The Town of Petrolia
Waste Management of Canada

CLASS ENVIRONMENTAL ASSESSMENT FOR WASTEWATER TREATMENT AND LANDFILL LEACHATE MANAGEMENT

TECHNICAL MEMORANDUM NO. 2 DEVELOPMENT AND EVALUATION OF ALTERNATIVE SOLUTIONS

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1. INTRODUCTION

1.1 BACKGROUND

The Town of Petrolia is situated within the County of Lambton, located in South Western Ontario.

Petrolia owns a wastewater treatment plant (WWTP) that services the properties within the Town. It is an extended aeration facility with tertiary filtration and ultraviolet disinfection, with a rated capacity of 3,800 m^3/d, discharging effluent to Bear Creek. The plant was originally constructed in 1975 and has undergone several improvements since that time. However, because most of the processes and structures are more than 35 years old, the plant requires major upgrades. Major tank processes do not provide adequate capacity to treat the Certificate of Approval rated flow and many of the plant processes continue to use equipment that is well past its useful life.

In addition to the major upgrades required, the Petrolia WWTP is operating at approximately 80% of its rated capacity, with flows in some months averaging between 85% and more than 100%. Recent growth and planning studies indicate that growth in the area within the next 25 years will require expansion of the plant capacity.

The Petrolia Landfill, also located within the Town, is owned and operated by Waste Management of Canada Corporation (WM). The site currently uses 26.02 hectares of land for disposal of municipal, industrial, commercial and institutional solid non-hazardous waste. Included in the Landfill are a gas management system for the collection of landfill gas and a leachate collection system. The leachate is currently hauled by truck to a number of alternative municipal treatment facilities. The landfill gas is utilized for electrical generation.

Since the Petrolia Landfill is located less than 1 km from the Petrolia wastewater collection system and approximately 2.5 km from the Petrolia WWTP, there is an opportunity to direct leachate through the wastewater collection system or a dedicated pipe from the landfill to the Petrolia WWTP for treatment. This would significantly reduce or eliminate the number of trucks, hauling distance and corresponding greenhouse gas emissions associated with the leachate disposal.

Currently the Petrolia WWTP does not have capacity or reliability to accept the additional loadings from the Petrolia Landfill leachate.

The Town of Petrolia and Waste Management of Canada are seeking the most environmentally sound and cost-effective solution to manage their wastewater and leachate and one solution that shows significant promise is to co-treat leachate with wastewater at the Petrolia WWTP. Completion of a Class Environmental Assessment (EA) study to plan for the management of wastewater and leachate will provide a sound, thorough approach evaluating a full range of solutions to identify preferred solutions for the Town and Waste Management, considering all potential environmental, community and cost impacts. This Schedule C Class EA is being undertaken to plan for the expansion of the Petrolia WWTP to meet growth needs in the Town, and to plan for long term management of the Petrolia Landfill leachate.

1.2 PURPOSE OF MEMO

The purpose of this memo is to present alternative solutions for the management of wastewater at the Petrolia WWTP, and the management of leachate from the Petrolia Landfill, for the planning period to the year 2041. This memorandum represents activities completed under Phase 2 of the Class Environmental Assessment study.

Information for each alternative is developed to enable a comparative evaluation that reflects environmental protection, community impacts and economic impacts. Preferred solutions are recommended, and rationale for the recommendations are presented

2. DESIGN CRITERIA

2.1 WASTEWATER FLOWS AND LOADINGS

Wastewater flows to the Petrolia WWTP and population projections for the year 2041 were presented in Technical Memorandum No. 1 (TM1). From these data, peak day and peak instantaneous factors were calculated and used to determine the 2041 design flows to the Petrolia WWTP. These criteria are presented in Table 1.

Table 1 Wastewater Design Flows for the Petrolia Service Area and Peak Flow Factors for 2041

Flow Parameter	Peak Factor (Flow Parameter/Average Flow)	Flows (m^3/d)
Monthly average	1	5,123
Peak day	2.7[1]	13,833
Peak instantaneous	4.0[2]	20,492

Notes:
1 Calculated from the maximum day flow of 8,126 m^3/d and average day flow of 3,028 m^3/d for data from 2008 to 2010.
2 Based on typical values presented in figure 3-13 from Metcalf & Eddy (2003) for a 2041 population of 9,200.

Wastewater design concentrations were also presented in TM1. Design loadings for the year 2041 were calculated using these concentrations and the anticipated monthly average flow of 5,123 m^3/d. The design concentrations and loadings for the 2041 monthly average flow are presented in Table 2.

Table 2 Wastewater Design Concentrations and Loadings for 2041

Parameters	Design Concentrations (mg/L)	2041 Average Monthly Flow (m^3/d)	2041 Design Average Loadings (kg/d)
Biochemical oxygen demand (BOD_5)	226	5,123	1,158
Total Kjeldahl nitrogen (TKN)	37.6		193
Total suspended solids (TSS)	199		1,020
Total phosphorus (TP)	5.6		28.7

These design flows and loadings were used to estimate sizing and costs of the Petrolia WWTP upgrades and expansion presented in the following sections.

2.2 LEACHATE FLOWS AND LOADINGS

Historic leachate flows were presented in TM1, with the monthly average flow based on monthly leachate haulage volumes from 2008 to 2011, while the maximum daily and weekly hauled leachate volumes were based on daily leachate haulage volumes for 2010 and 2011; however, leachate was not hauled every day. The maximum weekly hauled leachate volume is a more

reasonable value to use to determine a design leachate loading when considering treatment of leachate at the Petrolia WWTP.

Leachate flows are presented in Table 3.

Table 3 Leachate Design Flows

Parameter	Volume of Leachate Hauled
Monthly Average Flow (m^3/d)[1]	68
Maximum Daily Hauled Leachate Volume (m^3/d)[2]	239
Maximum Weekly Hauled Leachate Volume (m^3/d)[2]	140

Notes:
1 Based on monthly leachate haulage volumes from 2008 to 2011 provided by Waste Management.
2 Based on daily leachate haulage volumes from 2010 to 2011 provided by Waste Management; however, leachate was not hauled every day.

A leachate sampling program was initiated in October 2011 to characterise the quality of the leachate, as limited historic data were available. A detailed review of results as of December 28, 2011 was presented in the Leachate Sampling Program Update. The leachate design concentrations and loadings are presented in Table 4.

Table 4 Leachate Design Concentrations and Loadings

Parameters	Average Concentration (mg/L)	Average Design Loadings at a Flow of 68 m^3/d (kg/d)	Design Maximum Week Loadings at a Flow of 140 m^3/d[1] (kg/d)
BOD_5	590	40	83
COD (Chemical Oxygen Demand)	1,571	107	220
Ammonia-Nitrogen	947	64	133
TKN	1,034	70	145
TP	1.21	0.08	0.17
TSS	33.8	2.3	4.7
Alkalinity (mg/L as $CaCO_3$)	2,758	188	386

Notes:
1 Determined from daily leachate haulage volumes from 2010 and 2011.

Leachate design flows and loadings were used to develop size and costs for the upgrades and expansion required for various alternatives that include treating leachate at the Petrolia WWTP.

Waste Management anticipates that the volume of leachate generated at the Petrolia Landfill will decrease into the future. It is expected that the Landfill will close in 2012 and leachate generation will begin to decrease from 20,000 m^3 to 5,000 m^3 in 2020, at which point it will continue to be generated at about 5,000 m^3 per year up to the end of the planning period in 2041. The closure of the Petrolia Landfill has been delayed in the past, therefore in an effort to be conservative a second scenario is proposed where the landfill closure is delayed by 3 years to 2015.

Figure 1 shows the decrease in the yearly generated leachate volumes for the estimated closure date of 2012 (minimum scenario) and the conservative closure date of 2015 (maximum scenario). These yearly leachate volumes were used to estimate the life-cycle operating costs for the leachate management options for the 27 year planning period.

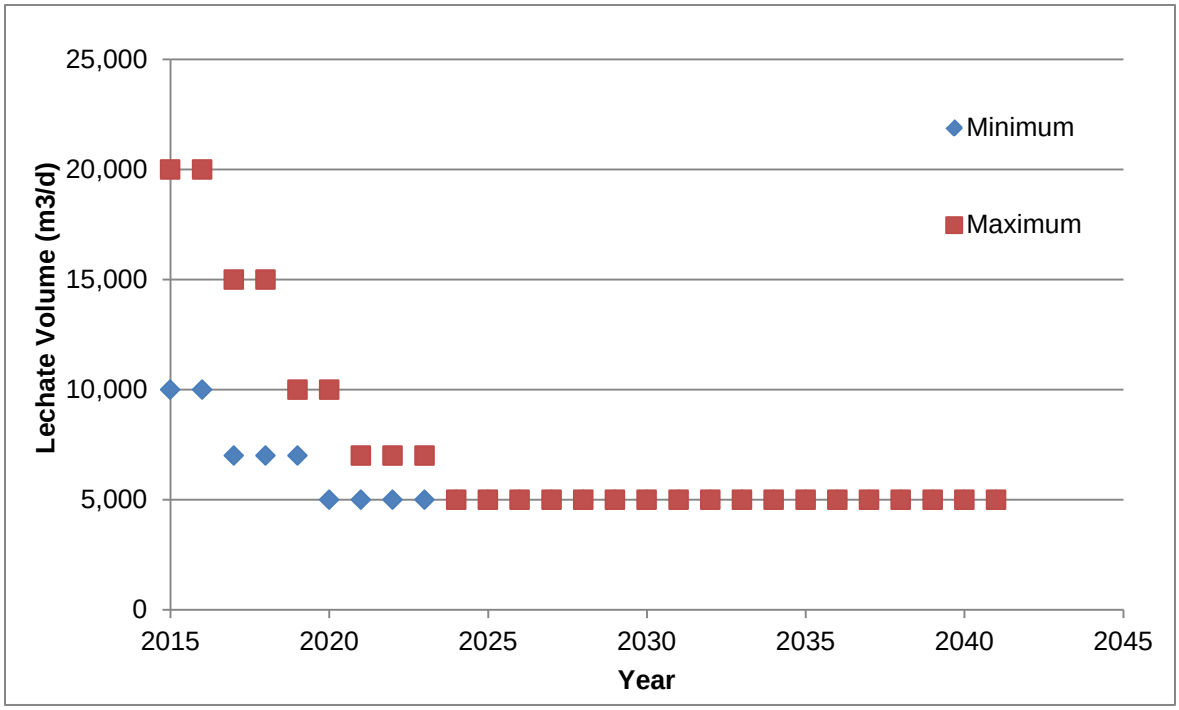

Figure 1 Projected Yearly Leachate Volume Generated at the Petrolia Landfill from 2012 to 2041

3. METHODOLOGY

Table 5 presents the basis for calculations used to assess design requirements, cost and other environmental impacts associated with each alternative solution.

