June 2, 2014. It is expected that detailed design will be completed prior to the LSPP deadline (detailed design is expected to be completed in 2012). However, the Town should have the WCES completed prior to June 2, 2014 in or to comply with the LSPP. The WCES should span the full planning horizon up to 2024 at a minimum. The WCES should:
    - Provide targets for conservation, efficiency, inflow and infiltration reduction to the Lakeshore WPCP;
    - Provide timelines for achieving the targets, as well as strategies, tactics, programs and initiatives to be used, including the cost to implement these;
    - Assess methods of achieving conservation measures such as improved management practices, the use of flow restricting devices and other hardware;

- Encourage water conservation incentives, education and demand monitoring in an attempt to reduce water consumption;
- Aggressively reduce wet weather peak inflow and infiltration rates into the collection system through enhanced system monitoring (flow measurement), system inspections and regular maintenance;
- Develop a strict Sewer Use Bylaw along with regular monitoring program;
- Assess the feasibility of non-potable effluent reuse/recycling complete with practices and technologies associated with water reuse/recycling
- Consider the potential impacts of climate change

- The WCES shall include a program for the reduction of inflow and infiltration from the Lakeshore WPCP collection system. This program shall include reduction priorities, targets, timelines, tactics and initiatives, and the associated costs to implement these;
- The WCES shall include an implementation plan for the proposed initiatives. It shall also include a monitoring and reporting plan to assess the effectiveness of the initiatives as well as the achievement of water conservation and/or efficiency targets;
- The Town of Innisfil will consult with the public, relevant government agencies and the Ministry of the Environment's Central Regional Office on its proposed WCES;
- The WCES shall include a review of best in class water conservation and efficiency programs, initiatives, strategies and tactics adopted by other jurisdictions. The review shall include an analysis of best in class tactics/strategies used by other jurisdictions throughout the world. This review shall be made public and shall form part of the consultation process for the WCES, as required above.

Year 2015 (estimated)

- Expansion of the existing LWPCP on Town owned property to 25 MLD using the extended aeration secondary treatment process with membrane filtration for tertiary treatment and aerobic sludge digestion with land application of biosolids and existing outfall pipe configuration;

Year 2024 (estimated)

- Expansion of the LWPCP on Town owned property to 40 MLD by converting the secondary treatment process to conventional activated sludge with biological nutrient removal, expansion of the tertiary membrane filtration facility, conversion to anaerobic sludge digestion and the opening of all diffuser ports on the existing effluent outfall pipe.
- Update the Water Conservation and Efficiency Strategy, in conjunction with detailed design of the proposed Lakeshore WPCP (Stage IV) Expansion, for the water and wastewater flows within the Lakeshore Water and Wastewater Service Areas, based on the monitoring and reporting plan completed between 2014 and 2024.

See hereinafter for a detailed description of the proposed plant expansions.

Additional comments were received during the Class EA planning process as follows:

- October 15 2009 email from P. More and letter response from Town dated March 13, 2010;
- May 12, 2010 email from C. Malcolmson – comments on the PIC material;
- July 20, 2010 email from C. Malcolmson and email response from Ainley dated July 22, 2010;
- July 28, 2010 letter from Environmental Defence (C. Malcolmson);
- August 23, 2010 letter from H. Levecque, Manager, Consultation Unit, Aboriginal Relations and Ministry Partnerships Division and letter response dated September 7, 2010;
- September 7, 2010 letter to Ministry of Aboriginal Affairs (H. Levecque) in response to August 28, 2010 letter;
- September 8, 2010 letter from J. P. Shankman representing Kimvar Enterprises in response to the July 28, 2010 letter from Environmental Defence; and

Copies of these items of correspondence are included in Appendix Q.

21.8 Effluent Filtration

21.8.1 Background

Recently, the Ontario Municipal Board (OMB) approved the Big Bay Point Resort Development (BBPRD) in the Town. Part of the negotiated settlement with the province was that the Town undertake a Class EA for the expansion to the LWPCP. The province asked that the Town demonstrate servicing certainty for the BBPRD though an expansion of the LWPCP. Significant discussions were held with the province at that time for servicing the BBPRD related to the low TP levels that would be required for the expanded LWPCP due to water quality constraints in Lake Simcoe. The province had concerns about the ability to meet the low TP limits (< 0.05 mg/L) at the expanded LWPCP on a consistent basis given that there are no plants in Canada meeting these limits. One of the conditions attached to the settlement was the need for the Town to undertake pilot testing of a phosphorous polishing process to demonstrate that the required TP limits could be met.

21.8.2 Performance of Plant to Meet Existing Total Phosphorous Limits

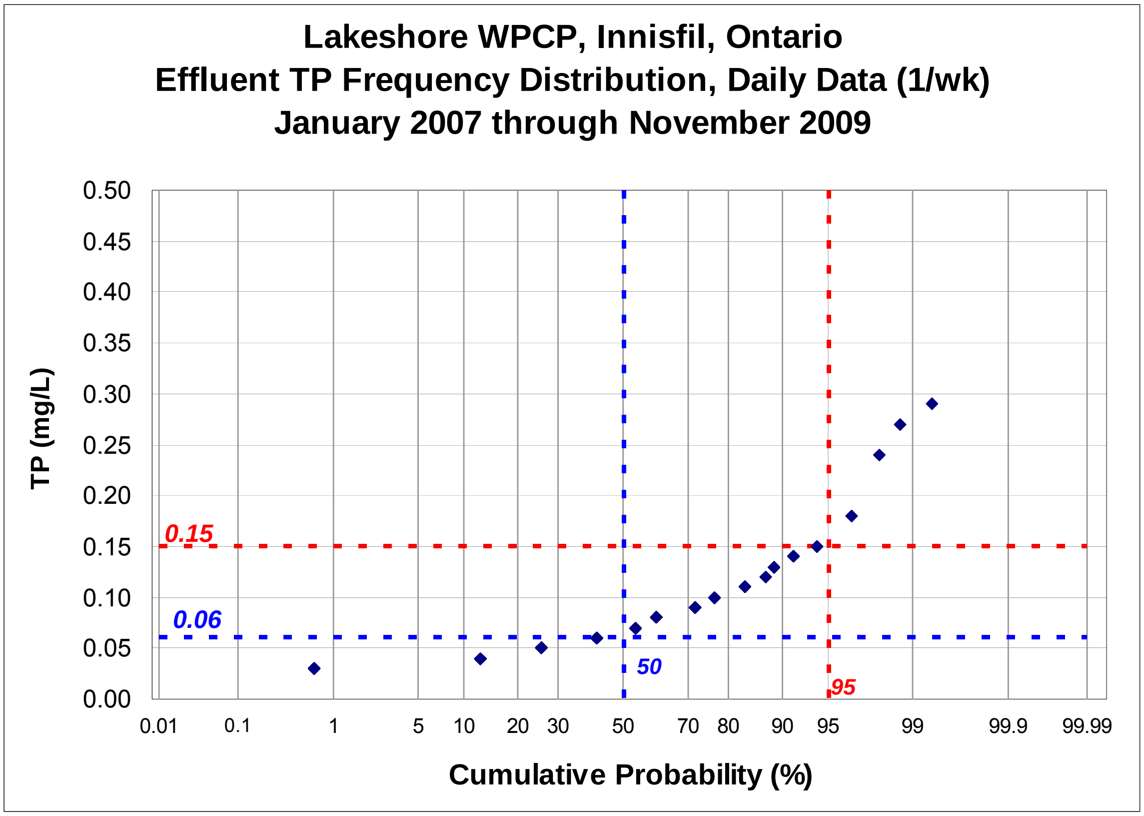
Effluent total phosphorus (TP) concentrations of around 0.09 mg/L are currently achieved at the LWPCP. The LWPCP was issued an interim TP allocation of 351 kg/year or 0.95 kg/day on average as part of the recent Lake Simcoe interim regulation. This TP allocation would have limited the average annual TP concentration to 0.024 mg/L after expansion to 40,000 m^3/d. During the course of this EA project, the MOE continued to develop their Phosphorus Reduction Strategy for Lake Simcoe. As outlined in the Lake Simcoe Phosphorus Reduction Strategy (MOE Document EBR-010-8696, February 2010), effluent phosphorus discharges from the LWPCP will be limited to 629 kg/yr, which corresponds to an average concentration of 0.069

mg/L TP for an average flow of 25 MLD and 0.043 mg/L TP at 40 MLD average daily flow. The existing filtration system alone cannot achieve this phosphorus limit reliably.

Because of the stringent phosphorus limitations that the LWPCP will be required to meet in accordance with the Lake Simcoe Phosphorus Reduction Strategy, the performance of the existing LWPCP for phosphorus removal is of particular importance when assessing alternatives for future treatment. The existing performance is summarized as follows:

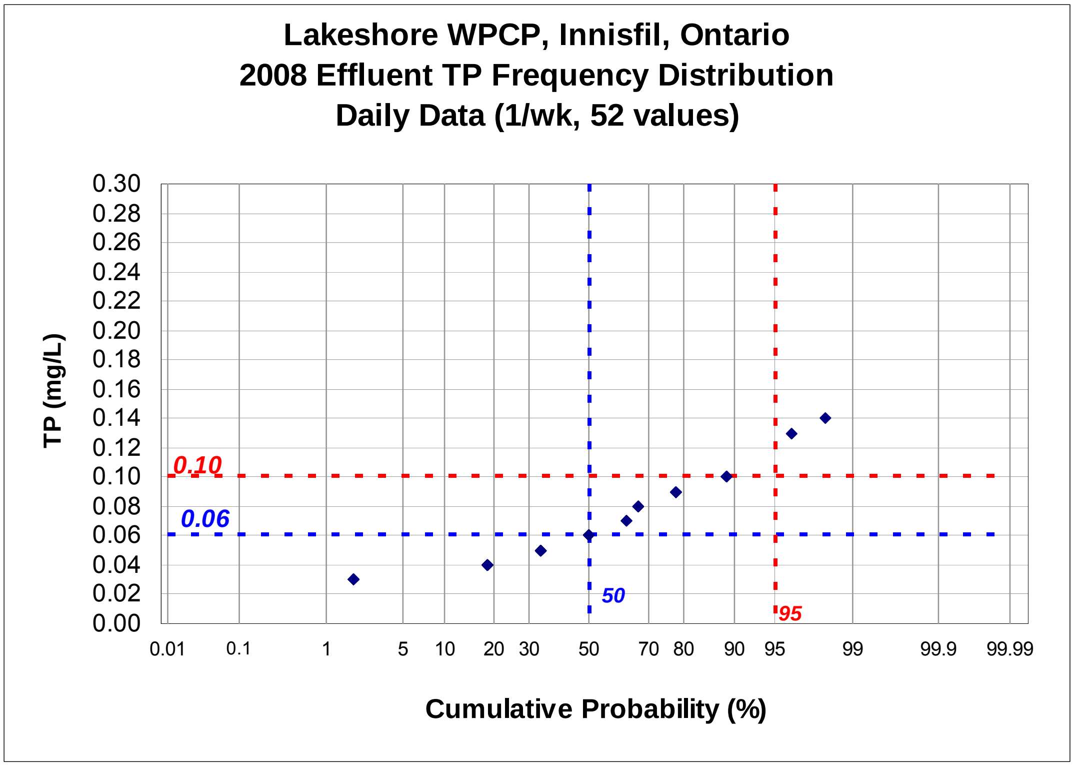
- The annual average flow at the LWPCP is about 9,000 m^3/d, so the plant was required to achieve lower than 0.10 mg/L TP to meet the 351 kg/d interim regulation limit. The existing phosphorus removal process consists of alum addition to the extended aeration activated sludge system. The LWPCP also operates effluent filters and has the capability to add alum to the filter influent wastewater flow (but does not have formal rapid mix and flocculation equipment which would be recommended as an optimization measure if long term operation in this mode is required).
- Under normal operating conditions, alum is added to the LWPCP aeration basin effluent mixed liquor prior to secondary clarification. Performance has been very good, and a probability plot of the weekly samples for effluent phosphorus is shown in Figure 21-6 for January 2007 through November 2009. This time period was selected because plant optimization efforts began in January 2007. The LWPCP is operating at just over 60% of the design flow and typically operates with most basins in service, thus gaining a potential benefit from operating with “excess” capacity. However, during tertiary phosphorus removal pilot testing performed in April and May 2009, LWPCP was operated with one aeration basin, secondary clarifier and filter out of service to more closely examine performance under the design loading conditions. Performance was very good, but there were a few higher effluent TP concentrations observed during this time period. This is likely the result of a requested reduction in the alum dosing to the upstream activated sludge process during pilot testing to ensure there was some phosphorus in the secondary effluent feed to the tertiary phosphorus removal pilots to facilitate testing.

Figure 21-6 Lakeshore WPCP Effluent Phosphorus Concentration Frequency Distribution for 2007 through 2009



- Based on the three years of data, the LWPCP achieved a phosphorus concentration of 0.15 mg/L TP 95% of the time, which was the threshold for reliability set during the WERF study for plants that must meet a given concentration limit on a monthly average basis. Calendar year 2008 represented the most consistent year of operation from the perspective of effluent TP concentrations with a 95th percentile concentration of 0.10 mg/L. It is noted that the 50th percentile value was 0.06 mg/L TP for the 2007 through 2009 time period as well as for calendar year 2008. This suggests that on a mass loading basis the LWPCP achieved phosphorus discharges to Lake Simcoe that were well below the limitation set by the Interim Regulation. This also supports the thought that longer averaging periods would protect water quality while allowing a degree of flexibility in the operation.
- However, these data also clearly demonstrate that meeting a compliance limit of 0.10 mg/L TP on a monthly average basis with "conventional" treatment (e.g. phosphorus removal in the activated sludge system or the secondary effluent followed by filtration) is challenging. The ability to achieve this level of performance without additional facilities will vary from plant to plant. Developing the compliance limit of 0.10 mg/L TP on an annual average or 50th percentile basis may be more realistic if the objective is to achieve this level of treatment without adding additional tertiary facilities.

Figure 21-7 Lakeshore WPCP Effluent Phosphorus Concentration Frequency Distribution for Calendar Year 2008



In conclusion, the data clearly demonstrates that meeting a compliance limit for the expanded LWPCP of less than 0.05 mg/L TP on a monthly average basis with "conventional" treatment (e.g. phosphorus removal in the activated sludge system or the secondary effluent followed by filtration) is not realistic with current technology.

21.8.3 Pilot Study

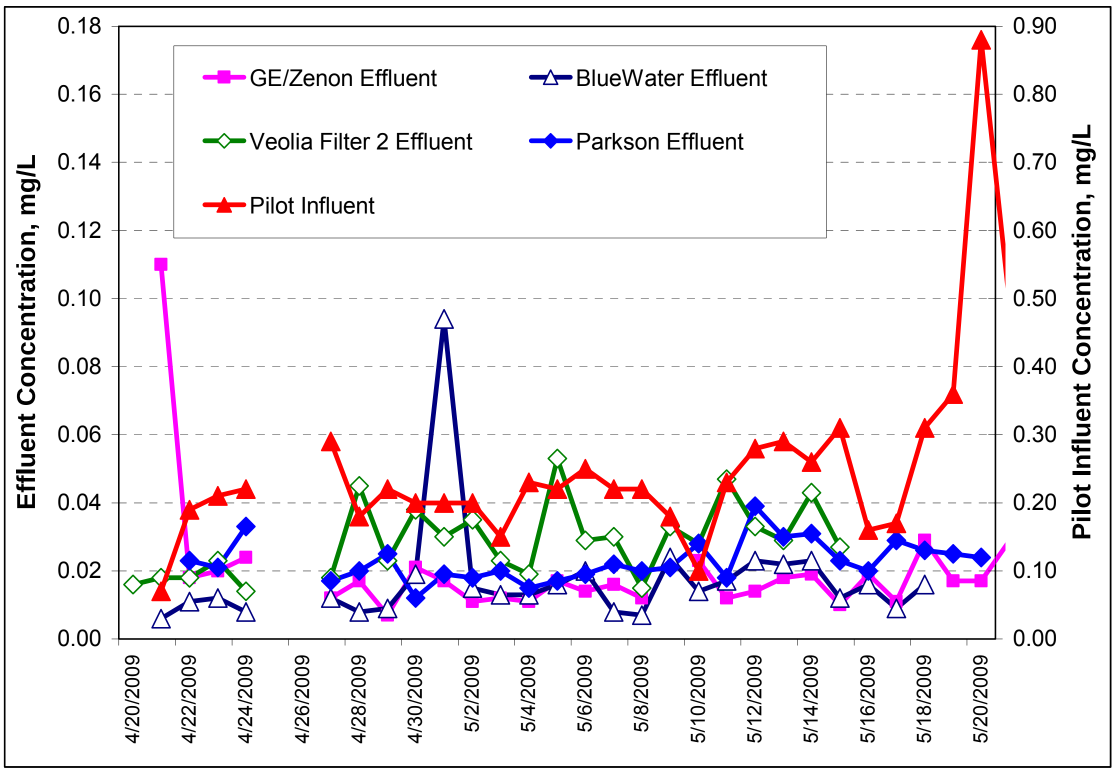
The effluent phosphorus discharges from the LWPCP will be limited to 629 kg/yr, which corresponds to an average concentration of 0.043 mg/L TP at 40 MLD average daily flow. A tertiary treatment pilot study was conducted at the LWPCP to demonstrate that the expanded plant could be upgraded to achieve effluent TP concentrations of 0.024 mg/L average. Given the duration of the pilot study, and the need to achieve the lowest effluent TP concentration possible, the pilot systems were operated to achieve a target of 0.010 mg/L TP. The tertiary treatment technologies selected for this study were as follows:

- GE Tertiary Ultrafiltration Membrane System
- Blue PRO Reactive Filtration Series System
- Veolia ACTIFLO Process followed by Gravity Filters
- Parkson DynaSand D2 Dual Filtration System

The pilot testing procedure and results were detailed in a report titled, "Lakeshore Water Pollution Control Plant Phosphorus Removal Pilot Testing" prepared by B&V dated December 20, 2009. The ESR should be read in conjunction with this report, but the Pilot report is not included.

Each of these technologies relies on chemical addition followed by solids separation. Figure 21-8 presents the pilot influent and effluent TP results for the entire study. To compare performance between all four pilots, results from Weeks 2 through 4 (April 27th through May 15th) were averaged (Table 21-6). This includes the weeks of steady state, diurnal variations, and stress testing. The chart graphically shows the phosphorus speciation results for this time period.

Figure 21-8 Pilot Influent and Effluent TP Results



In Association with BLACK & VEATCH Building a world of difference

Table 21-6 Average Pilot Results (Includes Data from April 27th through May 15th)

Manufacturer	Dissolved Acid Hydrolyzable P[1] (mg/L)	Ortho-P (mg/L)	Dissolved P (mg/L)	TP (mg/L)	TSS (mg/L)	Turbidity (mg/L)
Pilot Influent	0.083	0.055	0.095	0.22	6	2.5
GE Effluent	0.007	0.008	0.012	0.015	1	0.5
BlueWater Effluent	0.006	0.008	0.016 (0.013) [2]	(0.019 (0.015) [2]	1	0.5
Veolia F2 Effluent	0.009	0.007	0.018	0.031	1	0.6
Parkson Effluent	0.008	0.008	0.016	0.022	2	0.7

[1] dissolved acid hydrolysable P includes ortho-P

[2] (excluding 1 outlier of 0.073 mg/L Dissolved P and 0.094 mg/L TP on 5/1)

21.8.4 Preferred Total Phosphorous Process

Based on the pilot performance results, all of the technologies tested are capable of removing phosphorus to very low limits. Of the four technologies, GE and BlueWater achieved the lowest effluent TP results, demonstrating the capability of limiting effluent phosphorous to levels as low as 0.02 mg/L. Therefore they show the most promise for this particular application. When comparing the full-scale capital costs for phase 1 and phase 2 (40 MLD and 95 MLD as evaluated at the time of the pilot study), the capital costs of the systems are not significantly different between GE and BlueWater – both systems met the effluent TP goals and have similar capital costs. When considering the chemical cost estimates and current differences in pricing between alum and ferric chloride, the GE system would have a slight advantage. However, the membranes would need to be replaced after 8 to 10 years of operation, and replacement of the membranes is a significant recurring cost. Thus, the net present value of the BlueWater reactive filtration series system is expected to be lower than the GE membrane system. The two systems would have similar abilities to meet the proposed TP requirements. At this time, the additional advantages associated with the membrane system are attractive for the LWPCP expansion. Additional advantages and disadvantages between the two systems are summarized in Table 21-7.

Table 21-7 Advantages and Disadvantages of Reactive Filtration Series System and Membrane Systems

Membranes	Reactive Filtration Series System
Higher equipment cost	Lower equipment cost
Lower facility cost	Higher facility cost
Higher O&M cost	Lower O&M cost
Proven additional disinfection barrier (removal of bacteria, some removal of virus)	Some reduction in bacteria associated with turbidity removal to low levels but not to the degree of membranes
Public perception advantages	High quality effluent but not as much benefit to public perception
Does not utilize adsorption mechanism to remove phosphorus, which potentially results in higher chemical consumption	Uses adsorption mechanism to full benefit for phosphorus removal, thus reducing chemical consumption

In conclusion, the membrane process is the preferred technology to meet the required TP limits for the expanded LWPCP.

21.8.5 Existing Plants Meeting Low TP Limits

In response to phosphorus concerns in the North-Western United States, state environmental agencies and the EPA are requiring dischargers to reduce phosphorus concentrations in their effluent. Considering expansion needs and the costs for adding tertiary phosphorus removal technologies to existing plants, EPA Region 10 (includes the States of Alaska, Idaho, Oregon and Washington) initiated a project to evaluate municipal wastewater treatment plants which have demonstrated exemplary phosphorus removal. The goal of the project was to obtain and share information about the technologies and the associated costs and this information is summarized in the report Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorus (EPA, 2007). A total of twenty-three plants operating to meet low TP concentrations were surveyed.

Summary information is provided in Table 21-8 and is grouped by tertiary phosphorus removal technology. It is noted that the average concentrations listed consist of the average of monthly averages, and essentially represent an annual average concentration overall. The range of concentrations listed represents the range of actual monthly averages. The Pinery, CO; Stamford, NY; Walton, NY; Breckenridge, CO (Farmers Korner); and Summit County, CO Snake River plants all report annual average total phosphorus concentrations of lower than 0.03 mg/L. However, the range of monthly averages includes several months with higher TP concentrations. Meeting such limits is very difficult on a monthly basis, so a longer averaging period is advantageous from an operations perspective if water quality requirements can still being met.

Table 21-8 Summary Information for Plants Achieving Low Phosphorus Limits Taken from EPA, 2007 Report, and Grouped by Tertiary Phosphorus Removal Technology)

Plant Name and Location	Capacity (ML/d)	Phosphorus Removal Technology	NPDES Permit Limit for Phosphorus	*Average and Range of Monthly Average Effluent TP concentrations
Filtration				
Sand Creek WWRP, Aurora, CO	19	BNR, filtration	None	0.1 to 0.2 mg/L
Milford WWTP, MA	18	Multi-point chemical addition, filtration	0.2 mg/L	0.07 mg/L (0.04 to 0.16 mg/L)
Delhi, NY	3.1	Activated sludge, chemical addition, filtration	0.11 mg/L	0.04 mg/L (<0.02 to 0.085 mg/L)
Snyderville Basin WRD, UT	15	BNR, chemical addition, filtration	0.1 mg/L	0.04 mg/L (0.03 to 0.06 mg/L)
McMinneville WWTP, McMinneville, OR	21	Oxidation ditch BNR, chemical addition, multi-media traveling bed filtration	0.07 mg/L	0.058 mg/L (0.036 to 0.092 mg/L)
Tertiary Settling and Filtration				
Breckenridge SD, Iowa Hill WWRP, CO	5.7	BNR, chemical addition, tertiary settlers and filtration	0.5 mg/L daily max and 102 kg/yr (0.049 mg/L at 5.7 MLD)	0.055 mg/L (0.017 to 0.13 mg/L)
Breckenridge SD, Farmers Korner WWTP, CO	11.4	BNR, chemical addition, tertiary settlers and filtration	0.5 mg/L daily max and 102 kg/yr (0.025 mg/L at 11.4 MLD)	0.007 mg/L (0.002 to 0.036 mg/L)
Summit County, Snake River WWTP, CO	9.8	BNR, chemical addition, tertiary settlers and filtration	0.5 mg/L daily max and 155 kg/yr (0.043 mg/L at 9.8 MLD)	0.015 mg/L (<0.01 to 0.04 mg/L)
Rock Creek WWTP, Clean Water Services, OR	148	Chemical addition, tertiary settlers, filtration	0.1 mg/L monthly median	0.07 mg/l (0.04 to 0.09 mg/L)
Durham WWTP, Clean Water Services, OR	91	BNR, chemical addition, tertiary settlers, filtration	0.11 mg/L (monthly median limitation)	0.07 mg/L (0.05 to 0.1 mg/L)

Plant Name and Location	Capacity (ML/d)	Phosphorus Removal Technology	NPDES Permit Limit for Phosphorus	*Average and Range of Monthly Average Effluent TP concentrations
Alexandria Sanitation Authority AWWTP, Alexandria, VA	204	BNR, chemical addition, tertiary settling, filtration	0.18 mg/L	0.065 mg/L (0.04 to 0.1 mg/L)
Upper Occoquan Sewerage Authority WWTP, VA	160	Chemical (high lime), tertiary settling, filtration	0.1 mg/L	<0.088 mg/L (0.023 to <0.282 mg/L)
Fairfax County Noman Cole WWTP, VA	254	BNR, chemical addition, tertiary settling, filtration	0.18 mg/L	<0.061 mg/L (<0.02 to <0.13 mg/L)
Two-stage Filtration				
Pinery WWRF, Parker, CO	7.6	BNR, chemical addition, adsorption clarifiers/filters, filtration	0.05 mg/L and 138 kg/yr (0.05 mg/L)	0.029 mg/L (0.021 to 0.074 mg/L)
Stamford WWTP, NY	1.9	Chemical addition, two-stage filtration	0.2 mg/L	<0.011 mg/L (<0.005 to <0.06 mg/L)
Walton WWTP, NY	5.9	Chemical addition, two-stage filtration	0.2 mg/L	<0.01 mg/L (<0.005 to <0.06 mg/L)
Membrane Filtration				
Pine Hill WWTP, NY	1.9	RBC, sand filters, chemical addition microfiltration	0.2 mg/L	0.06 mg/L (0 to 0.12 mg/L)
NYC DEP – Grand Gorge STP, NY	1.9	RBC, sand filters, chemical addition microfiltration	0.2 mg/L	<0.04 mg/L (0 to 0.05 mg/L)
Hobart WPCF, NY	0.68	Activated sludge, sand filters, chemical addition, microfiltration	0.5 mg/L	<0.05 mg/L (0.026 to 0.07 mg/L)
Ashland WWTP, Ashland, OR	8.7	Oxidation ditch, chemical addition, membrane filtration	0.73 kg/d (= 0.083 mg/L)	0.07 mg/L (0.05 to 0.12 mg/L)

Notes:
(1) Average concentrations as listed consist of the average of monthly average measurements achieved as reported by the facility on NPDES discharge monitoring reports.

As permit limits have become more stringent, there have been a number of attempts to define the “limit of technology” (or LOT) for phosphorus and nitrogen removal at wastewater treatment plants. In some cases, the term LOT has been defined from a regulatory standpoint to correspond to certain effluent values. However, many factors impact the level of performance that can actually be achieved and the influence of different factors varies from plant to plant.

In an effort to better define LOT for nitrogen and phosphorus removal, the Water Environment Research Foundation (Alexandria, Virginia) has been working on this issue under its "Nutrient Challenge" research program. This work included developing a statistical approach to evaluating performance at WPCPs and applying this approach to a number of plants operating to very low phosphorus and nitrogen concentrations. A criterion for plants participating in the study was that at least three years of daily data be available for effluent phosphorus or nitrogen. The results were documented in three papers presented in 2009 at the WEFTEC conference in Orlando, Florida (Neethling et al, 2009; Parker et al, 2009; and Bott et al, 2009) and are briefly summarized below. These papers are included in the Appendices B, C and D of the Pilot Report.

In Neethling et al (2009), the terminology "technology achievable limit", or TAL, was introduced to describe the technology performance statistics of a process under the specific conditions of operation. It was noted that a number of conditions significantly impact the TAL for a given plant, including treatment goals, data source, seasonal fluctuations, exclusions of certain data from the dataset (e.g. during construction), operating flow and load versus plant capacity, scale of the facility, solids processing return streams, and other special conditions (such as weather extremes or industrial discharges). The lowest running 14 days (or 3.84 percentile) was generally defined as the lowest TAL as it corresponds to two weekly cycles of daily variations and also generally corresponds to one sludge age for most biological treatment systems. A 50th percentile (median) was utilized to define the "average" TAL and the 95th percentile was selected as a measure for reliable performance.

In Parker et al (2009), eleven nutrient removal plants (five operating to achieve low TN limits and six operating to low TP concentrations) were evaluated using the statistical methods detailed in Bott et al (2009). Individual papers and presentations were prepared for each facility and were presented in Workshop 101 at WEFTEC in 2008 (Chicago, Illinois). The individual presentations are available at *http://www.werf.org/AM/Template.cfm?Section=Nutrients*. It is noted that during the study no attempt was made to get into detail about the factors impacting on the various unit processes within the plant – rather the focus was to try to identify treatment capabilities of different overall flow sheets in meeting the LOT treatment objectives. The percentile values that are equal or lower than the stated concentrations were identified for 50, 90, 95 and 99 percent of daily values, monthly values (30 day average values) and annual average (12 month average values). It is noted that greater than 99 percentile probability would be needed to avoid exceeding a daily maximum permit limit, while 95th or 99th percentiles of monthly average and annual average are needed to avoid exceeding monthly or annual average limits. It is important to note that in applying daily data to examine the probability of meeting a monthly limit, that one should conduct the statistical evaluation on monthly average (or 30-day rolling average) values, in addition to examining daily data.

The Breckenridge, Colorado Iowa Hill plant is a tertiary phosphorus removal plant operating to meet a limit in the range proposed for Innisfil. The Iowa Hill plant includes ballasted flocculation

(Densadeg, manufactured by Infilco Degremont Inc.) followed by filters downstream from biological treatment. Based on the three years of data utilized for the study, this plant met daily maximum, monthly average, and annual average TP concentrations of 0.083 mg/L, 0.0556 mg/L and 0.0273 mg/L 99 percent of the time. A copy of the paper and presentation slides from WEFTEC 2008 Workshop 101 (Maher, 2008) is included in Appendix E of the Pilot Report.

WERF completed additional work in 2009, which includes evaluation of eight additional plants operating for low nitrogen and phosphorus concentrations. Of these, several operated for stringent TP limits in the range of 0.2 mg/L. The Pinery WWTP in Colorado operates a 5-stage Bardenpho process followed by chemical addition, tertiary adsorption clarifiers and filters (Microfloc Trident, manufactured by Siemens) to meet permit limits of 0.05 mg/L monthly average and 0.1 mg/L TP daily maximum. Based on the three years of data utilized for the study, this plant achieved daily maximum and monthly average TP concentrations of 0.062 mg/L and 0.038 mg/L 99 percent of the time. Copies of the paper and presentation from Workshop 216 at WEFTEC 2009 (Clark, 2009) are included in Appendix F of the Pilot Report.