Table 5 Basis of Calculations to Develop Alternative Solutions

Item	Factor	Basis/Source
Petrolia WWTP Design Requirements	Process capacity sizes for plant processes	• MOE Design Guidelines for Sewage Works (2008) • Historical flow and loading data to plant
Capital Cost	Capital costs for treatment processes, pumping and linear infrastructure (general)	• Based on typical costs for recently tendered similar projects • Allows contingency at design concept phase – cost estimates will be refined during Phase 3 of the Class EA
	Capital cost for treatment of leachate at Petrolia WWTP	• Based on prorated capital cost (taking into account an economy of scale) of expanding key processes (aeration tank, aeration system, biosolids management) due to incremental loading from leachate
Net Present Value Operating Costs	Net present value (NPV) operating costs (general)	• Based on 27 year life-cycle from 2015 to 2041 • Based on annual rates of inflation at 2% and interest at 4%
Operating Costs	Leachate flows	• Data provided by Waste Management • Minimum scenario based on landfill closure in 2012 • Maximum scenario based on landfill closure in 2015
	Leachate haulage to alternate wastewater treatment plants outside of Petrolia	• Based on 33,000 liters of leachate per truckload estimated from daily leachate hauling data • Based on $0.0119 per L for haulage • Estimated average round trip of 180 km • Based on additional $0.0124 per L for treatment • Data provided by Waste Management
	Leachate haulage (to Petrolia WWTP)	• Using existing costs, above, and based on 20% of existing cost ($0.0024) being a fixed cost for loading/unloading, and 80% being a per kilometer cost ($1.74 per km) • Estimated round trip to Petrolia WWTP of 12 km
	Leachate treatment at Petrolia WWTP	• Based on cost of wastewater treatment from Town's agreement with OMI, prorated from a $ per L cost to a $ per unit of oxygen demand (because leachate is low volume but concentrated), including a 10% allowance (refer to text below) • Estimated cost is $0.00504 per L[1]
Greenhouse Gas Emissions	For leachate haulage	• Calculated using Urban Transportation Emissions Calculator, or UTEC, version 3.0 (2011) from Transport Canada to determine carbon dioxide equivalents (CO_2e). • Conversion factor of approximately 0.87 kg CO_2e/km for heavy-duty commercial vehicles was used for haulage

Note:

1. Capital and operating costs for Waste Management to utilize the Petrolia WWTP and collection system are estimated for the purposes of evaluating options. Actual costs will be negotiated between the Town of Petrolia and Waste Management.

The estimated cost for treating leachate at the Petrolia WWTP was based on the oxygen demand required to treat BOD_5 and TKN, because although the leachate has a low flow, it has high BOD_5 and TKN concentrations resulting in high loadings, as shown in Table 4. In calculating treatment costs at the Petrolia WWTP, the Agreement for Operations, Maintenance and Management Services for the Petrolia WWTP (2009) between the Town and CH2M Hill - OMI was used as a baseline annual cost to the Town of Petrolia for wastewater treatment, totalling $371,271 per year for 2009. From this, a cost of $121.57 kg O_2/d was calculated using historic plant data (2008 to 2010) for BOD_5 and TKN loadings of 679 and 113 kg/d respectively. Using this treatment rate per kg O_2/d and a 10% markup, a treatment cost for leachate at the Petrolia WWTP was calculated.

4. DEVELOPMENT AND SCREENING OF ALTERNATIVE SOLUTIONS FOR WASTEWATER TREATMENT

Four options were considered in determining the future of Petrolia's wastewater management. These options are listed in Table 6 and the following sections discuss each option and their potential.

Table 6 List of Petrolia Wastewater Management Options

Option	Option	Description
1	Do Nothing[1]	• No change to the existing Petrolia WWTP
2	Limit Community Growth[1]	• Upgrade of the existing Petrolia WWTP • No expansion of the existing Petrolia WWTP
3	Expansion and Upgrade of the Petrolia WWTP on the Existing Site	• Upgrade of the existing Petrolia WWTP • Expansion of the existing Petrolia WWTP to provide capacity for growth in the Town
4	Construction of a New Wastewater Treatment Plant on a New Site	• Upgrade of the existing Petrolia WWTP • Construction of a new wastewater treatment plant to provide capacity for growth in the Town

Notes:
1 These solutions are required to be considered by the Municipal Class EA.

4.1 DO NOTHING

Option 1 for the Petrolia WWTP is to do nothing. For this option, the Petrolia WWTP would continue to operate in its current state. A physical condition and capacity assessment of the Petrolia WWTP completed by CIMA in August 2011(included in TM1) showed that there are many deficiencies that pose a risk to reliable plant operation and performance, and operator health and safety. The plant is operating at about 80% of its rated capacity, with flow in some months exceeding 100% of the rated capacity. Some of the individual plant processes do not have adequate capacity to maintain reliable performance at current flow or the rated design capacity.

With the expected growth of the Town, the result of doing nothing would be non-compliance due to growth and an increased risk of process failure. Option 1 is not a feasible alternative and was not considered further.

4.2 LIMIT GROWTH

Option 2 for the Petrolia WWTP is to limit the growth in the Town and maintain the current wastewater flows by preventing any population increase. Upgrades to various plant processes and equipment would still be required in order to improve plant performance and reliability, but there would be no need for expansion.

Since the existing plant does not provide adequate reliable capacity for rated flows and the County of Lambton's Official Plan for growth is projecting a population increase, this option would not meet performance and capacity requirements, and was not considered further.

4.3 EXPANSION AND UPGRADE OF THE PETROLIA WASTEWATER TREATMENT PLANT

Option 3 for the Petrolia WWTP is to complete upgrades to address deficiencies and expand the plant to provide for planned growth. For this alternative, the Town would complete the necessary upgrades to existing structures, equipment and processes and construct the additional process works required to increase the plant capacity. Land is available for expansion within the existing Town-owned plant site.

The result of the upgrades and expansion would be a more reliable plant capable of servicing the Town of Petrolia and its expected growth to the year 2041 and beyond. This solution was carried forward as feasible within Phase 2 of the Class EA.

4.4 CONSTRUCTION OF A NEW WASTEWATER TREATMENT PLANT

Option 4 for the Petrolia WWTP would be to construct a new wastewater treatment plant to treat some or all of the existing and planned flow from the service area. This option would require identification of a new site through an extensive Class EA process, and acquisition of land for the new plant. New collection and pumping infrastructure would be required to direct flow to a new site.

The potential delays for the Class EA and land acquisition, as well as the cost for a new plant, pumping and collection system make the construction of a new wastewater treatment plant an infeasible solution for the Town and was not considered further.

4.5 RATIONALE FOR SELECTION OF PREFERRED SOLUTION

Based on the descriptions above, the only feasible solution available for servicing existing and future growth from the Petrolia WWTP service area for the planning period is the upgrade and expansion of the current facilities. Rationale for this recommendation is highlighted as follows:

- This alternative would address existing deficiencies at the plant, which contribute to risks to performance, compliance and operator health and safety, while also providing capacity to accommodate growth.
- There is room for upgrade and expansion of the plant on the existing site.
- The ‘do nothing’ alternative would not address existing deficiencies.
- The ‘limit growth’ alternative would not provide capacity for growth projected in the County Official Plan.
- The ‘new plant’ alternative would have significantly higher capital cost and an extended planning and implementation period than the preferred alternative, and because the existing site has capacity for expansion, it does not make sense to pursue this solution.

4.6 DESCRIPTION OF PREFERRED SOLUTION

4.6.1 Effluent Criteria

CIMA completed an Assimilative Capacity Study (2012) to present rationale for the effluent criteria of the upgraded and expanded Petrolia WWTP and to assess the impacts of these discharges on the receiving water, Bear Creek. Table 7 presents recommended effluent criteria for the expanded plant. These criteria are preliminary, and will be confirmed through discussion with the Ministry of the Environment during the Class EA.

Table 7 Recommended Certificate of Approval Effluent Objectives and Limits for the Upgraded and Expanded Petrolia WWTP[1]

Parameters	Effluent Objectives		Effluent Limits[2]	
	Concentration (mg/L)	Waste Loading (kg/d)	Average Concentration (mg/L)	Average Waste Loading (kg/d)
5 Day Biochemical Oxygen Demand ($CBOD_5$)	5.0	25.6	10.0	51.2
Total Ammonia Nitrogen				
May 1 – Nov. 30	2.0	10.2	3.0	15.4
Dec. 1 – Apr. 30	4.0	20.5	6.0	30.7
Total Suspended Solids (TSS)	5.0	25.6	10.0	51.2
Total Phosphorous (TP)	0.37	1.9	0.74	3.8
E. Coli (Apr. 1 – Nov. 30)	150 organisms / 100 ml		200 organisms / 100 ml	
pH (at all times)	6.5 – 8.5		6.0 – 9.5	

Notes:
1 Based on a monthly average flow of 5,123 m^3/d.
2 Monthly average concentrations and loadings shall not exceed the effluent limits.