A comparison of the statistics for some of the phosphorus removal plants referenced in the WERF study is provided in Table 21.9.

Table 21-9 Comparison of Statistical Evaluations for Effluent Phosphorus Data from Plants Participating in WERF Study

Plant	Daily TP, 99th Percentile	Monthly Average TP, 99th Percentile	Annual Average TP, 99th Percentile
Iowa Hill, Breckenridge, CO	0.083	0.0556	0.0273
Pinery WWTP, Colorado	0.062	0.038	---
F. Wayne Hill, Gwinnett County, GA	0.161	0.094	0.065
Rock Creek WWTP, Durham, OR	0.516	0.210	0.166
Clark County, NV	0.33	0.166	0.11
Blue Plains AWTP, Washington, DC	0.262	0.167	0.106
Cauley Creek, GA	0.285	0.128	0.096
Kalispell, MT (BioP with Filters, no chemicals)	0.36	0.19	0.14

21.9 Effluent Disinfection Alternatives

The following methods of effluent disinfection were considered for the final effluent prior to discharge to Lake Simcoe:

- Chlorination/Dechlorination by sulphur dioxide
- Hypochlorination/Dechlorination by sodium metabisulphite
- Ultraviolet Irradiation
- Ozone

The advantages and disadvantages of each alternative are reviewed below.

21.9.1 Chlorination/Dechlorination

Chlorine is a well-known disinfecting agent that, when dissolved in water, attacks pathogenic organisms in a variety of ways. Dechlorination to remove residual chlorine following the disinfection process is often necessary to protect sensitive receiving streams, as chlorine is equally effective against desirable aquatic species. Gaseous sulphur dioxide is a commonly used dechlorination agent.

Liquid chlorine is supplied in 70 kg or 1000 kg cylinders and is passed as a gas through a chlorinator to produce a solution of predominantly hypochlorite ion in water. The solution is then mixed with the effluent, and thirty minutes contact time at average flow is provided in a contact chamber to ensure an effective kill of the pathogens.

Sulphur dioxide for dechlorination is supplied as a liquid in cylinders, and a water solution containing sulphite ion is produced in a sulphonator in a similar process to chlorination. Dechlorination is achieved through a nearly instantaneous reaction when the solution is mixed with the disinfected effluent.

Advantages

- Proven effectiveness against disease organisms
- Familiar to most operators, as it is the most common method of wastewater disinfection.
- Gas-handling equipment is proven to be reliable
- MOE guidelines for the use of chlorine are well established
- Chlorine may be used elsewhere in the plant to control odours or biological processes

Disadvantages

- Handling of chlorine and sulphur dioxide gases is a safety concern both to operators and to the surrounding land
- Chlorinated organics thought to be toxic are produced in the effluent and are not removed by dechlorination
- Inadvertent excess use of either chemical can cause harm to aquatic species

21.9.2 Hypochlorination/Dechlorination

This method of disinfection is essentially the same as chlorination/dechlorination, with the difference that solid or liquid chemicals, rather than gases, are supplied to produce the required solutions. Sodium hypochlorite is available most commonly as a liquid (bleach) containing 12% free chlorine by volume. The solution is dosed directly to the wastewater stream without further dilution, and a contact tank provides 30 minutes contact time at average design flow, similar to the chlorination process described above.

The dechlorination agent generally used is sodium metabisulphite, typically supplied as a dry powder and mixed with water to form a solution containing sulphite ions. The solution is dosed to the contact tank effluent, where dechlorination is nearly instantaneous.

Advantages

- Proven effectiveness against disease-causing organisms
- Chemicals present a minor hazard to operators and minimal hazard to surrounding land uses
- Chemical handling and dosing equipment is simple and reliable
- MOE guidelines for the use of chlorine are easily adapted to sodium hypochlorite
- Hypochlorite can be dosed elsewhere in the plant to control odours and biological processes

Disadvantages

- Chemicals may be more expensive than corresponding gases
- Chlorinated organics thought to be toxic are produced in the effluent and are not removed by dechlorination
- Inadvertent excess use of either chemical can cause harm to aquatic species

21.9.3 Ultraviolet Irradiation

Ultraviolet (UV) irradiation is becoming an increasingly popular method to disinfect wastewater. Lamps emitting UV light are immersed in the plant effluent in an open channel. Flow in the channel is regulated such that the lamps are submerged at all times with all of the wastewater receiving maximal exposure.

The UV light produced by the lamps is at a frequency known to cause maximum damage to the genetic structure of pathogenic bacteria and viruses. As a result of the genetic damage, pathogenic organisms are unable to reproduce. Under some circumstances, repair of the damage may occur in the presence of sunlight through a process called photoreactivation. The extent of this problem is still undetermined.

The effectiveness of UV light in the disinfection of effluent containing high levels of suspended solids is less understood. Particulate matter decreases the penetration of light from the lamps, reducing the effectiveness of the irradiation, and pathogens contained in particles are unaffected by the ultraviolet light. There is some evidence, however, that the pathogens are also protected from the effects of chlorine.

The suspended solids anticipated in the plant effluent are within the treatment capabilities of the UV irradiation system.

Advantages

- Simple, low-maintenance system
- Low operating and maintenance costs
- Process introduces no toxic compounds to the receiving stream
- No potential for damage to aquatic species in the receiving stream
- Minimal hazard to plant operators, no hazard to surrounding land uses
- Operations staff are familiar with this process

Disadvantages

- Extent of photoreactivation is unconfirmed

21.9.4 Ozone

Ozone is a highly effective disinfectant, both as a bactericide and a virucide. Unlike chlorine, ozone can exert a beneficial effect on the environment since ozone decomposes rapidly to oxygen after application, thereby increasing the DO in the effluent. The rapid reaction rate ensures that toxic ozone residuals are normally not found in the effluent by the time it reaches the receiving water.

Since ozone is unstable, it must be generated on-site from air or pure oxygen. The capital costs are high and the contact tanks must be deep to increase the contact time. The operating costs can be high since ozone generation is power intensive. The off-gas must be collected and treated to destroy the remaining ozone. Ozonation systems can be complicated to operate and maintain. For cost and operational reasons, ozonation is not recommended.

Advantages

- Efficient disinfecting agent
- Increases the DO in the effluent by rapidly decomposing to oxygen

Disadvantages

- High capital cost
- High operating costs
- Off gases need to be treated
- Complex system to operate and maintain
- Technology is not well proven in Ontario

21.9.5 Evaluation of the Disinfection Alternatives

Chlorination, chlorination/dechlorination, ozonation, and UV irradiation were evaluated for the following:

- Efficiency
- Ability to meet the compliance limits for fecal coliforms under all flow conditions
- Environmental impact
- Cost effectiveness

An economic analysis of the disinfection alternatives indicates that UV irradiation has significant economic benefits on a long-term basis, and is competitive in the short term. The capital cost for disinfection is included in the capital cost for the treatment alternatives previously provided. The process has advantages in that there are no toxic effects on Lake Simcoe and no potential serious hazards in the operation and maintenance of the system.

The advantages of the UV system are:

- Relatively simple process to operate
- Effective in the inactivation of pathogens
- Capable of complying with the disinfection goals

The main disadvantage of UV for this application is:

- Iron salts for phosphorus removal may cause the formation of scale on the UV lights, requiring frequent cleaning

Each parameter was given equal weight in the ranking system. With equal weighting used in the evaluation, the overall ranking from most to least preferable:

- UV irradiation
- Chlorination/dechlorination
- Chlorination
- Ozonation

Table 21-10 summarizes the evaluation of the four disinfection processes.

Table 21-10 Evaluation of Disinfection Alternatives

Parameter	Chlorination	Chlorination/ Dechlorination	UV Irradiation	Ozonation
Ability to meet fecal coliform limits under all flow conditions	○	○	○	◒
Environmental impact of disinfection by-products	●	○	○	◒
Ease of Operation	◒	◒	○	◒
Level of Complexity	○	◒	○	●
Economic Considerations	○	◒		●
Familiarity with Operations staff	◒	◒	○	◒

○ **Most Preferable**

◒ **Less Preferable**

● **Least Preferable**

21.9.6 Select the Recommended Alternative

The evaluation of the effluent disinfection alternatives indicated that the recommended alternative was UV Irradiation. This alternative:

- Is able to meet fecal coliform limits under all flow conditions
- Produces no toxic disinfection by-products
- Is a simple system that is easy to operate
- Has low operating and maintenance costs
- Operations staff are familiar with the process

21.10 Description of Treatment Processes for All Stages III Unit Processes

As discussed in this section, a Stage III expansion will increase the LWPCP capacity from 14 to 25 MLD using an extended aeration activated sludge process and tertiary phosphorus removal. This expansion will maintain the existing aerobic digestion process but will add WAS thickening. A future Stage IV expansion will increase the plant capacity from 25 to 40 MLD average daily flow. The Stage IV expansion also will convert the LWPCP to a conventional activated sludge process with biological nutrient removal (BNR). This expansion will include the addition of primary clarifiers, primary sludge thickening/fermentation, and anaerobic digesters in the overall treatment scheme. A site plan of the Stage III expansion is presented in Proposed Site Plan (see Appendix R). It is subject to change, pending completion of the Class EA and preliminary design. This section provides a brief description of the unit processes in the Stage III expansion to 25 MLD. The next section will summarize the requirements for the Stage IV expansion to 40 MLD average daily flow.

21.10.1 Headworks

It has been assumed that the current headworks containing two bar screens and two aerated grit tanks have been appropriately sized to meet the Stage II screening/degritting needs at a design peak flow of about 36,000 m^3/d. The existing headworks will need to be doubled to increase the capacity to treat the average day and peak flows for both the projected Stage III and Stage IV expansions. The headworks building expansion will include two new channels with the installation of a 20 MLD screen in one channel and a manual bar rack in the other. This channel will serve as the emergency bypassing channel in case of any screenings failures. The expansion will also include new washer/compactor(s) and upgrades to the existing loading bay. The two existing screens will continue to be used and may be upgraded with new bars to match the new screen. Additional grit removal will be added with the installation of two new grit vortex chambers including a grit classifier. Odour control will be provided for the building. An equalization chamber will also be considered to dampen peak flows from the three forcemains coming into the existing headworks facility. This will be looked at in more detail during the pre-design. The plant hydraulics will take into consideration the need for primary clarifiers ahead of the secondary's in Stage IV and the screening channel elevations and grit system will be adjusted accordingly.

21.10.2 Primary Clarifiers

The Stage III project will expand the existing extended aeration process and will not include primary clarifiers. However, since primary clarifiers are planned for the future Stage IV expansion, space for these future clarifiers is accounted for in the site plan. In addition, the future primary clarifiers will be accounted for in the plant hydraulic profile.

21.10.3 Aeration Tanks

The existing extended aeration activated sludge process at LWPCP consists of four aeration basins, each with a volume of 2500 m^3, and four 26 m diameter secondary clarifiers. Aeration basins and clarifiers must be sized as a system rather than individually, and based on the projected needs a significant expansion to aeration basin volume is needed while a much smaller incremental expansion to clarifier capacity would be sufficient. A total of three new aeration basins, each with a volume of 5,000 m^3 is proposed.

To provide the flexibility to operate in a partial BNR mode, the aeration basins will include anoxic zones at the inlet end. While operation for chemical phosphorus removal is planned, inclusion of the anoxic zones allows for operation for partial denitrification, which would provide a reduction in air requirements, reduce alkalinity requirements, and minimize potential denitrification in the clarifier sludge blanket. These zones would be mixed and could operate as anaerobic zones in the future to allow for some biological phosphorus removal to offset chemical needs for phosphorus removal. The anoxic zones would be equipped with mixers and diffusers to allow them to be used as anoxic or aerated depending on actual operation and process needs. Mixed liquor recycle pumps would be installed to transfer nitrified mixed liquor from the end of each aeration basin to the anoxic zones for denitrification.

21.10.4 Secondary Clarifiers

There are four existing 26 m diameter secondary clarifiers at LWPCP. In combination with the proposed aeration basin expansion, one additional 26-m diameter clarifier is needed for the Stage III expansion. The sizing of the secondary clarifiers will be based on MOE design guideline values for SORs and SLRs, and B&V's operational experience for other similar plants.

21.10.5 Filtration

The existing LWPCP has two sets of effluent filters, operating in parallel. The first consists of two traveling bridge filters that were constructed with the original plant. The second filters train consists of four upflow continuously backwashed filter cells (each cell consists of four airlifts for backwashing). As discussed in Section 21.7, effluent phosphorus discharges will be limited to 629 kg/yr, which corresponds to an average concentration of 0.069 mg/L TP. The existing filtration system alone cannot achieve this phosphorus limit reliably. Based on the results from the pilot testing of tertiary phosphorus removal technologies (conducted in April and May 2009), membrane filtration is the recommended technology for the upgrade of LWPCP.

There are several membrane manufacturers capable of providing the membrane system. Because of differences in the equipment and detailed layout between manufacturers, it is recommended that the membrane manufacturer be selected during the preliminary design phase so that the facility design can accommodate these requirements. For the purposes of this report, the membrane filtration system is based on a submerged system.

Two chemical addition trains, each consisting of a rapid-mix chamber followed by flocculation, would precede the membrane filtration system. The membrane system would consist of four membrane cells (depending on the final manufacturer selection). A fifth cell (initially not populated with membranes) would be accounted for in the layout to facilitate the future Stage IV expansion to 40 MLD. The membrane system would be supplied complete with backwash pumps, air scour blowers, and chemical cleaning equipment. These requirements also differ slightly between manufacturers. For the purposes of this report, citric acid and sodium hypochlorite are included.

21.10.6 Disinfection

The existing LWPCP has a Trojan UV disinfection system downstream from the filters. For the Stage III expansion, membrane filtration effluent flow would be directed to a new low-pressure high intensity UV system and the existing system would be decommissioned.

21.10.7 Existing Outfall

No upgrades would likely be required to the existing outfall to accommodate the increase in peak flows. The increased hydraulic gradient from the elevated tertiary building will provide sufficient head to allow the continued use of the existing outfall for sometime.

21.10.8 Aerobic Digestion and Biosolids Storage

Waste activated sludge is currently sent to the aerobic digesters for stabilization and VSS destruction. Digested sludge is stored in two aerated holding tanks. The 25 MLD plant will continue with a similar aerobic digestion process followed by solids storage. Proposed modifications include the following:

- Construct baffle wall in the large cell of the larger of the existing solids storage tanks to divide this volume into separate compartments.
- The existing primary and secondary digester cells, plus the 2700 m^3 sludge storage cell and one-third of the large (8100 m^3) biosolids storage cell will provide the necessary aerobic digester volume.
- The remainder of the existing 8100 m^3 biosolids storage basin will provide biosolids storage volume for the 25 MLD plant.
- New biosolids storage tanks will be constructed on the west side of the site to bring the total biosolids storage volume up to 240 days. An additional 24,000 m^3 storage volume is required beyond the volume of the existing basins.

21.10.9 WAS/Digested Sludge Thickening

The LWPCP currently relies on decanting of the aerobic digesters to thicken the biosolids. The Stage III expansion will incorporate WAS thickening to replace the decanting operation. Two mechanical thickeners (assumed to be rotary drum for the purposes of this report) will be installed above the digesters. The thickeners will be piped such that WAS can be partially thickened prior to sending it to the digesters. Digested sludge also can be thickened and directed back to the digester (in a recuperative thickening mode) or sent to the biosolids storage tank. The thickeners are expected to produce thickened solids in the range of 3 to 5%. The target solids concentration in the digesters is 2% (per MOE guidelines) and the target solids concentration in the biosolids storage tank will be 2 to 3%. A polymer storage and dosing system would be provided with the thickeners.

21.11 Description of Treatment Processes for All Stage IV Unit Processes (Expansion from 25 to 40 MLD)

The Stage IV expansion will expand the LWPCP from 25 to 40 MLD average daily flow capacity. This project also will convert the LWPCP to a conventional activated sludge process with biological nutrient removal (BNR). The expansion will include the addition of primary clarifiers, primary sludge thickening/fermentation, and anaerobic digesters in the overall treatment scheme. This section provides a brief description of the unit processes for the Stage IV expansion to 40 MLD average daily flow.

21.11.1 Headworks

The expanded headworks building from Stage III was constructed to accommodate the Stage IV expansion. A fourth screen and a third vortex grit chamber will be added to meet the design flows for both ADF and peaking requirements. The older screens from Stage II will be decommissioned and a new third 20 MLD fine screen will be installed in one of the existing channels for a total of three screens and one bypass channel. Additional washer/compactor and grit classifier capacity will also be added.

21.11.2 Primary Clarifiers

A conventional activated sludge plant includes primary clarifiers to reduce the organic loading on the downstream biological process and direct a concentrated solids stream to the anaerobic digestion. Three 24 m diameter primary clarifiers will be added. The new primary clarifiers would be located to the west of the existing aeration tanks and north of the new aeration tanks that are constructed under the Stage III expansion to 25 MLD. The settled primary solids (raw sludge) would be pumped to new gravity thickeners prior to anaerobic digestion.

21.11.3 Conventional Activated Sludge BNR System

Under the Stage IV expansion, primary clarifiers would be added upstream from the activated sludge basins. Approximately 60% of the influent solids and 30% of the influent BOD_5 would be removed in the primary clarifiers. Thus, even though there will be an increase in the overall plant capacity, the actual load to the activated sludge system is comparable to that of the Stage III expansion for the 25 MLD plant. Therefore, it will not be necessary to increase the aeration basin volume under this project.

Under the Stage IV expansion, the capability to operate for full biological nutrient removal would be provided. This includes the inclusion of anaerobic and anoxic zones upstream from the aeration zones. Anoxic zones are planned under the Stage III expansion. When the new primary clarifiers are constructed, each of the existing aeration basins would be modified. The anaerobic/anoxic zone volume would be expanded by adding a baffle wall to create a third mixed cell. The mixed liquor recycle pump capacity in each train would be expanded.

21.11.4 Secondary Clarifiers

The activated sludge basins and clarifiers are sized as a system. Based on the addition of primary clarifiers and using the Stage III activated sludge basin volume, two new 26-m secondary clarifiers will be constructed under the Stage IV expansion for a total of 7 secondary clarifiers.

21.11.5 Tertiary Phosphorus Removal and Filtration

Two new rapid-mix and flocculation trains and a membrane filtration system will be constructed under Stage III. Under Stage IV, this system will be expanded from 25 MLD to 40 MLD. Additional membranes would be added to the four membrane basins constructed under Stage III and a fifth membrane basin would be equipped with membranes.

21.11.6 Off-Spec Effluent Storage and Equalization

As discussed earlier, the current phosphorus allocation of 629 kg/yr would correspond to an average effluent concentration of 0.043 mg/L TP at 40 MLD. Because of the stringent nature of the effluent TP limits, it is recommended that storage volume be provided to allow off-spec effluent to be stored and retreated if necessary to meet permit limits. This volume would also be available for equalization and potential optimization of the membrane process operation. Off-spec storage volume of approximately 51,000 m^3 is recommended (this is equal to a full day of storage at the maximum month average flow for the 40 MLD plant).

21.11.7 Disinfection

The new UV system constructed under Stage III would be expanded for the Stage IV capacity requirements. This will be done by adding one additional UV disinfection train to the membrane filtration/disinfection building.

21.11.8 Primary Sludge Thickening

Primary sludge will be pumped from the bottom of the primary clarifiers to two new 14 m diameter gravity thickeners prior to digestion. The gravity thickeners would be sized to allow operation as primary sludge fermenters to produce volatile fatty acids as a food source for biological phosphorus removal. The VFA-rich fermentation would be pumped to the BNR process anaerobic zones. The design thickened sludge solids concentration to the digesters is 5%.

21.11.9 WAS Thickening

Under the Stage III expansion, mechanical thickening is being installed to partially thicken WAS prior to digestion, provide recuperative thickening in the aerobic digesters if desired, and to provide additional thickening of aerobically digested sludge prior to biosolids storage. The rotary drum thickeners installed under Stage III will be reused under the Stage IV expansion from 25 to 40 MLD. With the proposed new primary clarifiers and the switch to anaerobic digestion, WAS quantities at 40 MLD plant will be comparable to WAS quantities for the 25 MLD plant (which will operate an extended aeration process without primary clarifiers). The rotary drum thickeners would thicken WAS to approximately 4% solids prior to sending it to the new anaerobic digesters.

21.11.10 Anaerobic Digestion

Stabilization is the term used to describe processes applied in order to reduce the levels of pathogenic organisms contained in the waste biological solids. Stabilization is usually achieved through endogenous decay by either anaerobic or aerobic digestion, or through cell destruction by pH adjustment or heat pasteurization.

Converting to a CAS process will require the aerobic digestion process to be converted to anaerobic digestion. Two circular primary digesters, each with a volume of 2,268 m^3, will provide minimum 15 days solids residence time at maximum month sludge loading conditions. A new secondary digester of the same size would also be provided. The new digesters would be located on the west side of the plant site. The existing aerobic digesters that would be decommissioned or reused for another purpose (possibly sludge storage). A digester control building could be constructed to house all associated digester equipment including: mixers, heat exchangers, sludge transfer pumps, gas handling equipment, boiler, etc.