The plant will continue to have requirements for tertiary phosphorus removal, as well as a year round nitrification.

4.6.2 Headworks

The existing headworks facility consists of a manually cleaned coarse bar rack and a mechanically cleaned step-screen with a peak rated capacity of 6,000 m^3/d which is less than current peak flows at the plant. The headworks is hydraulically limited and bypassed on a regular basis.

The existing aerated grit chamber has a volume of 25.5 m^3 with a detention time of 2.4 minutes, the low end of the MOE Design Guidelines for Sewage Works (2008) of 2 to 5 minutes. The current design is poor, and in consideration of the inadequate screen capacity and poor overall condition, it is recommended that the entire headworks facility be replaced.

The new headworks facility will have a peak rated capacity of 20,492 m^3/d with coarse and fine screens, and a new grit removal system with screenings and grit conveyance.

4.6.3 Aeration Tanks

The existing aeration tanks have a total volume of 2,388 m^3, providing a solids retention time (SRT) of 12 days at current average flow and 9 days at the rated plant capacity, compared to a minimum of 15 days in the MOE Design Guidelines for Sewage Works (2008). Historically, the 12 day SRT has provided sufficient year round nitrification; however, as the flows increase the retention time will shorten, and additional aeration capacity will be required.

Using the MOE Design Guideline for Sewage Works (2008) for a SRT of 15 days, a volume of approximately 5,000 m^3 will be required to achieve sufficient year round nitrification in the year 2041. This will require an additional volume of approximately 2,600 m^3.

4.6.4 Oxygenation

Oxygenation is currently supplied by mechanical aerators and self-aspirating jet aerators. The mechanical aerators are approaching 35 years old and operating beyond their normal service life. The current oxygenation capacity does not meet the requirements of historic peak oxygen demands. It is recommended that a new aeration system replace all existing oxygenation equipment.

4.6.5 Secondary Clarifiers

Two square secondary clarifiers currently provide a settling surface area of 288 m^2, which is sufficient for the current plant design flow. Square clarifiers typically do not perform as well as circular or rectangular clarifiers. The sludge collection mechanisms are in poor condition and the scum collectors are not functional. Existing RAS piping is approaching 35 years and buried piping is corroding and with increasing flows, additional capacity will be required to treat 5,123 m^3/d.

The MOE Design Guidelines for Sewage Works (2008) requires a solid overflow rate of 40 m^3/m^2d, thus a surface area of 512 m^2 would be required for future flows into the year 2041. This will require an additional surface area of approximately 220 m^2.

4.6.6 Tertiary Filtration

Tertiary filtration is currently achieved using a traveling bridge sand filter and mechanism which is beyond its normal service life and is almost 35 years old. The existing filter area is 31.8 m^2 and the current hydraulic loading rate exceeds the MOE Design Guidelines for Sewage Works (2008). It was determined that a filtration area of approximately 113 m^2 is required for 2041 flows.

Use of a smaller surface area will be evaluated in phase 3 of the Class EA when developing the conceptual design, since an equalization tank is available to buffer flow prior to filtration and disinfection.

4.6.7 UV Disinfection

The existing UV disinfection system was installed in 1995 and is in good overall condition. In combination with the existing equalization tank, this system has adequate capacity to disinfect the peak design flow to the Petrolia WWTP.

4.6.8 Biosolids Handling

Existing sludge holding tanks use coarse bubble spargers fed by two blowers, but much of the system is broken, corroded or seized and needs to be replaced.

4.6.9 Phosphorous Removal

The current phosphorous removal system consists of an outdoor chemical storage tank surrounded by a concrete secondary containment area and a chemical feed pump in a dedicated

room within the administration building. A secondary containment area is required in the pumping room to meet Code and upgrades to the pumping system are required.

4.6.10 Electrical & Controls

A single MCC currently provides power to all unit processes, but it is almost 35 years old. There is no stand-by power, SCADA or automation available for critical processes and key equipment. Thus the MCC replacement and a new standby power facility are required. SCADA and automation for key equipment are also proposed to provide better monitoring and control of all plant unit processes.

4.6.11 Miscellaneous

Many miscellaneous repairs are required to address a number of structural and architectural deficiencies such as tank leaks, spalling, etc.

4.6.12 Capital Cost

The estimated capital cost to upgrade and expand the Petrolia WWTP to address deficiencies is $22.5 million allowing for 35% contingency and 15% engineering. The estimated costs associated with the upgrades required to each major plant process are outlined in Table 8. These costs will be refined as the conceptual design is developed in Phase 3 of the Class EA.

Table 8 Upgrade and Expansion Costs for the Petrolia WWTP

Process	Estimated Capital Cost
Headworks	$ 3,100,000
Aeration Tanks	$ 2,600,000
Oxygenation	$ 2,400,000
Secondary Clarifiers	$ 1,100,000
Tertiary Filtration	$ 4,000,000
Biosolids Handling Volume	$ 400,000
Phosphorous Removal	$ 100,000
Electrical & Controls	$ 1,000,000
Miscellaneous	$ 300,000
Subtotal	**$ 15,000,000**
Contingency 35%	$ 5,250,000
Engineering 15%	$ 2,250,000
Total	**$22,500,000**

5. DEVELOPMENT AND SCREENING OF ALTERNATIVE SOLUTIONS FOR LEACHATE MANAGEMENT

5.1 DEVELOPMENT OF SOLUTIONS FOR LEACHATE MANAGEMENT

Four options were considered for future treatment of leachate from the Petrolia Landfill. These options are listed in Table 9. The following sections present a description of these options.

Table 9 List of Leachate Management Options

Option	Option	Description
1	Do Nothing[1]	• Continue to haul leachate for treatment at various alternative wastewater treatment facilities
2	Haul Leachate to the Petrolia WWTP	• Haul leachate to the Petrolia WWTP for treatment
3	Discharge Leachate to the Petrolia Sewage Collection System	• Build a pumping station at the Petrolia Landfill • Install a forcemain to connect the Petrolia Landfill to the Petrolia sewage collection system
4	Discharge Leachate Directly to the Petrolia WWTP	• Build a pumping station at the Petrolia Landfill • Install a forcemain to connect the Petrolia Landfill directly to the Petrolia WWTP

Notes:
1 This solution is required to be considered by the Municipal Class EA.

5.2 OPTION 1: DO NOTHING

5.2.1 Description

Option 1 for the management of leachate from the Petrolia Landfill is to do nothing. For this alternative, leachate would continue to be hauled by truck from the Petrolia Landfill to various alternate wastewater treatment facilities.

5.2.2 Infrastructure Required

No infrastructure is required for Option 1.

5.2.3 Environmental Impacts and/or Risks

5.2.3.1 Greenhouse Gases

The primary environmental impact associated with Option 1 is greenhouse gas emissions associated with hauling the leachate to alternative wastewater treatment facilities. Based on the average distance to the sites in and around London, Ontario, a round trip would average 180 km. Greenhouse gas emissions for Option 1 are presented in Table 10.

Table 10 Greenhouse Gas Emissions for Leachate Management Option 1: Haul Leachate to Alternative Wastewater Treatment Facilities

Parameter	2011 Value
Round Trip (km)	180
Yearly Loads Hauled (#)	723[1]
Yearly Kilometers (km)	130,140
Yearly Greenhouse Gas Emissions (t CO_2e)	113.4[2]

Notes:
1 Based on 23,851,492 liters of leachate for 2011 provided by Waste Management.
2 Based on 0.87 kg CO_2e/km derived from the Transport Canada UTEC version 3 (2011).

5.2.3.2 Surface Water Protection

The primary risk to surface water and land is a leachate spill during transport. Other risks are minimal based on sufficient capacity being available for treatment of the Petrolia Landfill leachate at the alternative wastewater treatment destinations.

5.2.3.3 Construction

There are no construction activities required for Option 1.

5.2.4 Community Impacts

5.2.4.1 Truck Traffic

An average of 2 truckloads of leachate would be hauled per day. The truck route is along the outskirts of Petrolia, and on Highway 402, and therefore, would not have a significant impact on the community of Petrolia. Trucks may need to travel through residential communities and businesses to reach the destination treatment facilities.

It is anticipated that leachate volumes will decrease in the future requiring less than 1 truck per day to haul leachate by 2041.

5.2.4.2 Construction

There are no construction activities required for Option 1.

5.2.4.3 Odour

Odour is not expected to be a concern to the Petrolia community, as the truck loading will continue to be at the Petrolia Landfill and the unloading at the destination wastewater treatment facilities.

5.2.5 Costs

5.2.5.1 Capital Cost

There is no capital cost associated with Option 1.

5.2.5.2 Operating Cost

The primary operating costs for Option 1 are hauling and treating the leachate at alternative wastewater treatment facilities. The current and estimated 2041 operating costs for Option 1 are outlined in Table 11.

Table 11 Annual Operating Costs for Leachate Management Option 1: Haul Leachate to Alternative Wastewater Treatment Facilities

Item	Cost in 2011 (in 2012 $)	Cost in 2041 (in 2012 $)
Total Leachate (L)	23,851,492[1]	5,000,000[1]
Loads Hauled	723	152
Distance Hauled (km)[2]	130,140	27,360
Haulage Cost	$ 283,833	$ 59,500
Treatment Cost	$ 295,759	$ 62,000
Total Cost[3]	**$ 600,000**	**$ 100,000**

Notes:
1 Based on data provided by Waste Management.
2 Based on a 180 km round trip.
3 Costs rounded to the nearest $100,000.