21.11.11 Biosolids Storage and Dewatering

Under the Stage III expansion to 25 MLD, new liquid biosolids storage volume will be constructed. Approximately 24,000 m^3 of new biosolids storage volume will be provided (in addition to the existing volume) to provide 240 days of digested biosolids storage at 2.5 to 3% solids content. When the LWPCP is expanded to 40 MLD in Stage IV, another 20,000 m^3 of storage would be needed.

There are many process and equipment options to thicken, dewater, store, and dispose of the biosolids. Two biosolids handling approaches are typically used, as follows:

- Liquid system comprised of thickening the solids to achieve 2-5% total solids, storage of the biosolids in tanks during the winter for the required 240 days, followed by land application during the summer months
- Solid or "cake" system comprised of dewatering to 15-30% solids, temporary storage, followed by either land application or landfilling

Following current trends, it has been assumed that the current practice of aerobic digestion followed by biosolids storage and land application would continue after the Stage III expansion to 25 MLD as follows:

- A portion of the waste activated sludge from the extended aeration process would be mechanically thickened to allow a 2% solids concentration to be maintained in the aerobic digesters without decanting.
- Digested biosolids would be pumped from the digesters to the biosolids holding tank. A portion of the digested biosolids will be thickened to achieve a net target solids concentration of 2.5 to 3% solids in the holding tanks.
- Biosolids disposal – Liquid biosolids would be pumped into trucks and disposed of through land application during the summer months.

After the Stage IV expansion to 40 MLD, the plant would incorporate thickening, anaerobic digestion, additional storage and land application of the liquid biosolids. Incorporation of a dewatering process could be considered in the future.

Regulation 267/03 under the Nutrient Management Act (OMAFRA, 2002) spells out the requirements that the Town must meet with respect to land application of biosolids generated at the LWPCP. Since land application is the current biosolids disposal method, the Town is already meeting these requirements. Some key highlights of Regulation 267/03 include:

- The need to prepare a Nutrient Management Strategy (NMS) for submission and approval by the MOE. The Town is currently developing their NMS.
- Updating the NMS within prescribed time periods
- Biosolids sampling for *E. coli*, nutrients, regulated metals, solids concentration, according to a frequency set by WPCP capacity

- Developing contingency plans for unforeseen conditions
- Documentation of planned destinations for biosolids, the application rates, volumes applied, and brokers used
- Notifying municipalities and neighbours in areas of biosolids application prior to commencing application
- Nutrient addition is to be based on agronomic uptake for nitrogen and phosphorus. The Town's application rates are calculated by maximum solids loading. The agronomic balance for nitrogen and phosphorus are calculated and submitted to the MOE and the landowner.
- Providing annual reports and enhanced record keeping requirements. The Town currently submits an annual Biosolids Report to the MOE district office along with an Annual Operating Report.
- Providing evidence of an agreement between the generator and broker
- Observing land application standards for such things as application rates, water well setbacks, surface/groundwater proximities, seasonal timings, pre-harvest/grazing wait periods
- Providing biosolids storage for a minimum of 240 days' production unless the need for storage is eliminated by other means and observing restricted land application of biosolids from December 1 to March 31. The Town currently has biosolids storage and this storage volume will be expanded with each increase in LWPCP capacity.
- Option to form a *Local Advisory Committee* to provide for dispute mediation and public education regarding biosolids issues

21.12 Impact of Preferred Alternative on the Environment and Mitigating Measures

The preferred solution does not significantly impact environmental features within and surrounding the study area. The separating distance from the expanded LWPCP to the nearest existing residential building is approximately 70m. Any potential impact will be addressed, monitored, and mitigated as required.

21.12.1 Truck Traffic

During construction, vehicular traffic to and from the project area will increase as construction equipment is delivered and removed, and construction materials are delivered. To mitigate these impacts, construction times will be limited in accordance with local by-laws and in addition, it is likely that a new access road will be constructed off of the 6th Line. The need for a traffic impact study will be assessed during final design but it is considered that the long-term impacts will be minimal.

In order to mitigate the impacts to the local community, an established truck route should be selected by the Town.

21.12.2 Noise, Dust and Mud

Potential sources of noise, dust, and vibration include truck traffic and regular construction activities. These impacts can be mitigated as follows:

- Ensuring all vehicles and construction equipment are equipped with effective muffling devices and are operated in a fashion so as to minimize noise in the project area
- Enforcing the local noise by-law for all construction activities including rock blasting
- Restricting all truck traffic, excavation equipment, and other activity that potentially generates significant noise levels to normal working hours
- Excavated soil and rock material should be used on-site as much as possible in order to minimize truck haulage to off-site disposal areas
- Enclosing the backup generator in a building and using sound-dampening insulation
- Dust control agent can be applied as necessary

A noise assessment was completed to outline additional mitigation measures. A summary of that assessment is below.

21.12.3 Noise Assessment

A noise assessment of the impact of the proposed expansion was completed by J.E. Coulter Associates Limited and a report was issued March 2010. The assessment considered locations of proposed noise sources along with points of reception (neighbouring residences). Noise sources included estimated increases in truck traffic as well as proposed noise producing equipment on the LWPCP site. The sound impact of the existing facility was used to establish an acoustical reference. A table showing the sound impact from the proposed sources (including mitigation measures) is included in the report.

The report considered a 50% increase in capacity as well as the proposed future capacity of 40 MLD. For the first expansion, the increased noise, in terms of ambient sound, represents less than a 1 dB increase. For the future capacity of 40 MLD, an approximate 3 dB increase in the ambient sound level is expected.

The report concludes that the capacity increase to 40MLD is projected to have only a slight impact on the future residential receivers to the west, assuming a 100 m buffer zone. It was assumed that all receivers were 1.5 m from the ground. For receivers further from the ground, both ambient and plant sound levels will be slightly higher. The report noted that more specific plans for the future residential development are required to fine-tune the acoustical analysis in the future. This would be part of the detailed design and application for Certificate of Approval. It also noted that more detailed traffic projections are required to more precisely calculate the increase in the ambient sound due to road traffic. It is noted that higher ambient sound levels decrease the impact of the stationary sound emitted by the expanded LWPCP.

The report also included the following recommendations:

- Daytime (0700-1900) sewage truck operations have no impact. Due to the modest tonality of the sound, operation between 7:00 pm and 7:00 am is not recommended.
- A 1MW emergency power generator is proposed to be installed in the inlet building. Slightly better sound attenuation than existing will be required to reduce its sound by 2 dB to protect the houses east of Receiver #2 at the intersection of St. John's Road and the 6^{th} Line.
- The proposed flare burner at the northwest area of the plant, with Class 3 (Rural) receivers nearby, should be the enclosed type to keep its sound power level below 90 dBA. Due to flare, burner stack height mitigation at the source is the best option.
- A vacuum truck periodically (once in a few years, lasting several weeks) removes sludge from the plant and transfers it onto trucks for removal. The report recommends using a truck that creates 109 sound power level or less to prevent a noise impact, assuming that it is feasible to orient the truck so that the sound is directed into the plant. The most sensitive receivers are in a Class 3 (Rural) Area in the vicinity of the northwest area of the plant.
- A 6.4 m sound barrier was modelled for the vacuum truck with only a 2 dB reduction in sound for the receivers 1.5 m off the ground. The report therefore recommends that quieting the vacuum truck, operating it as far as possible from sensitive receivers to the west and orienting it into the central part of the plant to avoid the high 6.4 m sound barrier. It also recommended a further review to establish the best combination of measures.
- The report notes that the plant will require an odour buffer zone that will serve as an acoustical buffer as well. While not very effective, a berm along the north portion of the west perimeter of the plant could be considered as an option, if the soil is readily available as part of the construction process.

A copy of the report is included in Appendix S.

21.12.4 Odour Assessment

An odour assessment was completed by B&V in March 2010. Odour emission rates were modelled for both the existing and proposed facilities. The dispersion modelling was performed using the current sources and measured emissions to establish a base case for the purposes of comparison. The dispersion model was then re-run with the future conditions for the expansion project.

The dispersion modelling for the expansion showed a 0.30 percent decrease in the maximum model-predicted odour impact once the new facilities are completed. This is mainly due to existing sources being upgraded with the new sources and odour treatment being provided. There will be some new odour producing equipment but with the upgrades to the existing, the model predicts that there will be no net increase in off-site odour at the neighbouring residences.

The report also notes that the highest off-site impact would be the existing screw pump source group. It notes that if these areas are covered and treated with activated carbon, the model predicts a 71% decrease in the maximum odour impact to the existing base case conditions.

The report also outlines the following required improvements for the expansion to maintain the current magnitude of off-site impact:

- Cover and treat existing headworks
- Cover and treat existing grit tanks
- Cover and treat new headworks
- Cover and treat new grit tanks
- Anaerobic digester gas treated flare
- Cover and treat fermenters
- Contain and treat TWAS facility

A copy of the Report is included in Appendix T.

The Ministry of the Environment reviewed the Odour Assessment Report and provided comment in a letter dated October 4, 2010. Responses to the Ministry's letter were provided in Addendum # 1 to the Odour Assessment Report. A copy of the Ministry's letter and the Addendum are included in Appendix T.

21.12.5 Fuel Spills

During the refuelling of construction equipment, spills could occur with the potential of contaminating surface water and groundwater. Mitigation measures include:

- Preparing a contingency plan for cleaning up fuel spills
- Only allowing designated areas that are no closer than 15 m to any watercourse for refuelling construction equipment
- Providing spill containment for on-site storage tanks

21.12.6 Continuity of Operation

As the continuing operation of the LWPCP is of utmost importance, careful consideration will be given during the design and construction scheduling to avoid impacts on the plant operation. As an example, the new primary tanks, aeration tanks and secondary clarifiers will be constructed while the existing extended aeration process is in service.

21.12.7 Vegetation and Loss of Tree Cover

The construction will encounter some shrubbery, bushes, and trees, which will need to be removed. Protective fencing will be placed around all trees that are designated to remain, in order to clearly define the construction work area.

Vegetated lands disturbed during construction will either be replanted with natural wild grasses and saplings of trees indigenous to the area (save for areas that require clearing for the LWPCP expansion) or trees will be planted in other areas of the site such as along the property boundaries.

21.13 Opinion on Probable Cost

An opinion of probable capital cost for the short-listed wastewater treatment alternatives is provided in Table 21-11.

Table 21-11 Opinion of Probable Capital Cost for the Short-Listed Wastewater Treatment Alternatives

	25 MLD Expansion (Stage III) Cost to go from 14 to 25 MLD			40 MLD Expansion (Stage IV) Cost to go from 25 to 40 MLD		
	Alt 1 Conventional Activated Sludge + Full BNR	**Alt 2** Extended Aeration	**Alt 3** Conventional Activated Sludge (No BNR)	**Alt 1** Conventional Activated Sludge + Full BNR	**Alt 2** Extended Aeration	**Alt 3** Conventional Activated Sludge (No BNR)
Capital Costs						
Total LWPCP Construction Costs	$75 Million	$66 Million	$73 Million	$49 Million	$52 Million	$47 Million
Engineering Costs	$11 Million	$10 Million	$11 Million	$7 Million	$8 Million	$7 Million
O&M Costs						
Total Annual O&M Cost	$5.2 Million	$5.8 Million	$5.5 Million	$8.4 Million	$9.5 Million	$8.9 Million
NPV of 20 year O&M Cost	$65 Million	$72 Million	$69 Million	$105 Million	$118 Million	$111 Million
Total NPV	**$151 Million**	**$148 Million**	**$153 Million**	**$161 Million**	**$178 Million**	**$165 Million**

Cost Assumptions:

1) Level of estimating accuracy of capital costs is +50% to -30%
2) Capital costs do not include escalation to midpoint of construction
3) Capital costs do not include Engineering, Legal and Administrative Costs
4) All costs are in 2010 dollars
5) The NPV for the 20-year O&M costs is based on a 5% interest rate. The resulting 20-year present worth factor is 12.462

Breakdowns of Capital Cost Estimates are included in Appendix U.

22.0 Public's Principal Concerns

Based on a review of all PIC comments sheets, emails, letters etc, the public's principal concerns are summarized as follows:

- Implementing water conservation programs is considerably less costly that constructing plant upgrades;
- Implementing I and I reduction programs can reduce average daily flow;
- Design per capita demand should be based on historical data;
- MOE requested an Air Quality Impact Assessment (letter dated August 11, 2009 provides suggested approach);
- Resident concerned about odour in the future (does not experience odour now);
- Resident wants noise reduced from sludge trucks;
- Resident concerned about charges that might be passed on to the residents;
- Metis representative wondered if an aerator could be added to the discharge pipe to provide oxygen to the effluent;
- Advisory committee member wondered why servicing to Barrie was not being considered and expressed concern about the cost of servicing lands in the Highway 400 corridor;
- Resident enquired what "controls" will be put in place to prevent exceedances of phosphorous loading to the Lake;
- Advisory committee member enquired about financing plans, and;
- Advisory committee member asked if a "septic inspection program" is included as part of the solution.

In addition, a letter dated July 28, 2010 was received from Ms. Claire Malcomson of Environmental Defence (See Appendix Q). Ms. Malcomson's concerns are summarized as follows:

- "…Environmental Defence believes that any increase in phosphorous loads, from any source, must only take place where it has been demonstrated that a greater load will be offset somewhere else. Innisfil has not demonstrated this." "The Innisfil STP project as presently constituted is, in our respectful submission, a missed opportunity for the Lake."
- "…the public consultation component, has been conducted under the "chill" of tens of millions of outstanding law-suits against residents of Innisfil opposed to the Big Bay Point mega-marina and resort. Completing this EA under these circumstances is unacceptable." "..please explain how the public consultation component of this EA met your Environmental Bill of Rights duty to conduct public consultation in "an open and

consultative process when making decisions that might significantly affect the environment."

- "Water conservation is inadequately addressed in this EA."
- "Until each subwatershed and municipality affected by an STP expansion has a watershed plan it is premature to approve a Phosphorous load increase from any sector. Innisfil's plan is not complete…"
- "Reporting required for the financing ….is unclear."
- "piece-mealing…is not permitted by law" – referring to water supply to Big Bay Point.
- "A septic system inspection program must be in place and operating."
- "Other ideas: compliance reporting which covers progress on subwatershed plan implementation, and/or develop a Community Advisory Committee."

In response to the letter from Environmental Defence, a letter was received from Jeffery P. Shankman, Barrister & Solicitor, representing Kimvar Enterprises. Mr. Shankman provides a response to Ms. Malcomson's assertion that the public consultation was completed under the "chill" of law-suits and a "climate of fear". A copy of the letter is included in Appendix Q.

A formal response letter was sent to Environmental defence on November 26, 2010 and a copy of that letter is also included in Appendix Q.

23.0 Aboriginal Consultation

Aboriginal (First Nations) consultation was provided throughout the Class EA planning process. A summary of First Nations Consultation up to December 3, 2009, was prepared and submitted to the MOE on January 12, 2010. A summary of contacts was also submitted to the Ministry of Aboriginal Affairs under cover of a letter dated September 7, 2010.

The December 2009 summary provides a detailed list of the names of the contacts and any comments made as a result of the consultations. Notices were send to the various contacts for the Notice of Commencement and for each of the three PICs. A meeting was arranged and held with the Metis Nation of Ontario (MNO) on October 22, 2009 (see minutes of meeting in Appendix P). A favourable response to the meeting was received from James Wagner of the MNO (see email dated October 28, 2009 in Appendix P).

Based on a review of the responses received, no issues or concerns were raised by the Aboriginal Communities.

24.0 Design Considerations Resulting from Public and Agency Consultation

Based on input received from members of the public and from review agencies, several design considerations need to be addressed as part of the final design of the plant expansion.

- Implement water conservation measures
- Implement I and I reduction program
- Include identified odour mitigation measures and any other measures that are included in future odour assessments (see Odour Assessment in Appendix T)
- Address noise issues related to operation of the expanded facility (see Noise Assessment in Appendix S)

25.0 Summary of Preferred Servicing Alternative

25.1 General

This section includes a summary description of the LWPCP expansion. The Preferred Alternative for providing wastewater servicing for the Town is a 2-stage (Stages III and IV) expansion of the plant on lands owned by the Town. The Stage III expansion may be needed in 2015 to provide service up to the year 2024 and involves the expansion of the LWPCP to about 25 MLD. It is also recommended that the Stage IV plant expansion be undertaken in approximately 2024 to increase the rated treatment capacity to about 40 MLD to service growth up to about the year 2035. The overall Preferred Alternative is described in detail hereinafter.

25.2 Preferred Servicing Alternative

The key components of the LWPCP expansion are as follows:

<u>Prior to 2015</u>

- Commitment to the completion of a Water Conservation and Efficiency Strategy (WCES), to assess historical water/wastewater conditions and implement a strategy for water efficiency. The WCES is to be completed with implementation prior to June 2, 2014. The WCES shall:
    - o Provide targets for conservation, efficiency, inflow and infiltration reduction to the Lakeshore WPCP;
    - o Provide timelines for achieving the targets, as well as strategies, tactics, programs and initiatives to be used, including the cost to implement these;
    - o Assess methods of achieving conservation measures such as improved management practices, the use of flow restricting devices and other hardware;
    - o Encourage water conservation incentives, education and demand monitoring in an attempt to reduce water consumption;
    - o Aggressively reduce wet weather peak inflow and infiltration rates into the collection system through enhanced system monitoring (flow measurement), system inspections and regular maintenance;
    - o Develop a strict Sewer Use Bylaw along with regular monitoring program;
    - o Assess the feasibility of non-potable effluent reuse/recycling complete with practices and technologies associated with water reuse/recycling; and
    - o Consider the potential impacts of climate change.

    In addition;

    - o The WCES shall include a program for the reduction of inflow and infiltration from the Lakeshore WPCP collection system. This program shall include reduction priorities, targets, timelines, tactics and initiatives, and the associated costs to implement these;

- The Town of Innisfil will consult with the public, relevant government agencies and the Ministry of the Environment's Central Regional Office on its proposed WCES;
- The WCES shall include a review of best in class water conservation and efficiency programs, initiatives, strategies and tactics adopted by other jurisdictions. The review shall include an analysis of best in class tactics/strategies used by other jurisdictions throughout the world. This review shall be made public and shall form part of the consultation process for the WCES, as required above.

Stage III (Expanded Extended Aeration) by 2015 (estimated)

- Headworks – Expansion of the existing headworks with fine screens, new grit vortex chambers, washer/compactor for screenings, grit classifier and odour control. An equalization chamber will also be considered to dampen peak flows from the three forcemains coming into the new headworks. This will be looked at in more detail during the predesign. The plant hydraulics will take into consideration the need for primary clarifiers ahead of the secondaries and the screening channel elevations and grit system will be adjusted accordingly. The Stage III expansion of the headworks will be designed to take into consideration Stage IV requirements and as such, the building will include channels constructed for future screens and future grit vortex chambers.
- Aeration – Construction of an additional three extended aeration basins, each with a volume of 5000 m3 for a total of 25,000 m3 including existing. In order to provide flexibility and thus operate in a partial BNR mode, the aeration basins will include anoxic zones at the inlet end.
- Secondary – There are four existing 26 m diameter secondary clarifiers at LWPCP. In combination with the proposed aeration basin expansion, one additional 26 m diameter clarifier is needed for the Stage III expansion.
- TP Removal /Filtration – Decommissioning of the existing effluent filters and replacement with a new membrane filtration facility. Two chemical addition trains, each consisting of a rapid-mix chamber followed by flocculation, would precede the membrane filtration system. The membrane system would consist of four membrane cells (depending on the final manufacturer selection). A fifth cell (initially not populated with membranes) would be accounted for in the layout to facilitate the future Stage IV expansion to 40 MLD.
- Disinfection – Decommission the existing system and construction of a new low-pressure high intensity UV system downstream of the membrane process.
- Existing Outfall – No upgrades or revisions would likely be required to the existing outfall configuration to accommodate the increase in peak flows. The increased hydraulic

gradient from the elevated tertiary building will provide sufficient head to allow the continued use of the existing outfall.

- Aerobic Digestion and Biosolids Storage – Waste activated sludge is currently sent to the aerobic digesters for stabilization and VSS destruction. Digested sludge is stored in aerated holding tanks. The 25 MLD plant will continue with a similar aerobic digestion process followed by a new 24,000 m^3 biosolids storage tank facility, which will provide the required 240 days of storage.
- WAS/Digested Sludge Thickening – Stage III expansion will incorporate WAS thickening to replace the decanting operation. Two mechanical thickeners (assumed to be rotary drum) will be installed above the digesters. The thickeners will be piped such that WAS can be partially thickened prior to sending it to the digesters. Digested sludge also can be thickened and directed back to the digester (in a recuperative thickening mode) or sent to the biosolids storage tank. The thickeners are expected to produce thickened solids in the range of 3 to 5%. The target solids concentration in the digesters is 2% (per MOE guidelines) and the target solids concentration in the biosolids storage tank will be 2 to 3%. A polymer storage and dosing system would be provided with the thickeners.