Waste Management anticipates that the volume of leachate produced at the Petrolia Landfill will decline in the future as shown in Figure 1. The 27-year NPV operating cost for hauling and treating leachate is estimated between $2.9 and $4.1 million in 2012 dollars. These costs are presented in Table 12.

Table 12 NPV Operating Costs of Lechate Management Option 1: Haul Leachate to Alternative Wastewater Treatment Facilities

Cost Item	27 Year Net Present Value (in 2012 $)	
	Minimum	Maximum
Haulage	$ 1,400,000	$ 2,000,000
Treatment	$ 1,500,000	$ 2,100,000
Total[1]	**$ 2,900,000**	**$ 4,100,000**

Notes:
1 Costs rounded to the nearest $100,000.

5.2.5.3 NPV Cost

Since there is no capital cost associated with Option 1, the 27-year NPV cost for Waste Management is estimated between $2.9 and $4.1 million in 2012 dollars, to continue hauling leachate to alternative wastewater treatment facilities.

5.3 OPTION 2: HAUL LEACHATE TO THE PETROLIA WWTP

5.3.1 Description

Option 2 for the management of leachate from the Petrolia Landfill is to haul the leachate by truck to the Petrolia WWTP. Trucks are required to travel through residential communities in order to reach the plant located on Maude Street.

The leachate has high concentrations of BOD_5 and TKN therefore loadings to the Petrolia WWTP would be significant, as was presented previously in Table 4, thus additional capacity would be required to accommodate leachate, including an equalization tank and pumping on site to allow a controlled leachate feed to the plant.

5.3.2 Infrastructure Required

Additional aeration, oxygenation and secondary clarifier capacity at the Petrolia WWTP is required to treat the leachate BOD_5 and TKN loadings. At the plant, a holding tank will be required for the trucks to unload into. This tank will also serve to buffer leachate flow to the process, since the leachate will need to be equalized and bled into the plant, to minimize impacts of the high strength loadings.

5.3.3 Environmental Impacts and/or Risks

5.3.3.1 Greenhouse Gases

For Option 2 the traveling distance would be approximately 6 km from the Petrolia Landfill to the Petrolia WWTP, resulting in a round trip of 12 km. Greenhouse gas emissions are estimated at 7.6 t CO_2e in 2012, decreasing to 2041, as presented in Table 13.

Table 13 Greenhouse Gas Emissions for Leachate Management Option 2: Haul Leachate to the Petrolia WWTP

Parameter	Value
Round Trip (km)	12
Yearly Loads Hauled (#)	723
Yearly Kilometers (km)	8,676
Yearly Greenhouse Gas Emissions (t CO_2e)	7.6[2]

Notes:
1 Based on 23,851,492 liters of leachate for 2011 provided by Waste Management.
2 Based on 0.87 kg CO_2e/km derived from the Transport Canada UTEC version 3 (2011).

5.3.3.2 Surface Water Protection

The Petrolia WWTP would need to be expanded and upgraded to accommodate the Landfill leachate. The leachate would be stored on site in an equalization tank so that the leachate could be bled in on a continuous basis or flow could be stopped if there was ever an upset in plant operation. There would be minimal addition to effluent loads or impact on effluent quality because the leachate flow is small and capacity would be provided to treat the leachate.

There is a risk of leachate spill during transport or unloading. Impacts would be mitigated through normal safety procedures.

5.3.3.3 Construction

Construction required at the Petrolia WWTP for leachate treatment would be a small component of the overall Petrolia WWTP upgrades and expansion process. Environmental risk during construction for the plant and leachate works would be mitigated through good construction practices.

5.3.4 Community Impacts

5.3.4.1 Truck Traffic

The main community impact associated with hauling leachate to the Petrolia WWTP is truck traffic, with the truck load requirements described in Option 1. The blue route is approximately 6 km, the red route is approximately 8 km and the yellow route is approximately 11 km. Even though the trucks have a short travel distance, these vehicles would need to travel through residential areas of Petrolia to reach the plant, as shown in Figure 2.

Figure 2 Potential Routes for Hauling Leachate to the Petrolia WWTP

Regardless of the route selected, the truck traffic through the centre of Petrolia WWTP would increase community health and safety risks and may result in noise and odour concerns to affected residents and businesses.

5.3.4.2 Construction

The additional construction requirements for leachate treatment, relative to the overall Petrolia WWTP upgrade and expansion projects, are not anticipated to be significant. During construction, procedures for noise and dust control, working hours for construction, and other normal procedures, will be implemented to minimize impacts to the community during construction.

5.3.4.3 Odours

In addition to the odours related to hauling through the community, there may be a risk of odour release during unloading of the leachate at the Petrolia WWTP. Unloading facilities will be design to minimize the exposure of leachate odours to the environment.

5.3.5 Costs

5.3.5.1 Capital Cost

The additional Petrolia WWTP upgrade and expansion requirements and costs to accommodate leachate are presented in Table 14. The total capital cost is estimated between $0.9 and $1.4 million.

Table 14 Petrolia WWTP Upgrade and Expansion Requirements and Cost for Leachate Management Option 2: Haul Leachate to the Petrolia WWTP

Process	Estimated Capital Cost	
	Minimum	Maximum
Aeration Tanks Volume	$ 100,000	$ 250,000
Oxygenation	$ 300,000	$ 500,000
Secondary Clarifiers	$ 10,000	$ 10,000
Leachate Equalization Tank & Pumping	$ 170,000	$ 170,000
Subtotal	**$ 580,000**	**$ 930,000**
Contingency 35%	$ 203,000	$ 325,500
Engineering 15%	$ 87,000	$ 139,500
Total[1]	**$ 900,000**	**$ 1,400,000**
Notes: 1 Costs rounded to the nearest $100,000.		

5.3.5.2 Operating Cost

Operating costs associated with Option 2 include leachate transportation and treatment costs at the Petrolia WWTP. The current and estimated 2041 costs are presented in Table 15.

Table 15 Annual Operating Costs for Leachate Management Option 2: Haul Leachate to the Petrolia WWTP

Haulage	2011 (in 2012 $)	2041 (in 2012 $)
Total Leachate (L)	23,851,492[1]	5,000,000[1]
Loads Hauled	723	152
Distance Hauled (km)[2]	8,676	1,824
Haulage Cost	$ 62,738	$ 15,072
Treatment Cost[3]	$ 100,720	$ 25,180
Total Cost[4]	**$ 150,000**	**$ 40,000**

Notes:
1 Based on data provided by Waste Management.
2 Based on a 12 km round trip.
3 Based on flow data from Figure 1 and concentration data from Table 4.
4 Total costs are rounded to the nearest $10,000.

The 27-year NPV operating cost for transportation and treatment at the Petrolia WWTP is estimated between $0.9 and $1.2 million in 2012 dollars, as showing in Table 16.

Table 16 NPV Operating Costs of Leachate Management Option 2: Haul Leachate to the Petrolia WWTP

Cost Item	27 Year NPV (in 2012 $)	
	Minimum	Maximum
Haulage	$ 350,000	$ 450,000
Treatment	$ 550,000	$ 750,000
Total[1]	**$ 900,000**	**$ 1,200,000**

Notes:
1 Costs are rounded to the nearest $50,000.

5.3.5.3 NPV Cost

The estimated 27-year NPV of hauling leachate to the Petrolia WWTP for treatment is between $1.8 and $2.6 million in 2012 dollars, and includes the capital cost required to upgrade the plant to accommodate the leachate and the 27-year NPV operating costs. These costs are presented in Table 17.

Table 17 NPV-Cost of Leachate Management Option 2: Haul Leachate to the Petrolia WWTP

Cost Item	27 Year NPV (in 2012 $)	
	Minimum	Maximum
Capital	$ 900,000	$ 1,400,000
27 Year NPV Operating	$ 900,000	$ 1,200,000
Total	**$ 1,800,000**	**$ 2,600,000**

5.4 OPTION 3: DISCHARGE LEACHATE TO THE PETROLIA COLLECTION SYSTEM

5.4.1 Description

Option 3 for the management of leachate from the Petrolia Landfill is to provide a connection to Petrolia's municipal sewage collection system. This would require the construction of a new pumping station at the Petrolia Landfill as well as a sanitary forcemain. Similarly to Option 2, additional capacity would be required for several processes at the Petrolia WWTP to accommodate the leachate.

5.4.2 Infrastructure Required

Option 3 requires the installation of a forcemain and a pumping station to connect the leachate tank at the Petrolia Landfill to the municipal sewage collection system. The existing leachate tank at the Landfill would continue to be used to store and equalize leachate, so that pumping into the system could be on a continuous or off-peak basis to avoid sudden high loads at the plant. The same upgrades are required to the Petrolia WWTP processes as described for Option 2.

The existing sewer line capacity has been reviewed and adequate capacity is available for leachate flows from the Petrolia Landfill.

There are two options for the location of the forcemain and they are outlined in the following sections.

5.4.2.1 Route Option 3A

For Option 3A, the forcemain would be constructed along Oil Heritage Road with connection to the existing 300 mm sanitary sewer approximately 800 m north at Petrolia Line. From there the sewers flow to the East End Pumping Station at Petrolia Line and Barett's Lane and continue through the Town's trunk sewer system to the Petrolia WWTP on Maude Street. The route for Option 3A is shown in Figure 3.

5.4.2.2 Route Option 3B

For Option 3B, the forcemain would be routed west through future development lands located between Oil Heritage Road and 1st Avenue, connecting to the existing 350 mm gravity sewer at 1st Avenue and Garden Crescent. From there the sewers would flow to the East End Pumping Station at Petrolia Line and Barett's Lane and continue to the Petrolia WWTP on Maude Street. The route for Option 3B is shown in Figure 4.