<u>Stage IV (Conventional Activated Sludge with Full BNR) by Year 2024</u> (estimated)

- Update the WCES in conjunction with detailed design of the proposed LWPCP Stage IV Expansion, for the water and wastewater flows within the Lakeshore Water and Wastewater Service Areas, based on the monitoring and reporting plan completed between 2014 and 2024.
- Headworks – A fourth screen and third vortex grit chamber will be added to the expanded building from Stage III in order to meet the design flows for Stage IV. The older screens from Stage II will be decommissioned and a third 20 MLD screen will be installed in one of the existing channels. The fourth channel will be used for emergency bypass around the screens.
- Primary Clarifiers – Three 24 m diameter primary clarifiers will be added to the west of the existing aeration tanks and north of the new aeration tanks constructed under Stage III. The settled primary solids (raw sludge) would be pumped to new gravity thickeners prior to anaerobic digestion.
- Conventional Activated Sludge BNR System – With primary clarifiers added upstream from the activated sludge basins, the actual load to the activated sludge system is comparable to that of the Stage III expansion. Therefore, it will not be necessary to increase the aeration basin volume. Under the Stage IV expansion, the capability to operate for full biological nutrient removal would be provided.
- Secondary Clarifiers – Based on the addition of primary clarifiers and using the Stage III activated sludge basin volume, two new 26 m secondary clarifiers will be constructed under the Stage IV expansion

- Tertiary Phosphorus Removal And Filtration – Under Stage IV, the system will be expanded from 25 MLD to 40 MLD. Additional membranes would be added to the four membrane basins constructed under Stage III and a fifth membrane basin would be equipped with membranes.
- Off-Spec Effluent Storage And Equalization – Storage volume be provided to allow off-spec effluent to be stored and retreated if necessary and also be available for equalization and potential optimization of the membrane process operation. Off-spec storage volume of 51,000 m3 is recommended (this is equal to a full day of storage at the maximum month average flow for the 40 MLD plant).
- Disinfection – The Stage IV would be expanded by adding one additional UV disinfection train to the membrane filtration/disinfection building.
- Primary Sludge Thickening – Primary sludge will be pumped from the bottom of the primary clarifiers to two new 14 m diameter gravity thickeners prior to digestion. The gravity thickeners would be sized to allow operation as primary sludge fermenters to produce volatile fatty acids as a food source for biological phosphorus removal. The VFA-rich fermentation would be pumped to the BNR process anaerobic zones. The design thickened sludge solids concentration to the digesters is 5%.
- WAS Thickening – The rotary drum thickeners installed under Stage III will be reused under the Stage IV expansion from 25 to 40 MLD. With the proposed new primary clarifiers and the switch to anaerobic digestion, WAS quantities at 40 MLD plant will be comparable to WAS quantities for the 25 MLD plant (which will operate an extended aeration process without primary clarifiers). The rotary drum thickeners would thicken WAS to approximately 4% solids prior to sending it to the new anaerobic digesters.
- Anaerobic Digestion – Converting to a CAS process will require the aerobic digestion process to be converted to anaerobic digestion. Two circular primary digesters will provide minimum 15 days solids residence time at maximum month sludge loading conditions. A new secondary digester of the same size would also be provided. The existing aerobic digesters that would be decommissioned or reused for another purpose (possibly sludge storage). A digester control building could be constructed to house all associated digester equipment including: mixers, heat exchangers, sludge transfer pumps, gas handling equipment, boiler, etc.
- Biosolids Storage And Dewatering – Under the Stage III project, new liquid biosolids storage volume will be constructed. When the LWPCP expands to 40 MLD, an additional 20,000 m3 will be required to provide 240 days of digested biosolids storage at 2.5 to 3% solids content.
- Biosolids Disposal – Liquid system comprised of thickening the solids to achieve 3-5% total solids, storage of the biosolids in tanks during the winter for the required 240 days, followed by land application during the summer months.
- Existing Outfall – Open all existing currently closed diffuser ports.

26.0 Monitoring Requirements

26.1 Operations monitoring

After expansion activities of the LWPCP and plant acceptance testing are completed, the Town will assume full-time operation of the system. The Town intends to continue monitoring users discharging into the sewer system to ensure that they do not impact plant operation, and additionally, that the Town complies with applicable environmental regulations. For compliance with the MOE CofA's, the Town will put in place a monitoring program that satisfies both the provincial requirements and the plant's operational needs. The LWPCP will have a wastewater laboratory that will provide the necessary information to plant operations for process control, plant effluent quality, and solids quality monitoring to ensure that the plant complies with provincial and municipal requirements. Samplers will be provided to monitor raw and treated wastewater. An annual report will be prepared to document the plant's performance. The Town will monitor effluent quality, as required by the MOE's CofA.

The Town will continue to monitor flows in the collection system in an attempt to locate areas of excessively high inflow/infiltration (high wet weather flows). The Town will continue to rehabilitate the collection system as necessary.

In addition, the Town should review and upgrade its Sewer Use By-Law to limit wastewater flows and parameters from commercial and industrial sources. Such sources should be monitored.

27.0 Approvals/Scheduling Requirements/Future Studies

27.1 Permits and Approvals

The following submissions are to be made during detailed design once sufficient information has been prepared for agency review purposes.

The MOE Certificate of Approval that will be required include:

- C of A (wastewater) – required for all works, to be submitted near completion of design
- C of A (air) – required for emergency power systems for various parts of the LWPCP expansion and requires an air assessment/noise attenuation study in support of the C of A, to be submitted near completion of design.
- C of A Stormwater Management.

Other approvals and permits include:

- Site Plan Approval – required for all works, to be submitted to the Town near completion of design
- Building Permit – to be submitted to the Town prior to the start of construction.

27.2 Implementation Schedule

Based upon the findings within this ESR the following is the approximate dates for the key milestones:

• Posting of ESR for 30-day review:	December 2010
• Minister's denial of Requests for Part II Order	July 2011
• Completion of preliminary design report:	Sept 2011
• Completion of detailed design and approvals:	2012-2103
• Award of contract for construction:	2013-2014
• Completion of Construction	2015-2016
• Completion of WCES	2014

PHASE 4 REPORT

28.0 Notice of Completion

The Notice of Completion was published in the local newspapers on December 3, 2010 and December 10, 2010. The Notice was sent to residents within a 1km radius of the LWPCP. A copy of the Notice and mailing lists are included in Appendix V. The Notice was added to the Town's web site.

Prior to the publication of the Notice of Completion, a Draft version of the ESR was reviewed by the MOE. The Draft ESR was sent to the Ministry on September 17, 2010. The Ministry's comments on the Draft ESR were provided in a letter dated October 29, 2010. The MOE reviewed the November 2010 version of the DRAFT ESR and provided comment in a letter dated January 24, 2011. Copies of both letters are included in Appendix V. All applicable Ministry comments have been addressed in the ESR.

29.0 Requests for Part II Order

On December 24, 2010, a Request for a Part II Order was submitted to the Minister of the Environment by Environmental Defence (letter dated December 24, 2010). Receipt of the Request was confirmed by the Ministry in a letter dated December 31, 2010.

On January 2, 2011, a separate Request for a Part II Order was submitted to the Minister of the Environment by Mr. Jim Roberts, a member of the Innisfil Lakeshore WPCP Class EA Liaison Advisory Committee. Receipt of Mr. Roberts' letter was acknowledged by the Ministry in a letter dated January 14, 2011.

The Ministry of the Environment began immediately to assess the validity of these two Requests and information was provided by the Town to the Ministry as required.

Correspondence was also received by the Ministry of the Environment, disputing the claims made by Environmental Defence and by Mr. Roberts. Letters dated December 14, 2010 and January 6, 2011 were submitted by Susan Rosenthal of Davies Howe Partners, representing Kimvar Enterprises Inc. Ms. Howe suggested that the Requests for a Part II Order contained no sound technical objection to the Town's Class EA. The Ministry confirmed receipt of Ms. Rosenthal's January 6 correspondence in a letter dated January 14, 2011.

In an email dated January 5, 2011 to the Minister of the Environment, Mr. Bill Warnica, a resident of Big Bay Point in Innisfil, requested that "…the ministry ignore the antics of these special interest groups…". He further requested that "…this project go through and hope you have the ability to expedite its completion by denying these special interest groups in their stall tactics." The Ministry confirmed receipt of Mr. Warnica's email in a letter dated January 14, 2011.

In order to respond to the Requests, the Ministry was provided with a copy of the Draft ESR. Through January and March of 2011, Ministry staff required responses from the Town regarding the Class EA process and the Town provided responses in letters dated January 14 and February 8 and in emails dated February 4, February 10 and March 4.

As a result of Ainley letter dated January 14, 2011, Davies Howe Partners wrote to the Minister on January 25, 2011.

A summary of the future actions that need to be taken by the Town as a result of the Ministry's review of the Requests for Part II Order is as follows:

Correspondence	**Future Action by Town**
Ainley letter dated January 24, 2011	• Study the impacts and potential mitigation measures to reduce the effects of surface water run off resulting from urbanization. • Water Conservation and Efficiency Strategy by June 2014 • Confirm effluent requirements and if there are any revisions to what is proposed, reassess the assimilative capacity of Lake Simcoe • Completion of a Town wide Master Servicing Plan • Reassessment of historical flows during final design
Ainley letter dated February 8, 2011	• Flow monitoring program to assess feasibility of reducing I & I – ongoing inspections • Completion of Master Servicing Plan
Ainley email dated February 10, 2011	• Town will continue to monitor emerging technologies and best management practices and will incorporate where possible

Following its review of all of the information and documentation, the Ministry of the Environment concluded "…that an individual EA is not required". That decision was confirmed in a letter dated July 12, 2011.

Copies of all of the correspondence related to the Requests for Part II Order are included in Appendix V.

30.0 Recommendations and Conclusions

Considering all of the information provided in this ESR, it is recommended that:

- The Town proceed with the planning and implementation of a Water Conservation and Efficiency Strategy in conformance with the Lake Simcoe Protection Plan and in accordance with the Minister's letter dated July 12, 2011;

- The Town undertake a program to investigate the sanitary sewer system in order to reduce the wet weather flows to the plant;

- The Town complete the design of the Stage III expansion including obtaining all applicable approvals for an expansion of the existing WPCP to 25 MLD as outlined in this ESR;

- The Town complete the construction of the Stage III expansion in approximately 2015, and;

- The implement any mitigation measures associated with both the construction and the operation of the plant expansion.

This ESR concludes that an expansion of the Innisfil WPCP to meet future growth is feasible and that the technology exists to be able to meet the reduced TP loading as required by the Phosphorus Reduction Strategy.