The development area has been identified for future residential land use in the Town`s Official Plan; however, a detailed road pattern has not yet been established through any Planning Act approvals. A preliminary road pattern has been identified in the AECOM Development Study (April 2009) but alignments have not been confirmed. To implement Option 3B, utility easements would be required from all affected land-owners and these utility easements would need to be coordinated with future road patterns.

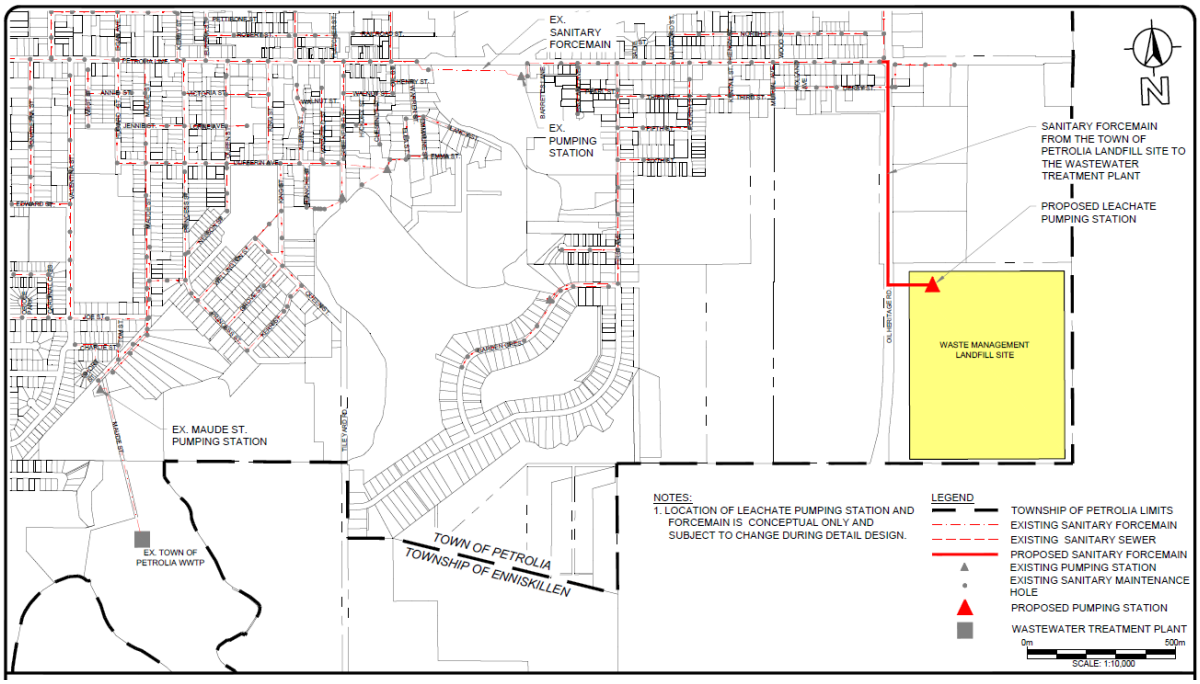

Figure 3 Route Option 3A: Discharge Leachate to the Petrolia Sewage Collection System

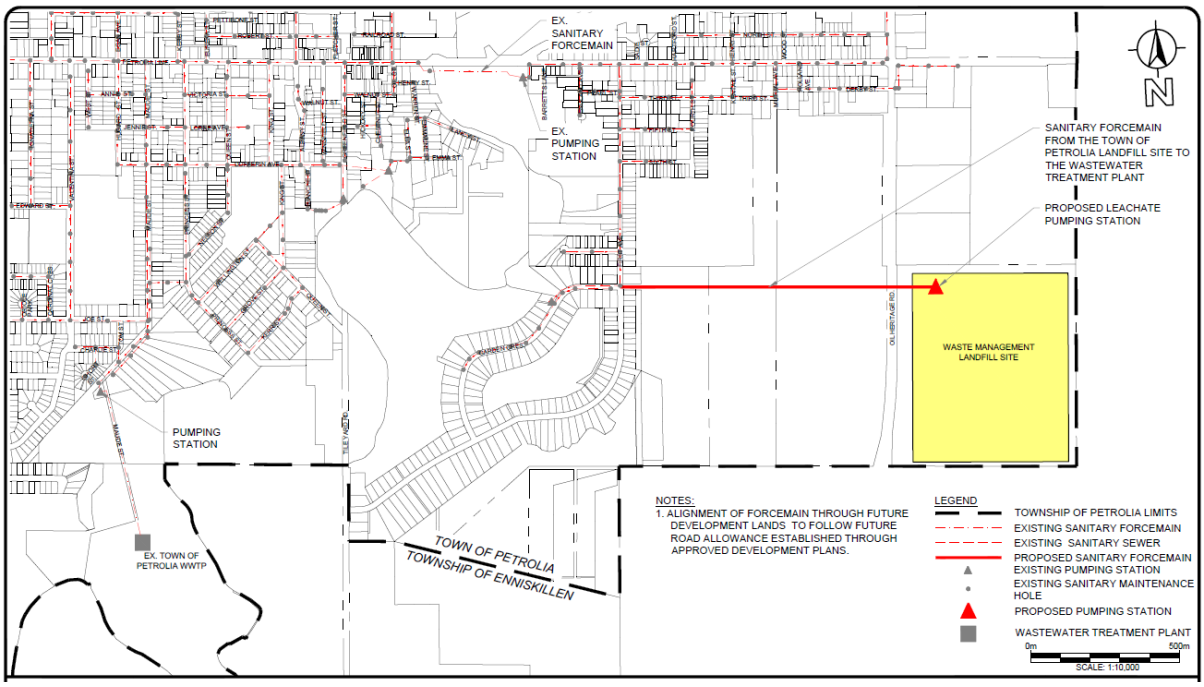

Figure 4 Route Option 3B: Discharge Leachate to the Petrolia Sewage Connection System

5.4.3 Environmental Impacts and/or Risks

5.4.3.1 Greenhouse Gases

No leachate transportation is required therefore only minimal greenhouse gas emissions will be associated with a nominal amount of pumping energy required to direct the small leachate volume through the municipal sewage collection system.

5.4.3.2 Surface Water Protection

In Options 3A and 3B, leachate will be pumped directly into the Petrolia sewage collection system from the equalization tank constructed at the Petrolia Landfill. The leachate will be fed into the collection system during off-peak hours, but the ability to control when the leachate arrives at the Petrolia WWTP is limited. There is a risk that the leachate may arrive during periods of high flows and it may have an impact on the effluent quality objectives and limits. This could be mitigated by giving the Town overall remote control over the leachate pumping operation.

5.4.3.3 Construction Risks

The construction activities required for Options 3A and 3B will be completed using good construction practices to mitigate risk. These activities include the forcemain, pumping station and the additional capacity required at the Petrolia WWTP to accommodate the leachate.

5.4.4 Community Impacts

5.4.4.1 Truck Traffic

There will be no truck traffic with Option 3A or 3B.

5.4.4.2 Construction

The construction required for the Petrolia WWTP upgrade and expansion in order to accommodate the leachate are the same as those presented for Option 2. Good construction practices will be implemented and these activities are not expected to adversely affect the residents of Petrolia, nor is the construction of a pumping station at the Petrolia Landfill.

Option 3A requires construction of a forcemain along Oil Heritage Road within the existing road allowance. Good construction practices will be implemented to mitigate impacts to traffic and the residents located along Oil Heritage Road between the landfill and Petrolia Line during construction.

Option 3B requires construction of a forcemain through future development land which is not currently occupied. Good construction practices will be implemented to mitigate impacts to traffic and residents during construction activities across Oil Heritage Road and while connecting to the existing sewers at 1st Avenue and Garden Crescent. Construction through the future development land would be required to follow the not yet developed road pattern.

5.4.4.3 Odours

There is the potential for odours while the leachate is pumped through the Petrolia sanitary sewage collection system; however, the volumes are not anticipated to be large and it is expected that mixing with the residential sewage will dilute it and mitigate odours caused by the leachate alone.

5.4.5 Costs

5.4.5.1 Capital Cost

Capital costs for the Petrolia WWTP upgrades and expansion to accommodate leachate for Options 3A and 3B are presented in Table 18. The capital costs in 2012 dollars for Options 3A and 3B are estimated between $1.05 and $1.6 million and $1.15 and $1.65 million, respectively.

Table 18 Capital Cost for Leachate Management Options 3A and 3B: Discharge Leachate to Petrolia Sewage Collection System

Process	Estimated Capital Cost			
	Option 3A		Option 3B	
	Minimum	Maximum	Minimum	Maximum
Aeration Tanks Volume	$ 100,000	$ 250,000	$ 100,000	$ 250,000
Oxygenation	$ 300,000	$ 500,000	$ 300,000	$ 500,000
Secondary Clarifiers	$ 10,000	$ 10,000	$ 10,000	$ 10,000
Leachate Forcemain & Pumping	$ 300,000	$ 300,000	$ 350,000	$ 350,000
Subtotal	**$ 710,000**	**$ 1,060,000**	**$ 760,000**	**$ 1,100,000**
Contingency 35%	$ 248,500	$ 371,000	$ 266,000	$ 388,500
Engineering 15%	$ 106,500	$ 159,000	$ 114,000	$ 165,000
Total[1]	**$ 1,050,000**	**$ 1,600,000**	**$ 1,150,000**	**$ 1,650,000**

Notes:
1 Costs rounded to the nearest $50,000.

5.4.5.2 Operating Cost

The estimated annual operating cost associated with Options 3A and 3B include only leachate treatment costs at the Petrolia WWTP and is the same as that presented for Option 2 in Table 15.

The 27-year NPV operating cost for treating leachate at the Petrolia WWTP for Options 3A and 3B is also the same as that presented for Option 2 in Table 16, totaling between $550,000 and $750,000 in 2012 dollars.

5.4.5.3 NPV Cost

The 27-year NPV cost for the management of leachate at the Petrolia WWTP by discharging to the Petrolia sewage collection system is estimated between $1.6 and $2.35 million for Option 3A and between $1.7 and $2.4 million for Option 3B, both in 2012 dollars. These costs are presented in Table 19.

Table 19 NPV Cost of Leachate Management Options 3A and 3B: Discharge Leachate to the Petrolia Sewage Collection System

Cost Item	27 Year NPV (in 2012 $)			
	Option 3A		Option 3B	
	Minimum	Maximum	Minimum	Maximum
Capital	$ 1,050,000	$ 1,600,000	$ 1,150,000	$ 1,650,000
27 Year NPV Operating	$ 550,000	$ 750,000	$ 550,000	$ 750,000
Total	**$ 1,600,000**	**$ 2,350,000**	**$ 1,700,000**	**$ 2,400,000**

5.5 OPTION 4: DISCHARGE LEACHATE DIRECTY TO THE PETROLIA WWTP

5.5.1 Description

Option 4 for the management of leachate from the Petrolia Landfill would be to provide a direct connection to the Petrolia WWTP. This would require the construction of a new pumping station at the Petrolia Landfill and a sanitary forcemain connecting the pumping station to the Petrolia WWTP inlet works. Similarly to Options 2 and 3, additional capacity would be required at the Petrolia WWTP in order to accommodate the leachate.

5.5.2 Infrastructure Required

Option 4 requires the installation of a pumping station at the Petrolia Landfill and a forcemain. The most direct route from the Landfill to the plant is a forcemain running west through the future development lands to 1st Avenue and Garden Crescent. The forcemain would then run south along 1st Avenue to Tile Yard Road, across private properties located in Enniskillen Township and across Bear Creek to the Petrolia WWTP. Figure 5 depicts the proposed forcemain route.

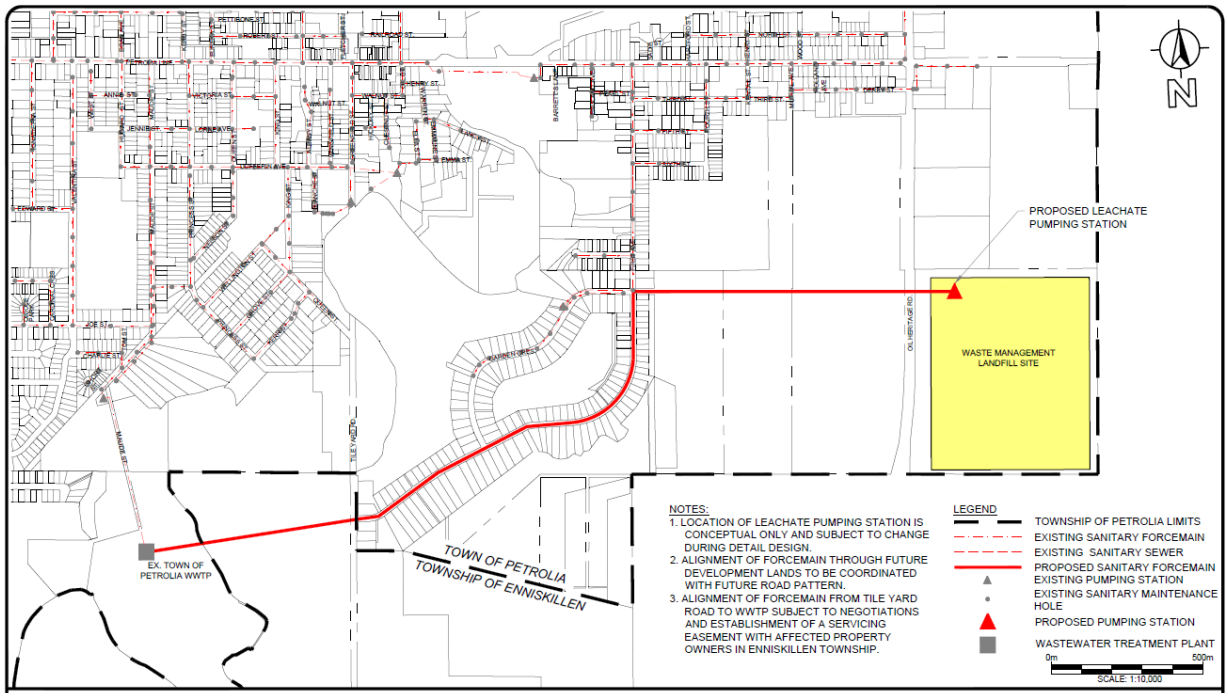

Figure 5 Route Option 4: Discharge Leachate Directly to the Petrolia WWTP

Installing the forcemain through the future development area, identified for residential use, should follow road alignments once they are established, as discussed for Option 3B. Installation along 1st Avenue to Tile Yard Road requires construction within an existing developed road allowance, significantly increasing construction costs. Continuing the forcemain through Enniskillen Township will require easements from affected property owners to permit the construction and maintenance required for the forcemain. The forcemain is also required to cross designated hazard lands associated with Bear Creek and this construction would need to be completed using trenchless installation methods, such as horizontal directional drilling, minimizing disturbances to the natural areas.

5.5.3 Environmental Impacts and/or Risks

5.5.3.1 Greenhouse Gases

No leachate transportation is required therefore there are no greenhouse gas emissions, except for a nominal amount of pumping energy to direct the leachate to the Petrolia WWTP.

5.5.3.2 Surface Water Protection

The Petrolia WWTP would need to be expanded and upgraded to accommodate the Landfill leachate. The leachate would be stored in an equalization tank at the Petrolia Landfill and could be controlled if there was ever an upset in plant operation. The small volume of leachate fed into the process would have an insignificant increase in effluent loads. Impacts to the treatment performance would be mitigated by controlling leachate flow based on continuous or off-peak pumping.

5.5.3.3 Construction Risks

Construction activities required for Option 4 pose some risk to the environment because the forcemain will be installed across a designated hazard zone surrounding Bear Creek. Great care and good construction practices will be implemented to mitigate risks. The pumping station to be installed at the Petrolia Landfill is not anticipated to pose significant risk to the environment.

5.5.4 Community Impacts

5.5.4.1 Truck Traffic

There will be no truck traffic with Option 4.

5.5.4.2 Construction

The primary community impact for Option 4 is the construction associated with the installation of the forcemain, specifically along 1st Avenue to Tile Yard Road and through the private properties of Enniskillen Township. Good construction practices will be implemented to avoid adversely affecting the residents of these areas. The construction of a pumping station at the Petrolia Landfill is not expected to adversely affect residents.

5.5.4.3 Odours

There is the potential for odours while the leachate is pumped to the Petrolia WWTP, however they are expected to be minor to non-existent and will not adversely affect residents.

5.5.5 Costs

5.5.5.1 Capital Cost

Capital costs for Option 4 are similar to Options 2 and 3, except a longer forcemain is required. The total capital costs in 2012 dollars for discharging leachate directly to the Petrolia WWTP are estimated between $2.0 and $2.5 million and are presented in Table 20.

Table 20 Capital Cost for Leachate Management Option 4: Discharge Leachate Directly to the Petrolia WWTP

Process	Option 4 Estimated Capital Cost	
	Minimum	**Maximum**
Aeration Tanks Volume	$ 100,000	$ 250,000
Oxygenation	$ 300,000	$ 500,000
Secondary Clarifiers	$ 10,000	$ 10,000
Leachate Forcemain & Pumping	$ 900,000	$ 900,000
Subtotal	**$ 1,310,000**	**$ 1,660,000**
Contingency 35%	$ 458,500	$ 581,000
Engineering 15%	$ 196,500	$ 249,000
Total[1]	**$ 2,000,000**	**$ 2,500,000**
Notes: 1 Costs rounded to the nearest $100,000		

5.5.5.2 Operating Cost

The operating cost for Option 4 includes only the treatment of leachate at the Petrolia WWTP, as presented in Table 15 for Option 2. The 27 year NPV Operating cost for Option 4, discharging the leachate directly to the Petrolia WWTP, is estimated between $550,000 and $750,000 in 2012 dollars, the same as presented in Table 16 for Option 2.

5.5.5.3 NPV Cost

The 27 year NPV cost to manage leachate by discharging directly to the Petrolia WWTP in 2012 dollars is estimated between $2.55 and $3.25 million, and is presented in Table 21.

Table 21 NPV Cost of Leachate Management Option 4: Discharge Leachate Directly to the Petrolia WWTP

Cost Item	27 Year NPV (in 2012 $)	
	Minimum	**Maximum**
Capital	$ 2,000,000	$ 2,500,000
27 Year NPV Operating	$ 550,000	$ 750,000
Total	**$ 2,550,000**	**$ 3,250,000**

5.6 COMPARISON OF FEASIBLE OPTIONS

A comparative evaluation of the Landfill leachate options was completed, using the criteria and ranking system provided in an earlier memorandum (included in Appendix 1) to the Town and Waste Management, and presented in Table 22. Table 22 also presents rational for the scoring of each option.

Table 22 Comparative Evaluation Matrix for Leachate Management Options

Criteria	Weight	Option 1 Do nothing - Continue to Haul Leachate to Alternative Treatment Facilities	Score	Weighted Score	Option 2 Haul Leachate to the Petrolia WWTP	Score	Weighted Score	Option 3 Direct Connection to the Petrolia Sewage Collection System	Score	Weighted Score	Option 4 Direct Connection to the Petrolia WWTP	Score	Weighted Score
Environmental Impact													
Surface Water Protection Maximize reliability in achieving effluent quality	7.3%	Negligible risks based alternative wastewater treatment facilities being able to accommodate leachate treatment	5	7.3%	Minor risks. Petrolia WWTP would be upgraded and expanded to accommodate leachate. Leachate storage at the Petrolia WWTP would enable operations staff to control leachate flow to add leachate continuously or off-peaks, to minimize risk to effluent quality.	4	5.8%	Moderate risks. Leachate is discharged to the Petrolia sewage collection system during off-peak hours, but less control as to when leachate would arrive at Petrolia WWTP. Leachate during plant upset events could impact treatment performance and effluent quality.	3	4.4%	Minor risks. Petrolia WWTP would be upgraded and expanded to accommodate leachate. Leachate storage at the Petrol Landfill would enable operations staff to control leachate flow to add leachate continuously or off-peaks, to minimize risk to effluent quality.	4	5.8%
Greenhouse Gases Minimize generation or net energy use	7.3%	Highest greenouse gas emissions compared to other alternatives, resulting from hauling leachate approximately 90 km from Petrolia Landfill to alternative wastewater treatment facilities.	2	2.9%	Minor impacts from greenhouse gas emissions to haul leachate from Petrolia Ladnfill to the Petrolia WWTP	4	5.8%	Negligible greenhouse gas emissions resulting from nominal energy requirements to pump leachate.	5	7.3%	Negligible greenhouse gas emissions resulting from nominal energy requirements to pump leachate.	5	7.3%
Operating Complexity Minimize risks to reliability and performance	3.6%	Negligible impact to operting complexity based on alternative wastewater treatment facilities currently accomodating leachate.	5	3.6%	Minor impact on operating complexity required to manage the feed of leachate into the Petrolia WWTP.	4	2.9%	Minor impact on operating complexity required to manage the feed of leachate into the Petrolia WWTP.	4	2.9%	Minor impact on operating complexity required to manage the feed of leachate into the Petrolia WWTP.	4	2.9%
Chemical Use Minimize use of additives	3.6%	Negligible impact based on alternative wastewater treatment facilities currently able to accomodate leachate.	5	3.6%	Negligible impact based on a nominal amount of alum required to treat additional leachate flows.	5	3.6%	Negligible impact based on a nominal amount of alum required to treat additional leachate flows.	5	3.6%	Negligible impact based on a nominal amount of alum required to treat additional leachate flows.	5	3.6%
Environmental Risk During Construction Minimize impacts to environment	3.6%	No construction activities required for Option 1.	5	3.6%	Minor risks as leachate construction activities at the Petrolia WWTP represent a small portion of the overall project and present minor additional risk.	4	2.9%	Moderate risks to the environment during construction due to forcemain installation. Leachate construction activities at the Petrolia WWTP represent a small portion of the overall project and present minor additional risk.	3	2.2%	Major risks to the environment during construction due to the forcemain installation through an environmental hazard area surrounding Bear Creek. Leachate construction activities at the Petrolia WWTP represent a small portion of the overall project and present minor additional risk.	2	1.5%
Treatment Plant Performace During Construction Minimize performance risks	7.3%	No construction activities required for Option 1 and alternative treatment facilities are currently able to accommodate leachate.	5	7.3%	Minor risk to plant performance during construction to accommodate leachate as these activities represent a small component of the overall project presenting minor additional risk.	4	5.8%	Minor risk to plant performance during construction to accommodate leachate as these activities represent a small component of the overall project presenting minor additional risk.	4	5.8%	Minor risk to plant performance during construction to accommodate leachate as these activities represent a small component of the overall project presenting minor additional risk.	4	5.8%
Spills Minimize environmental risks to surface water and land due to spills	7.3%	Moderate risks during loading, unloading and transporting leachate approximately 90 km to alternative wastewater treatment facilities.	3	4.4%	Minor risks during loading, unloading and transporting approximately 6 km to the Petrolia WWTP.	4	5.8%	Negligible risks of spills during leachate pumping.	5	7.3%	Negligible risks of spills during leachate pumping.	5	7.3%
Total Environmental Weighting	40%			32.7%			32.7%			33.5%			34.2%
Community Impact													
Aesthetics Maximize aesthetic appeal	6.2%	Negligible impacts based on existing alternative wastewater treatment facilities able to accommodate leachate.	5	6.2%	Negligible impact as construction will occur at remote Petrolia WWTP site.	5	6.2%	Negligible impact as construction will occur at remote Petrolia Landfill and Petrolia WWTP sites.	5	6.2%	Negligible impact as construction will occur at remote Petrolia Landfill and Petrolia WWTP sites.	5	6.2%
Land Use Maximize use of land	3.1%	Negligible impacts based on existing alternative wastewater treatment facilities able to accommodate leachate.	5	3.1%	Minor impact required to accommodate leachate as construction activities and footprint is minor compared to those already required at the Petrolia WWTP.	4	2.5%	Minor impact required to accommodate leachate as construction activities and footprint is minor compared to those already required at the Petrolia WWTP.	4	2.5%	Minor impact required to accommodate leachate as construction activities and footprint is minor compared to those already required at the Petrolia WWTP.	4	2.5%
Health and Safety Maximize protection to public and operators	6.2%	Negligible impacts to public and operators based on existing alternative wastewater treatment facilities able to accommodate leachate.	5	6.2%	Negligible impacts to public and operatiors based on the Petrolia WWTP upgrades and expansion to accommodate the leachate.	5	6.2%	Negligible impacts to public and operatiors based on the Petrolia WWTP upgrades and expansion to accommodate the leachate.	5	6.2%	Negligible impacts to public and operatiors based on the Petrolia WWTP upgrades and expansion to accommodate the leachate.	5	6.2%
Operations and Maintenance Staff Minimize certification/training requirements	3.1%	Negligible impacts based on existing alternative wastewater treatment facilities able to accommodate leachate.	5	3.1%	Minor certifiaction and/or training requiremed in order to accommodate leachate at the Petrolia WWTP.	4	2.5%	Minor certifiaction and/or training requiremed in order to accommodate leachate at the Petrolia WWTP.	4	2.5%	Minor certifiaction and/or training requiremed in order to accommodate leachate at the Petrolia WWTP.	4	2.5%
Odours Minimize odour	6.2%	Minor odour risks based on leachate being loaded and unloaded at the remote Petrolia Landfill and alternative wastewater treatment facilities.	4	4.9%	Minor ordour risks based on leachate being loaded and unloaded at the remote Petrolia Landfill and Petrolia WWTP.	4	4.9%	Minor ordour risks based on leachate being discharged to the Petrolia sewage collection system and eventually being diluted by municipal sewage.	4	4.9%	Moderate ordour risks based on leachate being discharged directly to the Petrolia WWTP.	3	3.7%
Noise Minimize noise	6.2%	Moderate noise impacts from approximately 2 trucks per day transporting leachate 90 km from the Petrolia Landfill to alternative wastewater treatment facilities, requiring travel through some residential and business areas.	3	3.7%	Minor noise impacts from approximately 2 trucks per day transporting leachate 6 km from the Petrolia Landfill to the Petrolia WWTP, requiring travel through some residential and business areas.	4	4.9%	Negligible noise impacts at the Petrolia Landfill to pump leachate to the Petrolia sewage collection system.	5	6.2%	Negligible noise impacts at the Petrolia Landfill to pump leachate directly to the Petrolia WWTP.	5	6.2%
Traffic & Safety Minimize traffic and maximize community safety	6.2%	Moderate risks from approximately 2 trucks per day transporting leachate 90 km from the Petrolia Landfill to alternative wastewater treatment facilities, requiring travel through some residenstil and business areas.	3	3.7%	Moderate risk from approximately 2 trucks per day transporting leachate 6 km from the Petrolia Landfill to the Petrolia WWTP, requiring travel through some residential and business areas.	3	3.7%	No traffic or safety risks to pump leachate from the Petrolia Landfill to the Petrolia sewage collection system.	5	6.2%	No traffic or safety risks to pump leachate from the Petrolia Landfill directly to the Petrolia WWTP.	5	6.2%
Construction Duration Minimize construction duration	3.1%	Negligible construction impacts based on existing alternative wastewater facilities able to accommodate leachate.	5	3.1%	Minor impacts as leachate construction activities at the Petrolia WWTP represent a small portion of the overall project and present minor additional work.	4	2.5%	Moderate impacts during construction for forcemain installation that may disrupt a small number of residents. Leachate construction activities at the Petrolia WWTP represent a small portion of the overall project and present minor additional work.	3	1.8%	Major impacts during construction for forcemain installation that may disrupt a moderate number of residents. Leachate construction activities at the Petrolia WWTP represent a small portion of the overall project and present minor additional risk.	2	1.2%
Total Community Weighting	40%			33.8%			33.2%			36.3%			34.5%
Economic Impact													
Minimize Capital Cost (2012 dollars)	8.0%	Negligible capital costs based on existing alternative wastewater treatment facilities able to accommodate leachate.	5	8.0%	Capital cost estimate is between $0.9 and $1.4 million.	2.33	3.7%	Capital cost estimate is between $1.7 and $2.4 million.	2.03	3.2%	Capital cost estimate is between $2.0 and $2.5 million in 2012 dollars.	1	1.6%
Minimize 27 Year Net Present Value Operating Cost (2012 dollars)	8.0%	Net present value operating cost is between $2.9 and $4.1 million.	1	1.6%	Net present value operating cost is between $0.9 and $1.2 million.	4.4	7.0%	Net present value operating cost is between $0.55 and $0.75 million.	5	8.0%	Net present value operating cost is between $0.55 and $0.75 million.	5	8.0%
Minimize Operating Cost Risks	4.0%	Moderate operating risks based on unknown potential increases in fuel costs to haul leachate 90 km and treatment costs at alternative wastewater treatment facilities.	3	2.4%	Minor operating risks based on fuel costs to haul leachate 6 km and treatment costs at the Petrolia WWTP.	4	3.2%	Negligible operating risks based on treatment at the Petrolia WWTP, based on establishing long term agreement with Town.	5	4.0%	Negligible operating risks based on treatment at the Petrolia WWTP, based on establishing long term agreement with Town.	5	4.0%
Total Economic Weighting	20%			12.0%			14.0%			15.2%			13.6%
Total Weighting	100%			78.6%			79.9%			85.0%			82.2%

Each option for the management of Landfill leachate was scored out of 5 points, and weighed according to its importance. Weighted scores were summed to result in a total score out of 100%. Table 23 summarizes the score in each relevant area.

Table 23 Summary of Scoring Results for Landfill Leachate Options

Criteria Group	Possible Score	Option 1 Do Nothing	Option 2 Haul to Petrolia WWTP	Option 3 Direct Connection to the Petrolia Sewage Collection System	Option 4 Direct Connection to the Petrolia WWTP
Environmental	40	32.7	32.7	33.5	34.2
Community	40	33.8	33.2	36.3	34.5
Economic	20	12.0	14.0	15.2	13.6
Total Score	**100**	**78.6**	**79.9**	**85.0**	**82.2**

Option 3, involving construction of a pumping station and forcemain to connect the leachate storage tank at the Petrolia Landfill to the Petrolia collection system, and upgrades to the Petrolia WWTP for the leachate loading, scored highest in both community and economic category, and had similar scores to other options in the environmental category. Advantages of Option 3 relative to other options are:

- Greenhouse gases: Greenhouse gas generation due to truck traffic will be eliminated because flow would be pumped directly to the collection system. This compares to Option 1, where greenhouse gas generation results from approximately 720 trucks per year on round trips of 180 km.
- Traffic: Relative to Options 1 and 2, there would be no community safety or noise impacts due to truck traffic.
- Minimized Cost Risk: The cost of leachate management could be established through a long term agreement with the Town, relative to Option 1, where Waste Management would need to re-negotiate contract costs with other wastewater treatment facilities and haulers, with a risk of higher costs in the future. It can also be noted that if the leachate volumes do not decline in the future, as predicted by Waste Management, there is significantly less cost risk with Option 3, since the per volume cost is considerably less for treatment at Petrolia WWTP than for hauling to and treating at more remote facilities.
- Net Present Value Costs: The total estimated NPV capital and operating cost for the 27-year period is estimated between $1.7 and $2.4 million, including capital and operating costs. This is much less than the estimated NPV cost for hauling and treating at alternative treatment facilities (not taking into account cost risk) for Option 1, and similar to than the NPV cost for Option 2.

6. SUMMARY AND NEXT STEPS

Solutions were evaluated for the planning period from 2015 to 2041 for wastewater treatment in the Town of Petrolia, and leachate management, from the Petrolia Landfill owned by Waste Management. The following are recommended as preferred:

- Petrolia wastewater: Expand the Petrolia WWTP to provide capacity for projected growth in the Town, and construct upgrades to address existing deficiencies to ensure long term reliable performance.
- Landfill leachate: Construct a pumping station and forcemain to pump the leachate to the Petrolia wastewater collection system, and include capacity in the Petrolia WWTP to also treat the low volume high-strength leachate.

These recommendations will be reviewed and confirmed with the Town of Petrolia and Waste Management of Canada. Preferred solutions will be presented to the public at an open house that is proposed to be scheduled in April 2012.

In Phase 3 of the Class EA, the preferred solutions will be developed further to establish conceptual designs and implementation plans. The conceptual designs will include more details on process requirements, Petrolia WWTP layout and the pumping and connection approach for the leachate.

7. REFERENCES

AECOM Development Study, April 2009

CIMA, Assimilative Capacity Study (2012)

County of Lambton, Official Plan, 2009

Metcalf & Eddy, Wastewater Engineering Treatment and Reuse, Table 3-13, Page 202, 4th Edition, 2003

Ministry of the Environment, Design Guidelines for Sewage Works, 2008

Town of Petrolia, By-Law Number 12 of 2009, Schedule A, Agreement for Operations, Maintenance and Management Services for the Petrolia WWTP (2009)

Transport Canada, Urban Transportation Emissions Calculator, version 3.0, 2011

APPENDIX 1
EVALUATION METHODOLOGY

Memorandum

To:	Town of Petrolia: Dianne Caryn, Joe Adams Waste Management: Wayne Jenken, Mike Hirlehey, Marc Leduc
From:	Deborah Ross
Subject:	**Evaluation Criteria and Weighting**
Project Name:	Class EA for Wastewater Treatment and Leachate Management in Petrolia
Date:	Updated March 1, 2012

This memo has been prepared to present the proposed evaluation methodology to be used in determining the preferred solution for wastewater treatment and leachate management in Petrolia to 2041.

Evaluation Methodology

For the evaluation of the alternative solutions, a Triple Bottom Line (TBL) evaluation methodology is proposed. This methodology is designed to select preferred solution that balances the criteria of environmental protection, minimizing community impacts, and minimizing economic impacts (costs).

A weighting and ranking system is proposed in order for the evaluation to be systematic, rational and reproducible in comparing the alternatives and identifying the preferred solution. For this project, we are proposing that environmental and community goals are equally weighted at 40% as they each are defined more indicator criteria, and the economic goal be weighted less at 20% as it is defined by fewer indicator criteria.

The methodology proposed is described as follows:

1. A series of indicator criteria are defined for each of the three criteria, which reflect how well an alternative would meet that goal. For example, an indicator of environmental protection is greenhouse gas generation.
2. The importance of each indicator criterion relative to the other indicators is given a value weight, which reflects the priorities and goals of the Town and WM. An indicator criterion with a higher value weight will have more significant impact to the overall evaluation scoring.
3. Each alternative will be scored based on how well it meets each indicator criterion, based on its relative impacts and/or risks and potential mitigation of risks. Proposed scoring is based on a scale of one to five, with '1' being the least able to meet the criterion and having the highest or most severe impact compared to other alternatives, and '5' being best able to meet the criterion and having no impact and/or providing an overall benefit, compared to other alternatives. The scoring will be evaluated using the following guidelines:

    - Score of 5: Alternative meets indicator criterion with negligible impacts and/or risks requiring no mitigation, or alternative results in a net benefit.
    - Score of 4: Alternative does not meet indicator criterion, but causes only minor impacts and/or risks requiring little mitigation.

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- Score of 3: Alternative does not meet indicator criterion, causing moderate impacts and/or risks requiring some mitigation.
- Score of 2: Alternative does not meet indicator criterion, causing major impacts and/or risks requiring significant mitigation.
- Score of 1: Alternative does not meet indicator criterion, causing sever impacts and/or risks requiring extensive mitigation.

For qualitative criterion, such as costs, the highest cost would receive a score of 1, the lowest cost a score a 5, and other costs would be prorated to receive a score between 1 and 5.

4. The final score for each alternative is determined as the sum of: the score of each indicator criterion multiplied by the value weight assigned to that criterion.
5. Scores for wastewater treatment solutions for the Town will be compared, and the highest scoring solution will be recommended as preferred. Likewise, the waste management solution with the highest score will be recommended as preferred.

Proposed Evaluation Criteria

A preliminary set of indicator criteria grouped by the Triple Bottom Line category, each with a short description, proposed to be used to rank the alternative solutions, are listed in Table 1. Also shown in Table 1 is the value weighting of each criterion. The value weight was determined based on the following:

- Low value has a relative weight of 1
- Medium value has a relative weight of 2
- High value has a relative weight of 4

The actual % value weight was based on the above relative weighting, and prorated for the number of indicator criteria and the % value of the goal (i.e., 40% for environmental and community, 20% for economics).

Table 1 Evaluation Criteria Used in Evaluation

Indicator Criteria	Goal	Importance	Prorated Value Weight
Protect Environment (40%)			
Surface Water Protection	Maximize reliability in achieving effluent quality limits under all average and peak flows and loadings to the plant	High	7.3%
Greenhouse Gasses	Minimize greenhouse gas generation or net energy use	High	7.3%
Operating Complexity	Minimize risks to reliability and performance with a system that is simple	Medium	3.6%
Chemical Use	Minimize use of chemical additives	Medium	3.6%
Environmental Risk During Construction	Minimize risk of impacts to surface water, groundwater, land, terrestrial resources and aquatic habitats during construction	Medium	3.6%
Treatment Plant Performance Risk During Construction	Minimize potential risk to performance and plant operations during construction	High	7.3%
Spills	Minimize potential risks to surface water and land due to spills	High	7.3%
Minimize Community Impacts (40%)			
Aesthetics	Maximize aesthetic appeal of the structures and area	High	6.2%
Land Use	Maximize land use to preserve site area for any future requirements	Medium	3.1%
Health and Safety	Maximize protection of public and operator health and safety from exposure to gaseous emissions, toxic organics or processing chemicals	High	6.2%
Operations and maintenance staff	Minimize operations certification and training requirements	Medium	3.1%
Odours	Minimize potential for odours affecting the community	High	6.2%
Noise	Minimize potential for noise affecting the community	High	6.2%
Traffic & Safety	Minimize truck traffic and during construction and operation and maximize community safety	High	6.2%
Construction Duration	Provide the shortest possible construction schedule and operational impact to neighbouring areas and operators	Medium	3.1%
Minimize Economic Impacts (Costs) (20%)			
Capital Costs	Minimize capital costs	High	8.0%
Operations and Maintenance Costs	Minimize operations and maintenance costs	High	8.0%
Operating Risks	Minimize operating cost risk due to dependence on electricity, fuels, chemicals or other on-going costs	Medium	8.0%